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EVALUATION OF SORGHUM GENOTYPES FOR FODDER UNDER DIFFERENT NITROGEN LEVELS

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ABSTRACT

Sorghum genotype RSSV 167 recorded significantly higher green fodder (582.7 q/ha) and dry matter yield (158.7 q/ha) over rest of the entries. The highest green fodder and dry matter of the genotypes was observed with 120 kg N/ha. The application of nitrogen improved the crude protein content of sorghum genotypes up to the highest dose of nitrogen i.e. 120 kg N/ha. Weed density, incidence of shoot fly and per cent leaf spot severity was significantly influenced by sorghum genotypes. Weed population increased with increase in nitrogen levels. Shoot fly incidence as well as foliar leaf spot severity also increased with increase in nitrogen levels. The genotype RSSV 167 was found to be tolerant to both shoot fly and leaf spots. The occurrence of shoot fly and leaf spots was significantly positively correlated with weed density.

Key words : Sorghum, nitrogen, weed density, genotypes, shoot fly, leaf spots.

Sorghum (*Sorghum bicolor*), locally known as *Chari* or *Jowar*, is the most important *kharif* cereal fodder of Punjab State. It is an important source of food as well as of fodder. Among the *kharif* fodders, it occupies about 51.1% area (2.62 lac ha) in the state, probably due to its suitability as a green fodder over a larger period and also because of its being converted into good *karbi* (dry fodder) which is utilized along with berseem during the scarcity periods of November-January. There occurs very little decline in its acceptability with the advancement in age. Thus, once sown, it can be fed to the animals in green form for a longer period without much loss of nutrients. Generally this palatable fodder is raised from April to August which supplies nutritious fodder to animals from June to November. Sorghum stalks rich in sugar content, also called 'sweet sorghum', are cultivated for forage, silage, animal and poultry feed, fuel, paper besides other industrial uses. In industry, it is widely used for ethanol production for petroleum industry, a source of biofuel and bioenergy as we are still deficit in ethanol. It is also a source of jaggery, sugar and starch. Sweet sorghum ensures food, fodder and energy security. Nitrogen is the key for higher fodder and grain yields of good quality as it improves the crude protein content of the fodder. Inside the plant, nitrogen converts to aminoacids (building blocks of proteins) which are used in forming protoplasm and in turn cell division, utilized in producing necessary enzymes for the metabolic pathways and lastly becomes part of the stored proteins in the seed. Dark green colour of the leaves due to nitrogen is a result of higher concentration of chlorophyll which is associated with the production of simple sugars from carbon, hydrogen and oxygen in the presence of sunlight and stimulating plant growth and development. Keeping into consideration the enormous importance of sorghum, its productivity will have to be increased by developing high yielding responsive

varieties/hybrids by applying optimum nitrogen having resistance to shoot fly and foliar diseases.

MATERIALS AND METHODS

The experiment was conducted to study the response of sorghum genotypes to nitrogen at Forage Research Farm, Punjab Agricultural University, Ludhiana during *kharif* 2012. The experimental site was sandy loam in texture, low in organic carbon (0.39%) and available nitrogen (232 kg/ha), medium in available P (21.3 kg/ha) and high in available K (195 kg/ha) with a pH of 8.2. The experiment consisted of eight sorghum genotypes (CSH 22, RSSV 104, CSV 19, SSV 74, SSV 84, CSV 24, RSSV 167 and HC 308) and two nitrogen levels (80 and 120 kg N/ha) and was conducted in randomised block design replicated thrice. The nitrogen was applied in two splits, i.e. half nitrogen at sowing and the remaining half nitrogen at 30 days after sowing. The sorghum genotypes were sown on 11th July 2012 with a seed rate of 62.5 kg/ha at a row spacing of 25 cm by *kera* method in a plot size of 4.5 m x 3.75 m. The genotypes RSSV 104, RSSV 167, CSV 19 and HC 308 were harvested on 12th October 2012 and remaining genotypes CSH 22, SSV 74, SSV 84 and CSV 24 were harvested on 20th October 2012. All other agronomic practices were applied uniformly to all the treatments. For biochemical analysis, two hundred gram plant samples were sun-dried and then dried in oven for obtaining the constant weight. The samples were analysed for crude protein content by the method as described by (1).

Assessment of shoot fly (*Atherigona soccata* Rondani) damage (in terms of per cent dead hearts) was carried out under unprotected conditions from 100 plants of each genotype per replication from four middle rows 28 days after appearance of seedlings. The damage due to shoot fly was rated as per the rating scale given by (2),

Table-1: Effect of nitrogen levels on the green fodder and dry matter yield of sorghum varieties.

Treatments	Green fodder yield (q/ha)	Dry matter yield (q/ha)	Plant height (cm)	Tillers/m row length	Leaf: stem ratio	Crude protein content (%)	Crude protein yield (q/ha)
Genotype							
CSH 22	452.3	114.9	192.4.	11.33	0.45	7.96	9.15
RSSV 167	582.6	158.7	270.0	11.83	0.36	7.09	11.25
CSV 19	541.2	139.2	256.2	13.17	0.32	6.64	9.24
SSV 84	260.2	69.4	191.5	10.75	0.45	8.95	6.21
SSV 74	387.2	113.4	187.6	8.67	0.49	7.88	8.94
CSV 24	455.8	123.4	194.8	8.08	0.52	6.73	8.31
RSSV 104	460.7	124.9	209.6	13.67	0.41	6.80	8.49
HC 308	483.0	129.4	251.3	9.68	0.41	7.24	9.37
CD 5%	30.6	8.03	11.31	3.33	-	1.24	1.41
Nitrogen levels (kg N/ha)							
80	407.0	108.3	215.6	9.02	0.41	6.57	7.11
120	498.7	130.0	224.1	9.50	0.43	8.26	10.74
CD 5 %	15.3	4.02	5.65	NS	-	0.87	0.93

where rating of 1= < 10% infestation (highly resistant), 3=10-20% infestation (resistant), 5 = 20-35% infestation (moderately resistant), 7 = 35-50% infestation (susceptible), 9= > 50% infestation (highly susceptible).

The foliar leaf spot data were recorded by randomly selecting 100 leaf samples from the plots comprising of 20 leaf sets from each corner of the plot and centre. The damage was further scored using 1-9 scale given by (3) on the basis of per cent leaf area infected as 1: <1.0 % infected area or isolated symptoms (Highly resistant, HR); 2: 1.0-5.0 % infected area (Resistant, R); 3: 5.1-10.0% infected area (Resistant, R); 4: 10.1-20.0% infected area (Moderately Resistant, MR); 5: 20.1-30.0% infected area (Moderately Resistant, MR); 6: 30.1-40.0% infected area (Susceptible, S); 7: 40.1-50.0% infected area (Susceptible, S); 8: 50.1, 75.0% infected area (Highly Susceptible, HS); 9: > 75.0% infected area (Highly Susceptible, HS) and per cent disease index was calculated.

RESULTS AND DISCUSSION

Fodder yield : Fodder yield was influenced significantly with sorghum genotypes (Table 1). Sorghum genotype RSSV 167 recorded significantly higher green fodder (582.7 q/ha) and dry matter yield (158.7 q/ha) over rest of the entries. Significantly low fodder yield (260.2 q/ha green fodder and 64.4 q/ha dry matter yield) was observed with genotype CSV 24 than rest of the genotypes. The genotype RSSV 167 gave 7.7, 17.1, 26.5, 27.8, 28.8, 50.5 and 123.9% higher green fodder and 14.0, 22.6, 27.1, 27.6, 39.9, 53.3 and 128.7 % higher dry matter yield over CSV 19, HC 308, RSSV 104, CSV 24, CSH 22, SSV 74 and SSV 84, respectively. The increase in fodder yield of genotype RSSV 167 was probably due to more plant height and its resistance to shoot fly and tolerance to foliar

blight diseases as compared to other genotypes (Table-3 and 4).

Nitrogen application significantly influenced the fodder yield of sorghum genotypes (Table-1). The highest green fodder (498.7 q/ha) and dry matter (130.0 q/ha) yields of all the genotypes were observed with 120 kg N/ha than 80 kg N/ha (407.0 q/ha green fodder yield and 108.3 q/ha dry matter yield). The magnitude of increase with 120 kg N/ha was 22.5% in green fodder and 20.0 % in dry matter yield over 80 kg N/ha. Taller plants, more tillering and higher leaf stem ratio might have contributed towards higher fodder yield at 120 kg N/ha. Increase in yield with increase in nitrogen might be due to high chlorophyll content of the leaves resulting in more photosynthesis and availability of nutrients which is associated with the production of simple sugars stimulating plant growth and development. Increase in nitrogen dose increased all growth attributes including fresh weight/plant which contributed towards high yield (4).

Fodder quality : The sorghum genotypes differed significantly in crude protein content and yield (Table-1). The highest crude protein content (8.95%) was observed in SSV 84 which was at par with CSH 22 and SSV 74 but was significantly higher over rest of the entries. The higher crude protein content of SSV 84 might be due to more shoot fly attack (Table 3) resulting in new growth (regeneration) having higher crude protein content.. The crude protein yield of genotype RSSV 167 (11.25 q/ha) was significantly higher over rest of the genotypes. The higher crude protein yield of RSSV 167 genotype might be due to more dry matter yield (158.7 q/ha) as compared to other genotypes (69.4 to 139.2 q/ha). Significant differences for crude protein content among sorghum genotypes were also observed by (5).

Table-2 : Weed density as influenced by sorghum genotypes and nitrogen levels.

Genotype	80 kg N/ha	120 kg N/ha	Mean
CSH 22	109.9	136.7	123.3
RSSV 167	72.2	76.7	74.5
CSV 19	76.7	83.3	80.0
SSV 84	119.9	154.4	137.2
SSV 74	127.8	133.3	130.6
CSV 24	117.8	127.8	122.8
RSSV 104	96.7	113.3	105.0
HC 308	87.8	104.4	96.1
Mean	101.1	116.2	-
CD 5%	Genotypes : 11.5	N : 5.73	G x N : 16.23

Note : N = Nitrogen; G = Genotypes

The application of nitrogen also improved crude protein content of sorghum (Table-1) besides yield. The crude protein content of sorghum increased significantly with increase in nitrogen level from 80 kg N/ha (6.57%) to 120 kg N/ha (8.26%). Similar trend was also observed in crude protein yield. Reddy and co-workers (5) also reported that nitrogen significantly improved the per cent crude protein content.

Weed density : Weed density was significantly influenced by sorghum genotypes (Table-2). The weed density was lowest in RSSV 167 (74.4 weeds/m²) which was significantly lower than CSH 22, CSV 24, SSV 74, SSV 84, RSSV 104 and HC 308 but was at par with CSV 19. The higher weed density in genotypes might be due to higher incidence of shoot fly (Table 3) which drastically reduced the growth of the genotypes. Weed population was influenced significantly with increase in nitrogen levels. The weed density increased with increase in nitrogen levels from 80 kg N/ha to 120 kg N/ha in all the genotypes. On an average of all the genotypes, the weed

Table-3 : Shoot fly incidence as influenced by sorghum genotypes and nitrogen levels

Genotype	80 kg N/ha	120 kg N/ha	Per cent dead hearts	Damage Rating (1-9)
CSH 22	54.3	68.3	61.3	9
RSSV 167	16.3	21.6	19.0	3
CSV 19	29.6	35.0	32.3	5
SSV 84	61.6	69.0	65.3	9
SSV 74	58.3	64.6	61.5	9
CSV 24	55.3	66.0	60.6	9
RSSV 104	52.6	53.6	53.1	7
HC 308	28.6	39.3	34.0	5
Mean	44.6	52.6	-	-
CD 5 %	Genotypes: 1.8	Nitrogen levels: 0.9	Genotypes x Nitrogen : 2.5	

density was 116.2 weeds/m² with 120 kg N/ha which was significantly higher than 80 kg N/ha (101.2 weeds/m²). Nitrogen application increased the weed density due to more availability of nutrients for its growth and development. El-Metwally and co-workers (6) reported that 60 kg N/ha markedly increased number and dry weight of broadleaved, grasses and total weeds 60 and 90 days after sowing compared with using of 15 kg N/ha.

Shoot fly incidence : The incidence of shoot fly was influenced significantly with varied nitrogen levels in different sorghum genotypes (Table-3). The shoot fly incidence ranged from 16.3 to 69.0 per cent dead hearts in different treatments irrespective of the nitrogen levels. On the basis of mean of both the nitrogen levels, the genotype SSV 84 recorded significantly highest shoot fly damage (65.3% dead hearts) whereas, RSSV 167 recorded the least shoot fly incidence (19.0% dead hearts). Resistant sources against shoot fly have also been reported by (7) and (8).

Table-4 : Foliar diseases as influenced by sorghum genotypes and nitrogen levels

Genotype	Grey leaf spot (<i>Cercospora sorghi</i>)				Zonate leaf spots (<i>Gloeocercospora sorghi</i>)			
	80 kg N/ha	120 kg N/ha	Mean disease severity (%)	Disease reaction	80 kg N/ha	120 kg N/ha	Mean disease severity (%)	Disease reaction
CSH 22	55.13	59.57	57.35	HS	34.67	37.00	35.83	S
RSSV 167	25.53	28.33	26.93	MR	15.67	19.67	17.67	MR
CSV 19	23.50	25.67	24.58	MR	17.33	21.33	19.33	MR
SSV 84	65.86	69.57	67.72	HS	43.67	46.25	44.96	S
SSV 74	59.94	62.90	61.42	HS	35.00	37.67	36.33	S
CSV 24	51.43	53.50	52.47	HS	32.33	33.67	33.00	S
RSSV 104	48.10	52.17	50.13	HS	28.33	31.00	29.67	MR
HC 308	29.67	31.00	30.33	S	22.00	24.33	23.17	MR
Mean	44.90	47.84	-		28.63	31.37		
CD 5 %	Genotypes 4.0				3.7			
	Nitrogen levels 2.0				1.8			
	Genotypes x Nitrogen NS				NS			

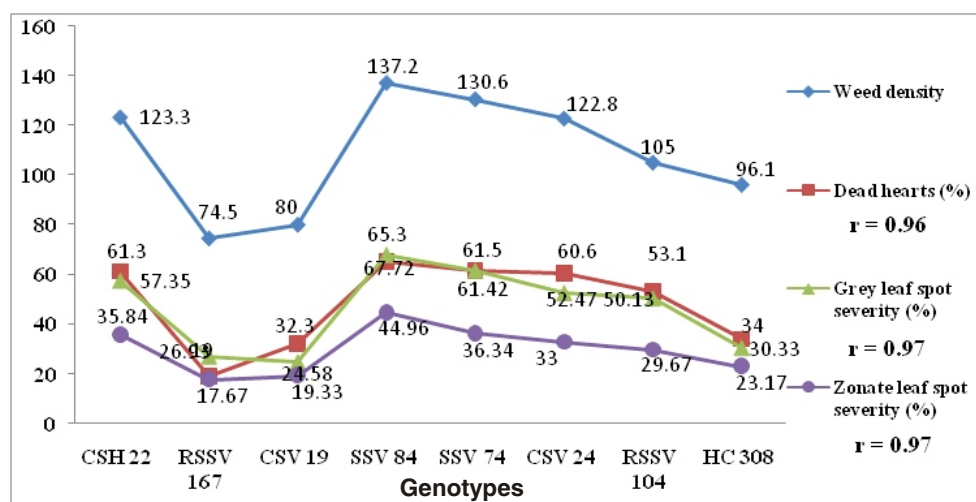


Fig. 1 : Correlation between weed density, shoot fly, leaf spots percent incidence/severity vis-à-vis nitrogen levels.

Disease score/reaction:

- 1: <1.0 % infected area or isolated symptoms (Highly resistant, HR)
- 2: 1.0-5.0 % infected area (Resistant, R)
- 3: 5.1-10.0% infected area (Resistant, R)
- 4: 10.1-20.0% infected area (Moderately Resistant, MR)
- 5: 20.1-30.0% infected area (Moderately Resistant, MR)
- 6: 30.1-40.0% infected area (Susceptible, S)
- 7: 40.1-50.0% infected area (Susceptible, S)
- 8: 50.1- 75.0% infected area (Highly Susceptible, HS)
- 9: > 75.0% infected area (Highly Susceptible, HS)

As is evident from Table 3, the shoot fly incidence increased with increase in nitrogen levels. The lower dose of nitrogen (80 kg N/ha) harboured less population of shoot fly as compared to higher dose of nitrogen (120 kg N/ha) in all the genotypes. On the basis of average of all the genotypes, the lowest shoot fly damage (44.6% dead hearts) was observed at 80 kg N/ha as compared to 52.6% dead hearts at 120 kg N/ha. High shoot fly population at higher nitrogen doses in susceptible genotypes might be due to the regrowth of the affected plants which were more succulent and tender as compared to the genotypes which were resistant or moderately resistant.

Foliar spot/blight severity

The leaf spots of sorghum were found to be prevalent on all the sorghum genotypes (Table 4). The genotypes viz., SSV 84, SSV 74, CSH 22 and CSV 24 were found to be highly susceptible to grey leaf spot (*Cercospora sorghi*) with mean per cent severity of 67.72, 61.42, 57.35 and 52.47, respectively, whereas CSV 19 showed minimum grey leaf spot severity of 24.58% followed by RSSV 167 with severity of 26.93%. Similarly, the genotypes SSV 84, SSV 74, CSH 22 and CSV 24 were also found to be susceptible to zonate leaf spot (*Gloeocercospora sorghi*) with mean per cent severity of 44.96, 36.33, 35.83, 19.33,

respectively. RSSV 167 showed moderately resistant reaction towards zonate leaf spot followed by CSV 19 with per cent severity of 17.67 and 19.33 per cent. Singh (9) reported that out of 10 sorghum genotypes, two single cut and 4 multicut genotypes were resistant to zonate leaf spot. The genotypes CSV 19 and RSSV 167 showed tolerance to both the diseases. Multiple disease resistance against grey leaf spot, zonate leaf spot and anthracnose has also been reported by (10).

The per cent leaf spot severity in case of both the diseases increased with increase in nitrogen level irrespective of the genotypes. The minimum grey and zonate leaf spot severity of 44.90 and 28.63 per cent was observed at 80 kg N/ha, whereas 120 kg N/ha showed maximum severity of 47.84 and 31.37 per cent.

Correlation between weed density viz-a-viz shoot fly incidence and foliar spots severity

The occurrence of shoot fly and leaf spots on sorghum increased with an increase in weed density ($r = +0.96$ and $+0.97$), indicating a positive correlation between the two factors (Fig. 1). It could, thus, be concluded that higher density of weed flora at higher nitrogen levels, provided suitable microclimate and habitat for the higher incidence and further development of shoot fly and diseases.

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EFFECT OF DATES OF SOWING AND WEATHER PARAMETERS ON THE INCIDENCE OF BUD NECROSIS DISEASE IN GROUNDNUT

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ABSTRACT

The effect of 4 sowing dates on the incidence of BND on groundnut sown during the *kharif* season of 2010 was studied at ARI, Hyderabad among the 4 sowing dates, the late sown (D_4) crop recorded more incidence of BND in the early stage of the crop while the early sown D_1 plot which recorded less incidence of disease. Correlation studies carried out between BND incidence with preceding one and two weeks observatory and crop weather parameters indicated that preceding two weeks weather had more significant relation with BND incidence. Among the weather parameters temperature, relative humidity and evaporation showed negative influence, while age of the crop showed positive influence and among the crop weather parameters, leaf wetness showed highly significant positive influence while relative humidity had negative influence on BND incidence.

Key words : Weather parameters, bud necrosis, groundnut.

Groundnut (*Arachis hypogaea* L.), a principal oilseed crop of the world is cultivated in about 12.29 million hectares in Asia. In India, it is grown in an area of 6.16 m. ha. (1). India and China are the largest producers of the crop. In Andhra Pradesh it is cultivated in an area of 1.77 m. ha. with an annual production of 1.55 million tones (1).

Pests and diseases are the major biotic stresses affecting the groundnut yield. Among the viral diseases attacking groundnut crop, Bud Necrosis Disease (BND) caused by tospovirus (2) and transmitted by *T. palmi* (3) is considered to be the most important disease and it is widely distributed in India. It also affects other crops such as greengram, blackgram, tomato, chilli, brinjal, soybean etc. It occurs at high incidence in some areas in the states of Andhra Pradesh, Gujarat, Karnataka, Maharashtra and Tamilnadu. Yield losses caused by the disease were estimated to be more than 89 million US dollars/year (4). In India the disease occurs in both rainy and post rainy seasons with incidence ranging from 0-98% (5). The PBNB symptoms in groundnut plant initially appear in the young leaflets in the form of chlorotic spots, which later develop into chlorotic and necrotic rings and streaks. The necrosis from the leaf extends to the petiole and to the growing terminal bud. The leaflets showing the above symptoms become flaccid and droop. Infection in young stage will result in death of the plant due to severe necrosis. As a result of necrosis of terminal bud, various secondary symptoms like stunting and proliferation of axillary shoots occur. Losses by PBNB mainly depend on the level of incidence and severity of symptoms. If the infection occurs on young plants (less than 60 days), pod yield loss will be 100 % (6). If infection occurs after pod formation, losses are negligible. Though many studies were made on the effect of weather parameters on the occurrence and severity of Bud necrosis disease (7)

practically no attempt was made to study the effect of micro climate (crop weather) on disease incidence. Hence an attempt was made to study the incidence of bud necrosis disease as influenced by micro and macro climate.

MATERIALS AND METHODS

The field experiment was conducted at Agricultural Research Institute, Rajendranagar, Hyderabad during *kharif*, 2010. The popular groundnut variety Narayani was used for the study. The experiment was laid out in a randomized block design (RBD) with four sowing dates and five replications in a gross plot size of 175 square meters with a spacing of 30 x 10 cm with a seed rate of 60 kg/acre. The first date of sowing was taken up immediately after the receipt of the first monsoon showers i.e on 19th June 2010 and the remaining three sowings were taken up at 15 days interval i.e on 3rd July, 19th July and 4th August. All the recommended routine agronomic practices except plant protection were followed for raising the crop. The whole experimental plot was divided into four equal sub plots of 7.2 x 6.0 m. with a gap of 5 m between each sub plot for sowing the crop with four dates of sowing. Five replications were maintained for each sowing date. The Bud Necrosis Disease in groundnut was observed starting from 20 days after sowing and the observations were recorded during every standard week. The incidence was recorded by counting the number of PBNB infected plants in one sq.m. area of each replication. The PBNB infected plants observed during every week were counted and marked with differently coloured pegs for different sowing dates. The observations were continued till the harvest of the crop. The PBNB infected plants were identified based on the symptoms. The per cent PBNB incidence was calculated by using the formula

Table-1 : Effect of different dates of sowing and age of the crop on the incidence of Bud Necrosis Disease in groundnut during *kharif*, 2010.

Age of the Crop (days)	Bud Necrosis Disease %								Means
	D ₁		D ₂		D ₃		D ₄		
	Std. week	Incidence (%)	Std. week	Incidence (%)	Std. week	Incidence (%)	Std. week	Incidence (%)	
20	27 (2-8 July)	0.00 (0.00)	30 (23-29 July)	2.01 (6.32)	32 (6-12 Aug.)	1.98 (5.08)	34 (20-26 Aug.)	3.56 (8.23)	1.88
27	28 (9-15 July)	0.00 (0.00)	31 (3-5 Aug.)	12.10 (20.04)	33 (13-19 Aug.)	6.76 (14.90)	35 (27-2 Sept.)	13.83 (21.58)	8.17
34	29 (16-22 July)	0.00 (0.00)	32 (6-22 Aug.)	12.10 (20.04)	34 (20-26 Aug.)	20.37 (26.37)	36 (3-9 Sept.)	23.87 (29.09)	14.08
41	31 (3-5 Aug.)	0.00 (0.00)	33 (13-19 Aug.)	14.34 (22.04)	35 (27-02 Sept.)	27.18 (31.28)	37 (10-16 Sept.)	32.88 (34.76)	18.6
48	32 (6-12 Aug.)	0.00 (0.00)	34 (20-26 Aug.)	15.08 (22.67)	36 (3-9 Sept.)	31.74 (34.00)	38 (17-23 Sept.)	38.24 (38.07)	21.26
55	33 (13-19 Aug.)	16.23 (23.23)	35 (27-2 Sept.)	19.89 (26.16)	37 (10-16 Sept.)	37.86 (36.86)	39 (24-30 Sept.)	49.38 (44.65)	30.84
62	34 (20-26 Aug.)	19.72 (25.99)	36 (3-9 Sept.)	30.10 (33.12)	38 (17-23 Sept.)	47.38 (43.48)	40 (1-7 Oct.)	52.55 (46.49)	37.43
69	35 (27-2 Aug.)	35.91 (36.73)	37 (10-16 Sept.)	44.07 (41.57)	39 (24-30 Sept.)	52.68 (46.78)	41 (8-14 Oct.)	54.97 (47.97)	46.90
76	36 (3-9 Sept.)	37.25 (37.54)	38 (17-23 Sept.)	46.50 (42.97)	40 (1-7 Oct.)	54.06 (47.59)	42 (15-21 Oct.)	62.16 (52.19)	49.99
83	37 (10-16 Sept.)	37.25 (37.54)	39 (24-30 Sept.)	55.75 (48.33)	41 (8-14 Oct.)	55.44 (48.39)	43 (22-28 Oct.)	63.70 (53.10)	53.03
Mean		14.64		25.19		33.55		39.51	
F1 (Date)	S.Em		CD at 5%						
F2 (Age)	1.09		2.15						
F1*F2	1.73		3.40						
(Date*Age)	3.36		6.80						

Values in the parenthese are square root transformed values.

$$\text{PBND (\%)} = \frac{\text{No. of PBND damaged plants}}{\text{Total No. of plants in one sp.m area}} \times 100$$

To determine the effect of various weather parameters on the incidence of PBND infesting groundnut weather data were collected from the weather station located adjacent to the experimental field at Agricultural Research Institute, Rajendranagar, Hyderabad. Along with observatory weather crop weather also recorded in the field by installing weather sensors in the field by Indian Institute of Technology, Mumbai. The data was analyzed statistically in RBD with factorial concept the data to angular transformation.

RESULTS AND DISCUSSION

The Bud Necrosis disease incidence (%) recorded in groundnut crop sown with different dates of sowing revealed that (table 1) in D₁ plot which was sown on June 19th, the disease started late (33rd standard week) with an initial incidence of 16.23 per cent and reached to a maximum of 37.25 per cent by the end of the crop season (37th standard week). In D₂ and D₃ plots the disease started with an initial infestation of 2.01 per cent (30th standard week) and 1.98 per cent (32nd standard week), respectively

and reached to a maximum of 55.75 per cent (39th standard week) and 55.44 per cent (41st standard week), respectively. In D₄ plot the initial infestation was higher (3.56 %) (34th standard week) than the other plots and it reached to 63.70 per cent by the end of the crop season (43rd standard week). The mean PBND (%) incidence recorded in D₁ to D₄ plots showed significantly lowest incidence in D₁ (14.64%), while significantly highest mean incidence of 39.51 per cent was recorded in D₄ plot.

The effect of age of the crop on the incidence of PBND indicated that the PBND infestation on the crop started with a low intensity of 1.88 per cent at 20 days age of the crop and reached to 53.03 per cent by the end of the crop season (83 days).

The interaction effect of dates of sowing and age of the crop on PBND revealed that in D₁ plot the PBND incidence was noticed at 55 days age (16.23 %) while in the other plots the infestation was observed from 20 days age of the crop and among the different dates, the D₄ plot sown on 4th August recorded maximum incidence of 63.70 per cent at 83 days age of the crop so that significantly lowest yield (752 kg/ha) was obtained from D₄ plot sown on August 4th. While the incidence observed

Table-2 : Correlation coefficients between Bud Necrosis Disease incidence and observatory weather Parameters (Preceding one week) in groundnut during Kharif, 2010

Observatory weather parameters	D ₁	D ₂	D ₃	D ₄
Maximum temperature	-0.11	0.07	0.25	0.18
Minimum temperature	0.24	-0.59	-0.55	-0.90**
Morning relative humidity (RH I %)	0.12	-0.24	-0.50	-0.78**
Evening relative humidity (RH II %)	0.16	0.40	-0.48	-0.69*
Rainfall (mm)	-0.25	0.55	0.05	-0.24
Rainy days (R.D.)	-0.49	0.31	-0.37	-0.60
Sunshine hours (S.S.H.)	0.06	0.20	0.37	0.43
Wind speed (W.S.) Km/h	-0.41	-0.52	-0.49	-0.56
Evaporation (E. pan) (mm)	-0.57	-0.77**	-0.80**	-0.66*
Mean temperature	0.03	-0.13	0.01	-0.32
Age of the crop	0.92**	0.95**	0.98**	0.98**

*Significant at 5% level

**Significant at 1% level

Table-3 : Correlation coefficients between Bud Necrosis Disease incidence and observatory weather parameters (Preceding two weeks) in groundnut during kharif, 2010

Observatory weather parameters	D ₁	D ₂	D ₃	D ₄
Maximum temperature	-0.26	-0.25	0.23	0.09
Minimum temperature	-0.09	-0.69*	-0.60	-0.92**
Morning relative humidity (RH I %)	0.48	-0.09	-0.47	-0.90**
Evening relative humidity (RH II %)	0.45	-0.30	-0.50	-0.82**
Rainfall (mm)	-0.15	0.66*	0.38	-0.39
Rainy days (R.D.)	-0.09	0.33	-0.13	-0.78**
Sunshine hours (S.S.H.)	-0.01	-0.01	0.45	0.51
Wind speed (W.S.) Km/h	-0.57	-0.50	-0.69*	-0.50
Evaporation (E. pan) (mm)	-0.66*	-0.85**	-0.82**	-0.74*
Mean temperature	-0.23	-0.42	-0.02	-0.51
Age of the crop	0.92**	0.95**	0.98**	0.98**

*Significant at 5% level

**Significant at 1% level

in D₂ (55.75%) and D₃ (55.44%) plots at the end of the season was on par with each other. The yield obtained from D₂ (1222 kg/ha) and D₃ plots (1777 kg/ha) was on par with each other. In D₁ plot, significantly less incidence of PBNB (37.25 %) was recorded at the end of the crop growth period (83 days after sowing) so that significantly higher pod yield was recorded in D₁ plot was 2862 kg/ha.

The results are in concurrence with the findings of (8). They stated PBNB incidence on young groundnut plants results in more infestation and plants infested nearing to maturity do not suffer with PBNB incidence. (9) who conducted on thrips transmitted necrosis virus on sunflower stated that the crop sown in July and August had severe incidence of necrosis. Similarly (6) observed highest incidence of PBNB in July sown crops where as June plantings recorded less incidence.

The relationship between the incidence of PBNB with preceding one week (one week lag) observatory weather (Macro climate) data during *kharif*, 2010 (table-2) in groundnut indicated a significant positive influence of

age of the crop (0.92, 0.95, 0.98 and 0.98, respectively) and significant negative influence of evaporation (-0.77, -0.80 and -0.66) with PBNB in all the three sowing dates except in D₁ plot which showed non significant (-0.57) relation on evaporation. The PBNB incidence in D₄ plot was more influenced by weather parameters which recorded significant relation with minimum temperature (-0.90), morning relative humidity (-0.78), evening relative humidity (-0.69) and evaporation (-0.66).

Preceding two weeks weather (Table 3) also showed the same trend. Age of the crop recorded positive significant influence (0.92, 0.95, 0.98 and 0.98), while evaporation had negative and significant influence (-0.66, -0.85, -0.82 and -0.74) on PBNB incidence of all the four sowing dates. In D₂ plot minimum temperature (-0.69) showed negative influence while rainfall recorded positive influence (0.66). In D₃ plot wind speed (-0.69) and in D₄ plot, minimum temperature (-0.92), morning relative humidity (-0.90), evening relative humidity (-0.82) and

Table-4 : Correlation coefficients between Bud Necrosis Disease incidence and crop weather parameters (preceding one week) in groundnut during kharif, 2010.

Weather parameters	D ₁	D ₂	D ₃	D ₄
Maximum temperature	-0.06	0.10	0.21	-0.07
Minimum temperature	0.26	0.10	0.45	-0.06
Morning relative humidity (RH I %)	-0.02	-0.42	-0.65*	-0.78**
Evening relative humidity (RH II %)	0.19	-0.57	-0.61	-0.85**
Leaf wetness (h)	-0.37	0.67*	0.57	0.77**
Age of the crop	0.92**	0.95**	0.98**	0.98**

*Significant at 5% level

**Significant at 1% level

Table-5 : Correlation coefficients between Bud Necrosis Disease incidence and crop weather parameters (preceding two weeks) in groundnut crop during kharif, 2010.

Weather parameters	D ₁	D ₂	D ₃	D ₄
Maximum temperature	-0.26	-0.31	0.22	-0.07
Minimum temperatures	-0.05	0.14	0.73*	-0.14
Morning relative humidity (RH I %)	0.34	-0.36	-0.64*	-0.91**
Evening relative humidity (RH II %)	0.51	-0.43	-0.61	-0.89**
Leaf wetness (h)	-0.22	0.67*	0.81**	0.71*
Age of the crop	0.92**	0.95**	0.98**	0.98**

*Significant at 5% level

**Significant at 1% level

Table-6 : Multiple regression equations developed for Bud Necrosis Disease incidence based on weather parameters (preceding one week) and age of the crop in groundnut during kharif, 2010.

Weather	Multiple Linear regression equation	Multiple Non linear regression equation	Coefficient of determination (R ²)	
			Linear	Non linear
Observatory weather	$Y = 412.29 - 1.81 \cdot RH\ II - 3.45 \cdot W.S - 15.02 \cdot E\ pan - 6.93 \cdot T.\ mean + 0.38 \cdot Age.$	$Y = 58.83 - 64.76 \cdot RH\ I - 3.37 \cdot W.S - 79.58 \cdot E\ pan + 245.12 \cdot T.\ mean + 0.39 \cdot Age + 0.35 \cdot RH\ I^2 + 0.002 \cdot W.S^2 + 10.21 \cdot E\ pan^2 - 4.85 \cdot T.\ mean^2 - 0.00006 \cdot Age^2.$	0.89	0.91
Crop weather	$Y = 245.85 + 2.24 \cdot T.\ max - 14.99 \cdot T.\ min + 0.89 \cdot Age.$	$Y = -1728.41 + 39.88 \cdot T.\ max + 114.37 \cdot T.\ min + 1.038 \cdot Age - 0.64 \cdot T.\ max^2 - 2.95 \cdot T.\ min^2 - 0.0001 \cdot Age^2.$	0.85	0.86
Combination (observatory+crop weather)	$Y = 298.49 - 11.36 \cdot T.\ min - 0.98 \cdot RH\ I + 0.58 \cdot RH\ II + 2.97 \cdot L.W - 4.83 \cdot R.D - 2.02 \cdot W.S + 0.64 \cdot Age.$	$Y = 762.87 + 51.05 \cdot T.\ min - 26.65 \cdot RH\ I - 1.14 \cdot RH\ II + 5.37 \cdot L.W + 12.54 \cdot R.D - 5.22 \cdot W.S + 1.21 \cdot Age - 1.42 \cdot T.\ min^2 + 0.15 \cdot RH\ I^2 + 0.001 \cdot RH\ II^2 + 0.003 \cdot L.W^2 - 3.40 \cdot R.D^2 + 0.32 \cdot W.S^2 - 0.0005 \cdot Age^2.$	0.91	0.93

rainy days (-0.78) showed negative and significant effect on PBND.

The relationship between PBND incidence with one week preceding crop weather data and age of the crop (Table-4) revealed that weather parameters did not show significant influence on PBND in D₁ and D₂ plots, while age of the crop showed significant positive influence (0.92, 0.95, 0.98 and 0.98) in all the dates of sowing. Leaf wetness recorded significant positive relation with PBND of D₂ (0.67) and D₄ plots (0.77), while morning relative

humidity of D₃ (-0.65) and D₄ (-0.78) and evening relative humidity of D₄ (-0.85) plot recorded negative and significant effect while the other weather parameters showed non significant influence on PBND incidence.

Similar trend observed with crop weather of preceding two weeks weather (Table-5). Age of the crop significantly and positively influenced the PBND incidence (0.92, 0.95, 0.98 and 0.98) in all the plots while, leaf wetness also showed significant positive influence with PBND in three dates of sowing (0.67, 0.81, and 0.71)

except D₁ plot (-0.22). Morning relative humidity of D₃ (-0.64) and D₄ (-0.91) and evening relative humidity of D₄ plot (-0.89) showed significant negative relation and minimum temperature of D₃ plot (0.73) had positive correlation with PBNB incidence.

The results strongly support the findings of (10) who reported a positive correlation of sunflower necrosis with minimum temperature. (11) observed that evening relative humidity and rainfall were negatively correlated with necrosis disease in sunflower.

The weather based disease prediction models developed for PBNB indicated that both linear and non linear models developed with preceding two weeks weather (93% and 96%, respectively) (Table-7) predicted the disease incidence more accurately than with preceding one week weather parameters (0.91% and 0.93%, respectively) (Table-6). (12) used multiple regression analysis for understanding the effects of climate variability on tomato spotted wilt virus in peanut and the model predicted TSWV by 86%, 40%, 64%, 66.6% and 60% during 1998, 2002, 2004 and 2005, respectively.

The overall findings observed from the study clearly indicated the role of weather parameters and sowing dates on PBNB incidence. The results clearly stated the early sown groundnut crop (2nd week of June) escaped the BND incidence, while late sown crop was severely infested by the disease. Similarly correlation coefficient worked out between abiotic factors and PBNB incidence indicated that preceding two weeks weather helped in predicting the disease with more accuracy than with preceding one week weather. In addition, the PBNB incidence was more influenced by the leaf wetness of the crop. Hence for developing weather based prediction models for groundnut crop both crop as well as weather parameters need to be considered to get high precision.

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EFFECT OF SEED COATING WITH SYNTHETIC POLYMERS AND CHEMICALS ON SEED QUALITY DURING STORAGE IN SUNFLOWER HYBRID

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ABSTRACT

A laboratory experiment was carried out at Seed Research and Technology Centre, Rajendranagar, Hyderabad during 2011-12 to know the effect of seed polymer coating on seed quality parameters of sunflower hybrid KBSH-53 during storage. The experiment was carried out with six treatments viz., polymer seed coating @ 5 ml/kg of seed (T_1), flowable thiram (Royal flow 40 SC) @ 2.4 g/kg seed (T_2), polymer @ 5 ml/kg of seeds along with flowable thiram (Royal flow 40 SC) (T_3), vitavax 200 @ 2g/kg seed (T_4), Polymer seed coating along with Vitavax 200 (Thiram 37.5% + Carboxyl 37.5%), 2g/kg seed (T_5) and untreated seed lot as control (T_0). Then these seed lots were stored in two types of containers (Gunny and high density polythene (HDPE) bags) and stored under ambient conditions. The data were recorded at bimonthly intervals and statistical analysis was done in factorial CRD with three replications. After a period of 8 months storage, the seed lots treated with polymer along with thiram and stored in HDPE bag recorded significantly superior germination (84%) as against the untreated control stored in gunny bag (39%) and also exhibited superior performance for all the seed quality parameters.

Key words : *Seed quality, polymer, fungicide, pesticide, gunny bag and high density polythene (HDPE) bag.*

Seeds are the delivery systems in Agriculture. High quality seed leads to good seedling performance in the field. Development of higher value seeds mean there are added benefits in maintaining the health of the seed in storage, transport and sowing. The appropriate seed coating can play a major role in making sure every seed has the opportunity to fulfill its potential.

In India sunflower is cultivated over an area of 1,911 thousand ha with the production of 1,463 thousand tonnes. However, the productivity is very low (765 kg ha⁻¹). In Andhra Pradesh, it is cultivated in an area of 4.5 to 5 lakh ha with a productivity of 650 kg/ha (1). The seed contains 40-50 per cent edible oil and predominantly contains erucic acid, which is safer to coronary attacks and useful as feed to poultry and other livestock industries.

Maintaining seed vigour and viability during storage is a matter of prime concern in India. Of late, many seed companies are using the technology of seed coating along with insecticides and fungicides. Seed coating technology is a sophisticated process of applying precise amount of active ingredients along with a liquid material directly on to the seed surface without obscuring its shape and total seed weight up to 1-2 per cent (2). The seed coating formulations consists of a mixture of polymer, plasticizer and colorants (3) that are commercially available as ready to use liquids or as dry powders (4). The seed coating facilitates uniform imbibitions of water during germination and free flow through drills while sowing and prevents damage to the seed and makes sowing operation easier. The coat is thin (8 μ m), simple to

apply and provides protection against ageing which includes fungal invasion. Polymer coat provides protection from stress imposed by accelerated ageing also. By encasing the seed with in a thin film of biodegradable polymer, the adherence of the seed treatment to the seed is improved. Hence, an attempt was made to understand the effect of polymer coating along with fungicide and insecticide on seed quality of sunflower hybrid during storage. The polymer coating and chemical treatments keep the seed intact, as it acts as binding material and covers the minor cracks and blocks the fungal invasion. Further, the synergetic effect of both polymers and chemicals contribute for better germination and vigour and slow down the process of ageing.

MATERIALS AND METHODS

The current study was executed at Seed Research and Technology Centre, Rajendranagar, Hyderabad, ANGRAU during July 2011 to March 2012, to study the effect of seed coating with polymer in combination with fungicide and insecticides in two types of containers (Gunny and high density polythene (HDPE) bags) on seed quality parameters of sunflower hybrid KBSH-53 during storage. The freshly harvested hybrid seed material of sunflower hybrid KBSH-53 grown during rabi 2010-11 by sowing CMS 335 S (Female parent) and RHA 95-C-1 (Male parent) in 3:1 ratio with a spacing of 60 x 30 cm. Rouging was done by removing plants which do not confirm to their respective parental lines for their morphological characters. Female rows were critically observed for pollen shedders and yellow pollen mass were removed. Hand pollination was effected regularly between 8-11 A M at an alternate day throughout the

Table-1 : Moisture content (%) of coated seed lots of Sunflower hybrid during storage.

S. No	Treat ment	Moisture (%) during storage (months)												
		0	2			4			6			8		
			C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean
1	T0	7.0	8.5	7	7.75	8	7.97	7.99	7.93	7.88	7.91	8.29	8.04	8.17
2	T1	7.0	7.8	6.7	7.25	7.33	7.67	7.50	7.21	7.53	7.37	7.81	7.75	7.78
3	T2	7.0	7.3	7.1	7.20	7.61	7.65	7.63	7.55	7.47	7.51	7.79	7.60	7.70
4	T3	7.0	6.8	6.4	6.60	7.82	7.61	7.72	7.64	7.75	7.70	7.5	6.87	7.19
5	T4	7.0	6.8	6.7	6.75	7.7	7.33	7.52	7.62	7.25	7.44	7.55	7.40	7.48
6	T5	7.0	7.7	7.7	7.70	7.86	7.65	7.76	7.64	7.54	7.59	7.57	7.33	7.45
	Mean	7.0	7.64	6.93	7.28	7.78	7.64	7.71	7.60	7.57	7.58	7.75	7.49	7.77
			T	C	T x C	T	C	T x C	T	C	T x C	T	C	T x C
	CD at 5%	0.36	0.54	0.34	0.79	0.35	0.22	0.5	0.55	0.39	0.48	0.23	0.15	0.33

T : Treatment C : Container C₁ : Gunny bag; C₂ : HDPE bag

T₀ = untreated control; T₁ = polymer coating; T₂ = Flowable thiram (Royal flow); T₃ = polymer + flowable thiram;

T₄ = Vitavax 200; T₅ = polymer + vitavax 200

Table-2 : Germination (%) of coated seed lots of sunflower hybrid during storage

S.No.	Treatment	Germination (%) during storage (months)												
		0	2			4			6			8		
			C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean
1	T0	87.0	84.3	87.3	85.8	79.0	80.0	79.5	76.3	78.3	77.3	39.0	42.3	40.7
2	T1	87.0	85.3	87.6	86.5	80.7	81.6	81.2	78.6	82.3	80.5	70.6	74.6	72.6
3	T2	87.3	86	88.6	87.3	84.3	85.6	85.0	86.3	86.3	86.3	77.0	78.3	77.7
4	T3	91.0	89.3	90.6	90.0	85.3	87.3	86.3	84.3	85.6	85.0	81.6	84.0	82.8
5	T4	88.7	88.3	84.0	86.2	87.3	86.0	86.7	86.6	88.0	87.3	63.6	67.0	65.3
6	T5	89.3	67.6	63.7	65.7	61.6	66.3	64.0	69.3	69.6	69.5	66.3	69.0	67.7
	Mean	88.6	86.5	83.6	85.1	79.7	81.3	80.5	80.2	81.6	80.9	66.3	69.2	67.7
			T	C	TxC	T	C	TxC	T	C	TxC	T	C	TxC
	CD at 5%	2.21	6.93	2.08	9.80	5.18	3.27	7.32	4.89	3.32	5.87	4.44	2.81	6.28

T : Treatment C : Container C₁ : Gunny bag; C₂ : HDPE bag

T₀ = untreated control; T₁ = polymer coating; T₂ = Flowable thiram (Royal flow); T₃ = polymer + flowable thiram;

T₄ = Vitavax 200; T₅ = polymer + vitavax 200

flowering period. The male row was harvested first and removed from the field to avoid the risk of physical contamination. Then female rows were harvested, threshed, cleaned and dried to a moisture percent of 7.0 and then imposed the treatments.

The treatment combinations were polymer seed coating @ 5 ml / kg of seed (T₁), flowable thiram (Royal flow 40 SC with an active ingredient of 6% Tebuconazole and 20% Thiram)@ 2.4 g/ kg seed (T₂), polymer @ 5 ml / kg of seed along with flowable thiram (Royal flow 40 SC) (T₃), vitavax 200 (Thiram 37.5% + Carboxyl 37.5%) @ 2g / kg seed (T₄), polymer seed coating along with vitavax 200, 2g/ kg seed (T₅) and untreated control (T₀). The liquid polymer used for seed coating was polykote manufactured by PHS limited, Chennai. One kilo gram of seeds were taken in a polythene bag and added polymer @ 5 ml per kg of seed (T₁). The bag was closed tightly trapping air in it to form a balloon. Then the poly bag was vigorously

shaken till the seeds were uniformly coated. Later, the treated seeds were spread on a sheet under the shade and dried completely. The dried seeds were used for the experiment. The treatments of fungicides and insecticides were given before polymer coating. Utmost care was taken during mixing to have uniformity in coating. The seeds were dried back to its original moisture content. The experiment was designed in factorial completely randomized block design (FCRD) with three replications. The seed material was packed in gunny and high density poly ethylene (HDPE) bags and stored under ambient conditions of Seed Research and Technology Centre, Hyderabad. Bimonthly observations on germination per cent (5), moisture percent (5), field emergence and seedling vigour index (SVI) (6) were recorded. The statistical analysis was done using the procedure described by (7).

Table-3 : Field emergence (%) of coated seed lots of sunflower during storage.

S. No.	Treat ment	Field emergence (%) during storage (months)												
		0	2			4			6			8		
			C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean
1	T ₀	87.3	85.0	87.0	86.0	71.6	76.67	74.1	76	78.3	77.2	30.0	37.0	33.5
2	T ₁	83.0	87.6	89	88.3	72.6	77.67	75.1	80.3	81.3	80.8	62.0	69.0	65.5
3	T ₂	87.0	85.6	86	85.8	71.3	79.33	75.3	83.6	85.3	84.5	68.7	72.6	70.7
4	T ₃	90.0	88.6	89	88.8	82.3	83.3	82.8	83	86.0	84.5	72.6	76.0	74.3
5	T ₄	86.3	88	87.3	87.7	83.6	84.3	84.0	85.3	86.0	85.7	58.3	60.0	59.2
6	T ₅	89.0	61	71.6	66.3	68.0	65.6	66.8	69.0	62.1	65.6	61.3	64.6	63.0
	Mean	87.1	82.6	84.9	83.7	74.9	77.8	76.3	79.5	79.8	79.6	58.8	63.2	61.0
			T	C	T x C	T	C	T x C	T	C	T x C	T	C	T x C
	CD at 5%	1.92	4.66	2.95	6.59	6.33	4.00	8.95	7.12	6.87	3.25	3.10	1.96	4.38

T : Treatment C : Container C₁ : Gunny bag; C₂ : HDPE bagT₀ = untreated control; T₁ = polymer coating; T₂ = Flowable thiram (Royal flow); T₃ = polymer + flowable thiram;T₄ = Vitavax 200; T₅ = polymer + vitavax 200**Table-4** : Seedling vigour index (SVI) of coated seed lots of sunflower hybrid during storage.

S.No	Treat ment	Seedling vigour index during storage (months)												
		0	2			4			6			8		
			C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean	C ₁	C ₂	Mean
1	T ₀	2163	1676	1935	1805	1948	2167	2057	2326	2523	2424	1253	1341	1297
2	T ₁	2196	1741	2008	1874	2541	2422	2481	2449	2418	2433	2570	2161	2515
3	T ₂	2055	1726	1743	1734	2450	2874	2662	2887	3065	2976	2571	3133	2852
4	T ₃	2378	1888	1993	1940	2926	3254	3090	2726	2816	2771	3289	3065	3177
5	T ₄	2367	1839	1895	1867	3580	3941	3760	2699	3035	2867	1885	2173	2029
6	T ₅	2340	1539	1571	1795	1578	1578	1578	1958	2053	2005	1582	1829	1705
	Mean	2250	1734	1857	1795	2503	2706	2604	2507	2652	2579	2192	2284	2238
			T	C	T x C	T	C	T x C	T	C	TxC	T	C	T x C
	CD at 5%		346.6	219.2	490.2	310.7	196.5	439.4	332.5	119.5	335.4	4.17	2.63	5.9

T: Treatment C: Container C₁ : Gunny bag; C₂ : HDPE bagT₀ = untreated control; T₁ = polymer coating; T₂ = Flowable thiram (Royal flow); T₃ = polymer + flowable thiram;T₄ = Vitavax 200; T₅ = polymer + vitavax 200

RESULTS AND DISCUSSION

Seed coating provides opportunity to every seed to express its potential at the time of storage. Seed coating with polymer is one such pre-storage treatment that can be used either singly or in combination with other pesticides to protect the seed against pests and diseases.

Effect of seed coating on moisture content of sunflower seed : Seed moisture content is the most important factor influencing the seed viability during storage. The seed moisture content increased in both coated and uncoated seeds irrespective of the containers. But, there is no significant difference between the containers with respect to moisture content in the seed lots. The increase was gradual in case of HDPE bag stored seeds when compared to gunny bag stored seeds. The fluctuations in the seed moisture content was higher

in gunny bag than HDPE bag storage. The initial moisture content of 7.0 per cent increased to 8.29% in the untreated seed stored in gunny bag, while it was 6.87 per cent in the seed lot treated with polymer along with thiram stored in HDPE bag at the end of 8 months storage period. This underlines the suitability of seed coating as barrier to the entry of moisture strengthening them against the fungal infection as experimentally demonstrated by (8) in hybrid rice, (9).

Effect of Seed coating on germination of Sunflower seed: The results showed that germination per cent declined with the progress of storage period irrespective of the storage container. However, at the end of storage, the seed stored in HDPE bag (69.2%) was significantly superior over seed stored in gunny bag (66.3%). The initial germination percentage of untreated control seed lot was 87 which decreased to 39 and 42.3 per cent over a

period of 8 months when stored in gunny and HDPE bags, respectively (Table-2). The seed lot coated with polymer @ 5 ml/kg of seed along with flowable thiram (T_3) recorded significantly superior germination per cent in both the containers (84) in HDPE bag and 81.6 in gunny bag after a period of 8 months storage, followed by seed lot coated with thiram (T_2) by recording the mean germination per cent of 77.7 as against the lowest recorded in untreated control stored in gunny bag (40.7%). The reduction in viability and vigour might be due to ageing effect, leading to depletion of stored food that leads to decline in synthetic activity at the embryo apart from death of seeds due to fungal invasion and insect damage (8) in hybrid rice, (9) in soybean and (2). Similarly, decrease in germination with increase in storage period was reported by earlier studies of (9) in soybean. (10) also stated that thiram acts as a protective agent against seed deterioration due to fungal invasion and physiological ageing as a result of which the seed viability was maintained for comparatively longer period. Similarly, the performance of the seed lot coated with polymer @ 5 ml/kg of seed along with flowable thiram (T_3) was significantly superior for field emergence (76%) against the untreated control (37%) stored in HDPE bag after a period of 8 months storage (Table 3). The higher field emergence of seed coated with polymer was due to increase in rate of imbibition, where the fine particles of the coating act as moisture attracting material.

Effect of Seed coating on seedling vigour index (SVI) of Sunflower seed: The seedling vigour index (SVI) is an important seed quality parameter found to decrease gradually in all the treatment combinations with increase in storage period. SVI (Based on seedling length) was significantly higher in seed lot coated with polymer @ 5 ml/kg of seed along with flowable thiram (3289) stored in gunny bag, while the lowest seed vigour index of 1253 was recorded in untreated seed lot stored in gunny bag (Table 4). There was no significant difference between the storage containers as the performance was same in gunny as well as HDPE bag with respect to SVI. The present results are in agreement with the finding of (11) who noticed higher germination percent, vigour index compare to control in maize seed lots coated with pink poly coat @3 g /kg seed along with fungicide and insecticide treatment. similarly, (12) also noticed that seed coating with polymer @12 ml + thiram @ 2g/kg seed recorded higher germination, vigour index, dry weight of seedlings and lower seed infection as compared to control in onion seed.

CONCLUSION

In the present study an effort was made to identify the suitable polykote combination treatment that could reduce

the seed deterioration during storage. From the observations it is clear that seed coated with different combinations of polykote treatments in general decrease at slower pace as manifested with higher per cent of germination and field emergence.

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AN ANALYSIS OF CONSUMPTION PATTERN OF FRUITS AND VEGETABLES IN BIHAR

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ABSTRACT

The main purpose of present study is to assess the expenditure pattern of fruits and vegetables in rural and urban people, their expenditure elasticity as well as relationship between price and supply of fruits and vegetables over the period. Study were undertaken during the year 2010- 2013 and based on both primary as well as secondary data. Primary data were collected from 44 villages of 11 selected districts. Secondary data on consumption expenditure were collected from N.S.S.O., Govt. of India of 5 major rounds. Data of 5 major round i.e. 38, 43, 50, 95 and 66th shown a positive growth in annual per capita expenditure on fruits and vegetables and it was found more in urban areas than in rural areas. The consumption of vegetables and fruits was found to increase with increase in income in both rural and urban areas. Study results shows that vegetables have emerged as an essential commodity recording income elasticity of demand lower than most of non-cereal commodities, while fruits continued to be more elastic. The percentage change in consumption expenditure on fruit was comparatively 2 times higher than expenditure on vegetables was observed across all income groups. It clearly indicated that, people having higher income made more expenditure on fruits and vegetables rather than others food items in contrast to the people having low income; they made more expenditure on food. Engel's law also states that the poorer the family, the greater is the proportion of its total income devoted to provision of food. The relationship between the price and arrivals was found to be negative and significant for mango. However for banana and litchi it was positive i.e. arrival and prices both were shown an increasing trend. It revealed that extent of influence of arrival on prices of fruits was comparatively more than that of vegetable over the reference period.

Key words : Consumption pattern, expenditure elasticity, logarithmic function, fruits and vegetables.

Fruits and vegetables occupy a significant place in the human diet and provide essential vitamins and minerals for human growth. These are also play an important role in generating employment, income and meeting household nutritional security, production of fruits and vegetables is being viewed as 'sunrise enterprise'. During the year 2012-13, Bihar produces 4249.19 thousand metric tonnes of fruits accounting for 5 per cent of total fruits production of India and produces 162325.68 thousand MT vegetables accounting for 10 per cent of total vegetable production of India. The productivity of fruits in Bihar is more (10.2 t/ha) comparatively national average (8.09 t/ha) (1). A shift in consumption pattern towards fruit was observed for all the socio-economic groups living in rural and urban area due to increase in availability of fruits in the state (2). It is hypothesized that the urbanization shift in dietary pattern, economic and population growth will enhance the fruit consumption per person and national demand in future (3) The per capita availability of fruits in India was estimated about 182 gm/capita/day where in Bihar it was estimated as 112 gm/capita/day during the year 2013. However availability of vegetables was estimated as 363.2 gm for India and 430gm for Bihar during the same time (4). Regarding consumption, National Nutrition Guidelines recommended that average 300 gm of vegetable and 100 gm fruits for a person/day and these amounts of vegetable should take as green leafy vegetable (50 gm), roots and tubers (50 gm) and other vegetable (200 gm) in 7-9 servings per day. Regional office for Asia and Pacific, FAO recommend that

leafy vegetable per day for adult man 40 gm and 100 gm for adult women while other vegetable should be 60–80 gm and 40–100 gm for adult man and women respectively (5). FAO and WHO recommended that adults should consume at least 400 gm fruit and vegetable per capita per day, while 420 gm recommended by ICMR, New Delhi. Therefore future strategy would require a remarkable change in consumption pattern and impact of prices on arrival of major fruits and vegetables in Bihar. This article seeks to examine the change in consumption pattern and impact of price on arrival as well as elasticity of demand of fruits and vegetables in Bihar. It was necessary because Bihar is third largest producer of vegetables and it has vast growth potential (6). Regarding % change in the level of self-sufficiency it has been declined from 118 per cent to 87 per cent for vegetables whereas for fruits it was estimated as 102% in 2011 would be sufficient for 56 per cent of population respectively up to 2026 (7). Therefore the study on consumption pattern is very important as it is related to poverty and standard of living of society. It is necessary to study the changes in food consumption pattern under the changing situations of liberalization, privatization and globalization. The analysis of changing food consumption pattern over time would help in designing appropriate policies related to crop production and distribution. The food production pattern in India is diversifying towards high value crops (3). The genesis of study further lies in fact that there is hardly any comprehensive survey based study related to consumption pattern, in Bihar were carried out which

Table-1 : Consumption pattern of fruits and vegetable in Bihar (Kg/cap/year).

Year	Vegetable	Fruits	Total
1983	63.6	3.6	67.2
1987-88	68.1	7.6	75.4
1993-94	79.4	11.5	90.9
1999-00	91.4	7.3	98.7
2003-06	96.11	8.5	104.61
2009-10	100.82	8.2	109.02
% change	58.52	127.77	62.23

Source : Compilation of NSSO data.

could help in improvement in the pattern of production, consumption and marketing prospects of these crops and suggest policy measure for improvement thereof in a backward economy.

RESEARCH METHODOLOGY

The study was mainly based on collection of primary data however to find out the elasticity of demand, different round of NSS data on consumption expenditure was collected from NSSO, Govt. of India. Data of 5 major round i.e. 38, 43, 50, 95 and 66th pertaining to the periods 1983-84, 1988, 1993-94, 1999-2000, 2005-06 and 2009-10 respectively, primary data on consumption expenditure as well as price and supply of fruits and vegetables were collected from the 240 farmers of 44 villages of 11 different districts using purposive sampling techniques. Major fruits were Mango, litchi and Banana and major vegetables were Okra, Cauliflower, Tomato and Potato for the study. To know the quantity supply and prevailing prices of selected crops, one market from each district were selected randomly.

Expenditure elasticity of fruit for rural and urban sector were estimated on the basis of collected NSSO data by fitting logarithmic function of the type $\log y_i = \log a + b \log x_i$, while for estimating impact of prices on supply the following function was used.

$$\log (P_{ij}) = a + b \log (x_{ij})$$

Where,

P_{ij} = Average price of fruits in its month of jth year

a = Intercept

B = Regression co-efficient

x_{ij} = Supply of fruits and vegetables in main markets.

RESULTS AND DISCUSSION

Consumption Pattern of Fruits and Vegetable in Bihar

Table 1 indicate the data pertaining to annual per capita consumption of vegetable and fruits in Bihar, from

1983-2010. It was observed that, over the 30 year i.e. from 1983-2010, an increase in per capita annual consumption of vegetable and fruit in Bihar was found from 63.6Kg to 100.82 Kg i.e. 58.5 per cent for vegetables and 127 per cent i.e. from 3.6 Kg to 8.2 Kg respectively for fruits. It clearly indicated that the percentage change on consumption expenditure on fruit was more than 2 times compared to consumption on vegetables across all income groups in Bihar. It shows that urbanization changes the dietary pattern of individual household in study districts of Bihar. Similar trend was observed in the study of (8).

Over long term change in consumption pattern of vegetables was observed in comparisons to fruits as indicated that yearly per capita consumption of vegetables in rural area in 1993 was 78 to 79 kg which was estimated in 2011 as 70 kg/capita/year i.e. declined by -10.4 per cent where as in urban area it was declined by -11.8 per cent. However for fruits the change in consumption on fruits was more on rural area than urban area i.e. 68 per cent and 9.4 per cent respectively. Same trend was also observed in the studies of (7).

Consumption Expenditure on Fruits and Vegetable in Bihar : Table-2 indicates that tremendous changes in consumption expenditure of vegetable and fruit were observed in both rural and urban area. The increase in expenditure on vegetable and fruit was comparatively higher in rural household (477.18 per cent and 727.43 per cent for vegetable and fruit, respectively) than in urban household i.e., 385.88 per cent and 443.09 per cent respectively for vegetable and fruit however with respect to fruits, the percentage change in per capita expenditure it was greater in urban household as it was estimated to be 1.04 per cent in the year 83-84 which was estimated as 1.84 per cent in 2009-10 and in rural areas it was 0.741 and 1.59 per cent respectively. This clearly indicated that there was a wide disparity in consumption levels of fruit and vegetables between rural and urban household. Similar trend was observed in the study of (8).

Monthly per capita consumption expenditure on vegetable doing 1983-84 in rural area was estimated to Rs15.30 which has been increased to Rs. 88.31 by approximately 5 times in the year of 2009-10. The monthly per capita expenditure on fruit consumption has been increased from Rs. 1.5 to 12.41 during same mentioned period. The increase in expenditure during the period was highest for fruit i.e. 727.73 per cent followed by vegetable 497.18 and 206.61 per cent respectively on food item. Similar trend was observed in urban area too. Thus it may be concluded that Food expenditure pattern is an excellent indicator of economic well-being of people. If the society is wealthy proportionately high expenditure will be made on secondary necessities, comfort, luxury

Table-2 : Monthly per capita consumption expenditure on fruits and vegetable in Bihar (Rs.).

Food items	Rural			Urban		
	83-94	2009-10	% change	83-84	2009-10	% change
Total food	120.07 (60.07)	504.81 (64.70)	320.42	210.76 (52.59)	654.97 (53.00)	210.76
Vegetable	15.30 (7.64)	88.31 (11.31)	477.18	20.12 (5.02)	97.76 (7.89)	385.88
Fruit	1.50 (0.74)	12.41 (1.59)	727.73	4.20 (1.04)	22.81 (1.84)	443.09
Non food	80.05 (40.00)	35.29 (780.15)	-243.97	190.00 (47.40)	582.57 (47.07)	206.61
	200.12 (100.00)	780.15 (100.00)	289.84	400.76 (100.00)	1237.54	

Source : Compilation of NSSO data.

Table-3 : Income group wise monthly per capita expenditure on fruits and vegetable (%)

Vegetable	Rural				Urban			
	LIG	MIG	HIG	All	LIG	MIG	HIG	All
1983-84	10.00	17.60	18.30	15.30	11.02	19.04	30.32	20.12
2009-10	79	90.90	95.03	88.31	70.00	103.0	120.28	97.76
% change	690	416	419	477.18	535.20	440.96	296.70	385.88
Fruit								
1983-84	0.50	1.50	3.0	1.50	2.0	4.20	6.40	4.20
2009-10	5.23	12.0	20.0	12.41	14	24.43	30.00	22.81
% change	946	11.00	5.66	727.33	600	481.66	368.75	443.09

Source : Compiled by author.

products and conspicuous consumption. On the other, if the society is at subsistence level, people will spend proportionately more on food. Engel's law also states that the poorer the family, the greater is the proportion of its total income devoted to provision of food (9, 10).

Across different income group a wide variation on percentage change over period for both rural and urban area was observed which has been presented in Table No.3. It revealed that % change on budgetary expenditure on vegetable in rural area was comparatively higher (690.0 per cent) than urban area (535.20 per cent). However lowest parentage change on consumption expenditure on vegetable was observed in high income group for both urban and rural areas among all income groups but in fruit MIG of rural areas shown highest percentage change over the same period followed by lower income group and higher income respectively. Overall, % change on consumption expenditure for urban area was estimated to be 443.09 per cent and for rural area and it was 727.33 per cent. It clearly indicated that rural people is more price sensitive than urban people of all income groups. In rural area both group of people they hardly expenses 1 per cent on fruit but on vegetable they makes more expanses *i.e.* 11 per cent of total food expenditure during the year of 2009-10 which was estimated to be 7.5 per cent for vegetable and 0.9 per cent for fruit during the year of 1983. The consumption of vegetables and fruits was found to increase with increase in income in both rural and urban areas. A similar finding was observed in the study of (7).

Expenditure Elasticity of Demand for Vegetable and Fruit in Bihar :

The expenditure elasticity of vegetable was very high for bottom group consumers of both urban (1.44) and rural areas (1.10). In case of fruit, the bottom group consumers also had very high expenditure elasticity of 1.38 for rural area and 1.52 for urban consumers.

Among all income groups the expenditure elasticity on fruit and vegetable was comparatively lower in upper classes of both rural and urban areas in Bihar which were estimated as 0.56 and 50 for vegetable and 0.80 and 0.69 for fruits respectively followed by middle and bottom income groups. Over all the elasticity of fruits in rural and urban area was estimated to be 1.06 which indicates that price of fruit did not make any significant difference on demand for fruits. However the estimated value of elasticity of vegetables was comparatively lower than fruits irrespective of level of income, it clearly indicates that consumption of vegetable was observed as an essential component of every household and was estimated about .88 and .96 respectively which was lower than that of fruits. Therefore, it may be concluded that the expenditure elasticity of vegetable was very high for bottom group consumers of both urban (1.44) and rural areas (1.10). For fruits similar pattern was observed and it was estimated about 1.38 for rural and 1.52 for urban consumers respectively. For upper class the expenditure elasticity on fruit and vegetable was comparatively lower for both rural and urban areas. Over all the elasticity of fruit in rural area and urban area was same. It indicates that in urban area price of fruit does not make any

Table-4 : Expenditure elasticity of demand for vegetables and fruits in Bihar.

	Vegetable		Fruit	
	Rural	Urban	Rural	Urban
Bottom	1.10	1.44	1.38	1.52
Middle	0.98	0.96	1.01	0.98
Upper	0.56	0.50	0.80	0.69
Bihar groups	0.88	0.96	1.06	1.06
India groups	0.28	0.30	0.47	0.48

Source : Survey study, 2011-12.

significant difference on demand of fruit for people. Result also revealed that vegetables have emerged as an essential commodity recording income elasticity of demand lower than most of non-cereal commodities, while fruits continued to be more elastic which was also observed in the studies of (7) on demand, supply and trade prospectus of major fruits in India. An inequality of PCE was found to be comparatively higher in urban areas for all the items together while that on vegetables was higher in rural areas. The inequality in PCE in both rural and urban sectors was lower in terms of per capita income. The expenditure elasticity provided an idea of the consumer behaviour for food and non-food commodity groups. (11) also observed similar finding in his studies on variation in consumption expenditure between rural and urban area.

Impact of Production (arrivals) on Price of Major Vegetable and Fruits in Bihar : An arrival of major fruits and vegetables has been taken as a proxy variable for supply of fruits and vegetable in order to capture the price behaviour during different year or month. To understand how far arrivals accounts for total production the percentage share of total arrivals in total production was estimated and it has been found to be 40 per cent for fruits and 50 per cent for vegetable in most of the years under study. The relationship between the price/year and arrivals for the last 10 years was found to be negative and significant for mango it was estimated to be -3.14 i.e. value of regression co-efficient, indicating that an increase in the prices of fruit would reduce the supply of major fruits to the market and vice-versa (Table-5).

Table-5 shows that among fruits supply i.e. arrivals of mango was declined over 10 years and price of mango shown an increasing trend i.e., about 31.14 per cent. However, for banana and litchi arrivals as well as prices too shown an increasing trend and estimated to be increased by 12.1 per cent and 10.0 per cent respectively. For vegetable over the 10 years the extent of influence of arrivals on prices indicated that among vegetable okra was reported highest percentage change and found to be about 6% followed by cauliflower and tomato in which

Table-5 : Regression co-efficient of price and arrivals of major fruits and vegetables in selected district of Bihar.

Particulars	Co-efficient	Intercept	Equation
Mango	-3.14	Lg. 21.14	$\log y = 24.1427 + (-3.14) \cdot \log x$
Litchi	1.24	0.0020	$y = [0.0020] \cdot x \cdot (1.2435)^*$
Banana	1.001	0.6539	$y = (0.6539) \cdot x \cdot (1.00165)^*$
Okra	0.56	1.0012	$y = [1.0012] \cdot x \cdot (0.56)$
Tomato	0.47	1.002	$y = 1.00224 \cdot x \cdot (0.4745)$
cauliflower	0.49	1.0004	$y = [1.000040] \cdot x \cdot (0.4972)$

Source : Survey study, 2011-12,* Significant at 1%.

percentage change in price was estimated as 5 per cent and 4 per cent respectively. Extent of influence of arrival on prices of fruits was more than that of vegetable over the reference period. Decline in the market arrival of fruits and vegetables is another significant issue highlighted in the study indicated that only 40% of total production and 50% of vegetables only reach into the market during the mentioned period same trend has been reported by the chamber's study as just about 22 per cent of fruits and vegetables produced in India reach the wholesale market.

Conclusion and Policy Implications : Present study shows a positive growth in annual per capita expenditure on fruits and vegetables in both urban and rural areas while the consumption of vegetables and fruits were found to increase with the increase in income of the household in both rural and urban areas. Result also revealed that vegetables have emerged as an essential commodity recording income elasticity of demand lower than most of non-cereal commodities, while fruits continued to be more elastic. Across all income groups, the expenditure elasticity of vegetable was very high for bottom group consumers of both urban (1.44) and rural areas (1.10) and similar pattern was observed for fruits. For upper class the expenditure elasticity on fruit and vegetable was comparatively lower for both rural and urban areas. Over all the pattern of expenditure on fruit between rural and urban area according to level of income was same and it indicates that in urban area price of fruit does not make any significant difference on demand of fruit for people. Across all income group the percentage change on consumption expenditure on fruit was more than 2 times compared to consumption on vegetables was observed in of Bihar. An inequality of PCE was found to be comparatively higher in urban areas for all the items together while that on vegetables was higher in rural areas. The inequality in PCE in both rural and urban sectors was lower in terms of per capita income. The relationship between the price/year and arrivals for the last 10 years was found to be negative and significant for mango it was estimated to be -3.14. However for banana (1.2) and litchi (1.0) it was positive arrival and prices both were shown an increasing trend while for vegetables it

was found .56, .47 and .49 for okra, tomato and cauliflower respectively. It can be concluded that extent of influence of arrival on prices of fruits was more than that of vegetable over the reference period. Decline in the market arrival of fruits and vegetables are another significant issue highlighted and indicated that only 40% of total production of fruits and 50% of vegetables could only reach into the market during the mentioned period. A wide spread increase in consumption of vegetables and fruits was observed across different income groups in both rural and urban area. The relationship between supply and price of major fruits and vegetable indicated that during the peak period price of vegetable and fruit was low and during off season the price of any fruits and vegetable was comparatively higher but due to lack of processing plant, storage facility of fruit and vegetable, prospects of trade of these product has been declining in the state. The study suggested that vegetable and fruit are now being viewed at market of national importance owing to the fact that these have large export potential, thus, it can be said that efficient domestic marketing system can only promote the export of these crop. The per capita consumption of non-cereal based food and processed foods is increasing implying that there is a great demand for these products in the urban and semi-urban areas. The share of these products in the total expenditure is increasing over the years but high prices are acting as constraint in the consumption of value-added products. The consumption and the share of different food items as well as consumption on vegetable and fruits have changed appreciably. Increase in income, education and easy availability of ready-to-eat foods may bring about enormous changes in the food consumption pattern in the near future. Therefore production, processing and distribution of processed fruits and vegetables should have priority in the policies of the state.

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COMBINING ABILITY OVER ENVIRONMENTS FOR SEED YIELD AND ITS COMPONENTS IN CASTOR (*Ricinus communis* L.)

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ABSTRACT

Combining ability for seed yield and its components in castor was studied over three environments (sowing dates) in a set of four pistillate lines, 13 monoecious lines and their resultant F_1 's with check hybrid GCH-7. The pooled analysis showed that both GCA and SCA variances were highly influenced by the environments implying that the parents and crosses must be evaluated over a wide range of environments to have unbiased estimates. The analysis of variance indicated preponderance of additive type of gene action in the expression of 100-seed weight, while non-additive gene action was observed to be more important for days to 50% flowering of primary raceme, days to maturity of primary raceme, plant height upto primary raceme, number of nodes upto primary raceme, length of primary raceme, effective length of primary raceme, number of effective branches per plant, number of capsules on primary raceme, shelling out-turn, seed yield per plant and oil content. One line (JP-89) and five testers (PCS-124, DCS-85, SKI-215, JI-353 and JI-357) were good general combiners for seed yield per plant having high concentration of favourable genes as indicated by significant and positive GCA effect for these parents. Twelve crosses were found to be good specific combiners for seed yield per plant with maximum SCA effect in cross JP-96 x PCS-124.

Key words : General and specific combining ability, environment, yield component, castor.

Castor (*Ricinus communis* L.) is one of the most important non-edible oilseed crops in the world. It is generally distributed in the tropical, sub-tropical and warm temperate zones (1). Castor is a highly cross pollinated crop in which, most of the cultivars have been developed by hybridization followed by selection. Constant efforts are being made to improve seed yield and yield contributing characters through hybridization. Proper selection of parents is very crucial in any planned hybridization programme. Certain parents nick well, whereas others which appears equally good but produce poor progenies in combinations. Eventually, the lines, which produce good progenies on crossing, are of immense value to the plant breeder. In a crop improvement programme much of the success depends upon isolation of valuable gene combinations as determined in the form of lines with high combining ability. Therefore, an attempt has been made to evaluate four pistillate lines, 13 monoecious lines and their F_1 's over three environments (sowing dates) for combining ability estimates.

MATERIALS AND METHODS

Fifty two crosses were generated from crossing between four pistillate lines as females and 13 monoecious lines as males in line x tester fashion during kharif 2012-13. Pistillate lines (JP 96, SKP-84, SKP-106 and JP-89) and monoecious lines (PCS-124, DCS-85, SKI-215, SKI-343, SKI-341, SKI-352, JI-244, JI-353, JI-357, 48-1, RG-2800, RG-2826 and JC-18) were selected on the basis of desirable agronomic characters. The experimental material, consisting 70 entries including 17 parents and their resultant 52 crosses along with one check hybrid

(GCH-7), was raised in a randomized block design with three replications at Main Oilseeds Research Station, J.A.U. Junagadh over three environments (sowing dates) during kharif 2013-14. Environments were created through different dates of sowing during kharif 2013-14 i.e. E_1 = 1st week of August, E_2 = 3rd week of August and E_3 = 2nd week of September. Each entry was accommodated in single row of 7.2 m. length spaced at 90 cm apart with plant-to-plant spacing of 60 cm. recommended practices and plant protection measures were adopted timely to raise the healthy crop. The observations on five randomly selected plants were recorded for characters viz., length of primary raceme (cm), effective length of primary raceme (cm), number of effective branches per plant, number of capsules on primary raceme, shelling out-turn (%), seed yield per plant (g), 100-seed weight (g) and oil content (%). The combining ability analysis was carried out according to the method suggested by (2).

RESULTS AND DISCUSSION

The pooled analysis of variance (Table-1) showed significant differences among the environments for all the characters studied except number of capsules on primary raceme indicating wide variation in the environments created by different date of sowing. Mean square due to lines and testers were significant for all the characters studied the presence of considerable diversity among the parental material. The interactions of lines and testers being significant suggested that lines may perform differently in crosses depending on the types of testers used. Similarly, the variances due to lines x environments, testers x environments and (lines x testers) x

Table-1 : Analysis of variance for combining ability pooled over environments for seed yield and its components in castor.

Source	DF	Length of primary raceme (cm)	Effective length of primary raceme (cm)	No. of effective branches per plant	No. of capsules on primary raceme	Shelling out-turn (%)	Seed yield per plant (g)	100-seed weight (g)	Oil content (%)
Lines (L)	3	1168.00*+	1115.28*+	95.99*+	5520.10*+	75.95*+	3739.93*	626.63*+	23.93*+
Testers (T)	12	218.44*	271.09*	84.76*+	1307.49*	44.69*	69675.88*+	147.23*+	6.86*
Lines x Testers (L x T)	36	228.43*+	315.20*+	22.78*+	1605.49*+	23.38*+	13112.12*+	22.83*+	7.36*+
Envt. (E)	2	847.49*+	459.00*+	325.35*+	22.88	249.22*+	105482.88*+	17.66*+	3.58*+
L x E	6	126.99*+	97.26*	36.17*+	146.37*	9.01*	20592.94*+	0.39	0.69
T x E	24	46.08*	36.72*	9.11*	256.20*	13.98*	5263.96*	0.35	0.67
L x T x E	72	49.83*	50.43*	6.68*	178.23*	12.11*	6597.56*	0.27	0.54
Pooled Error	306	10.28	14.08	0.54	29.34	2.03	415.47	0.58	0.67
Variance components									
Lines (2l)		9.90	9.41	0.81	46.93	0.63	28.41	5.35	0.20
Testers (2t)		5.78	7.14	2.34	35.50	1.18	1923.90	4.07	0.17
Lines x Testers (2lt)		24.24	33.46	2.47	175.13	2.37	1410.74	2.47	0.74
2l x e		2.99	2.13	0.91	3.00	0.18	517.37	@	0.01
2t x e		2.98	1.89	0.71	18.91	0.99	404.04	@	@
2lt x e		13.18	12.11	2.05	49.63	3.36	2066.70	@	@
2GCA		8.93	8.88	1.17	44.24	0.76	474.41	5.05	0.19
2SCA		24.24	33.46	2.47	175.13	2.37	1410.74	2.47	0.74
GCA/ SCA		0.37	0.27	0.48	0.25	0.32	0.34	2.04	0.26

*,+ Significant at P = 0.05 against error and interaction mean squares, respectively @ Estimate negative.

environments were also significant indicating the importance of environments for the expression of traits except 100-seed weight and oil content.

The additive component due to lines ($\sigma^2_{L \times e}$), testers ($\sigma^2_{T \times e}$) and non-additive component due to hybrids ($\sigma^2_{LT \times e}$) significantly interacted with environments in pooled analysis. However, comparing its magnitude, non-additive component due to hybrids ($\sigma^2_{LT \times e}$) was more sensitive to fluctuating environments as compared to additive component due to lines ($\sigma^2_{L \times e}$) and testers ($\sigma^2_{T \times e}$) for most of the characters, which indicated that the hybrids were more sensitive to environmental fluctuations than lines and testers. This also suggested that the estimation of components of genetic variance for these characters is necessary in a more number of environments to arrive at a correct decision regarding their relative importance.

The variance estimates of GCA and SCA suggested that both additive and non-additive gene action were important for the expression of all the traits. However, the magnitude of σ^2_{SCA} was greater than σ^2_{GCA} for length of primary raceme, effective length of primary raceme, number of effective branches per plant, number of capsules on primary raceme, shelling out-turn, seed yield per plant and oil content. The results thus, indicated preponderance of non-additive gene action in the expression of these characters. As observed in the present study, the predominant role of non-additive gene

action in the inheritance of seed yield was observed by (3, 4). This emphasized the use of heterosis breeding approach to exploit hybrid vigour in this crop.

The estimates of σ^2_{GCA} were higher in magnitude than that of σ^2_{SCA} for 100-seed weight in all the individual environments and pooled over the environments. The results indicated that this character was predominantly under the control of additive gene action. Greater importance of additive type of gene action for this character suggested that directional selection could be highly effective and better lines could be isolated from the segregating populations. Predominance of additive type of gene action for 100-seed weight has been reported by (5, 6).

General combining ability effect of parents (Table-2) revealed that none of the parents was found good general combiner simultaneously for all the characters. However, the line JP-89 and testers PCS-124, DCS-85, SKI-215, JI-353 and JI-357 were good general combiners for seed yield per plant having high concentration of favourable genes as indicated by significant and positive gca effect for these parents. Besides having good combining ability effect for seed yield per plant, these parents were also observed to be good combiners for yield contributing characters. For example, JP-89 was also good general combiner for number of effective branches per plant, shelling out-turn and 100-seed

Table-2 : General combining ability effect for lines and testers pooled over environments for seed yield and its components in castor

Parents	Length of primary raceme (cm)	Effective length of primary raceme (cm)	No. of effective branches per plant	No. of capsules on primary raceme	Shelling out-turn (%)	Seed yield per plant (g)	100-seed weight (g)	Oil content (%)
Lines								
JP-96	1.86**	1.83**	-0.49**	3.92**	-0.32*	-3.46	2.42**	0.39**
SKP-84	3.31**	2.67**	-0.86**	5.02**	0.80**	-3.24	-0.19*	-0.39**
SKP-106	-1.55**	-0.25	0.15	1.05	-0.98**	-1.70	-3.08**	0.39**
JP-89	-3.62**	-4.25**	1.21**	-10.00**	0.50**	8.40**	0.87**	-0.40**
SEgi +	0.30	0.35	0.07	0.50	0.13	1.88	0.07	0.07
Testers								
PCS-124	-0.22	0.53	2.06**	-0.48	-1.39**	50.15**	-4.53**	0.65**
DCS-85	1.06	1.09	0.95**	2.05	0.60	15.02**	-2.18**	-0.03
SKI-215	-2.11*	-0.05	0.59**	1.90	0.62*	33.51**	0.63**	0.26
SKI-343	3.84**	1.45	-0.64**	-8.86**	0.60	-27.35**	-0.77**	-0.47*
SKI-341	4.15**	5.44**	-1.52*	7.32**	0.75*	-9.00*	0.55**	0.20
SKI-352	-0.54	0.27	-1.13**	8.33**	-1.04**	-11.96*	-1.85**	-0.10
JI-244	-1.60*	-0.45	-0.84**	-2.45*	0.72*	-35.62**	1.55**	0.37*
JI-353	-2.83**	-2.44*	1.85**	-0.22	-0.28	44.90**	-0.28	0.59**
JI-357	1.98*	1.71*	1.86**	4.94**	1.16**	67.95**	2.10**	-0.23
48-1	0.70	1.96*	-0.35*	6.48**	-1.01**	7.96	0.36*	0.24
RG-2800	-2.18**	-1.40	-2.90**	-2.07	-1.78**	-88.72**	-0.28	-0.68**
RG-2826	-3.64**	-6.22**	1.19**	-10.19**	1.86**	3.57	1.64**	-0.69**
JC-18	1.40*	-1.89*	-1.12**	-6.76**	-0.81*	-50.41**	3.05**	-0.11
SEgi +	0.53	0.62	0.12	0.90	0.24	3.40	0.13	0.14

*,** Significant at 5 and 1% levels, respectively.

Table-3 : Specific combining ability effects of selected 12 hybrids pooled over environments for seed yield and its components in castor.

Crosses	Length of primary raceme (cm)	Effective length of primary raceme (cm)	Number of effective branches per plant	Number of capsules on primary raceme	Shelling out-turn (%)	Seed yield per plant (g)	100-seed weight (g)	Oil content (%)
JP-96 x PCS-124	5.81**	6.08**	3.02**	21.87**	2.86**	82.37**	-0.98*	-0.32
JP-96 x DCS-85	0.79	0.69	0.79*	0.15	1.41*	25.06*	-1.25**	-0.26
JP-96 x JI-353	5.47**	9.69**	2.64**	16.69**	-0.35	72.45**	0.01	0.20
JP-96 x RG-2800	3.03**	5.20**	-0.96*	13.47**	1.00	25.33*	0.52	1.38**
SKP-84 x SKI-215	-1.29	-0.21	2.68**	-0.42	0.05	52.35**	-1.08**	-0.74*
SKP-84 x 48-1	-0.20	0.56	1.42**	3.09	0.34	43.46**	-0.98*	-0.35
SKP-106 x SKI-352	3.78*	0.22	0.41	-0.77	-0.97	27.17*	-2.25**	0.73*
SKP-106 x JI-357	6.66**	6.66**	1.77**	14.25**	-0.67	55.26**	0.86*	1.05*
SKP-106 x 48-1	-4.11*	-4.98**	1.98**	-11.35**	0.63	30.08**	0.19	0.19
SKP-106 x JC-18	-1.64	0.99	0.33	6.57*	-0.82	21.04*	2.41**	0.59
JP-89 x JI-357	6.74**	9.95**	1.54**	19.45**	0.67	57.90**	2.08**	0.52
4JP-89 x RG-2826	-2.87*	-0.98	-0.57	-3.26	-1.48*	30.19**	-1.66**	-0.89*
SE sij +	1.07	1.25	0.24	1.80	0.47	6.80	0.25	0.27

*,** Significant at 5 and 1% levels, respectively.

weight; PCS-124 for number of effective branches per plant and oil content; DCS-85 for number of effective branches per plant; SKI-215 for number of effective

branches per plant, shelling out-turn and 100-seed weight; JI-353 for number of effective branches per plant and oil content and JI-357 for length of primary raceme,

effective length of primary raceme, number of effective branches per plant, number of capsules on primary raceme, shelling out-turn and 100-seed weight. The present findings also revealed high degree of correspondence between per se performance of parents and their gca effect for majority of the characters studied, which indicated that per se performance can be used as a reliable criterion for selection of parents for hybridization.

Selected hybrids, exhibiting significant and positive specific combining ability effects for seed yield per plant along with its components are listed in Table-3. The maximum SCA effect for seed yield per plant was shown by JP-96 x PCS-124 (82.37) followed by JP-96 x JI-353 (72.45) and JP-89 x JI-357 (57.90). All these hybrids recorded significant and desirable sca effect for one or more component traits of seed yield e.g., JP-96 x PCS-124 had significant sca effect for seed yield per plant along with length of primary raceme, effective length of primary raceme, number of effective branches per plant, number of capsules on primary raceme and shelling out-turn. The cross combination JP-96 x JI-353 had high sca for seed yield per plant along with high sca effect for length of primary raceme, effective length of primary raceme, number of effective branches per plant and number of capsules on primary raceme. The cross JP-89 x JI-357 had high sca effect for seed yield per plant and also expressed high sca effect for length of primary raceme, effective length of primary raceme, number of capsules on primary raceme and 100-seed weight. Similar findings, as observed in present study, were also reported by (7, 8). The high sca effect for above components was also accompanied with high heterosis

as well as high per se performance. Thus, on the basis of these results, it can be expected that such crosses may give desirable segregants in segregating generations and hence, it would be worthwhile to use them for improvement in seed yield *per se*.

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EFFECT OF PHOSPHORUS, RHIZOBIUM AND PSB ON GROWTH AND YIELD ATTRIBUTES TRAITS OF CHICKPEA (*Cicer arietinum* L.)

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ABSTRACT

A field experiment was conducted on chickpea during Rabi, 2013-14 at Agronomy farm, College of Agriculture, Bikaner. The soil of the experimental field was loamy sand in texture, alkaline in reaction (pH 8.15), low in organic carbon (0.08%), available nitrogen (87.72 kg/ha), available phosphorus (20.72 kg/ha) and potassium (164.14 kg/ha). The treatment comprised of four levels of biofertilizers [Control (C₀), Rhizobium (C₁), PSB (C₂) and Rhizobium + PSB (C₃)] and three levels of phosphorus (0, 60 and 80 kg P₂O₅/ha). The 12 treatments combinations were laid out in split plot design and replicated three times. Present investigation was carried out to the impact of Biofertilizers and Phosphorus levels on growth parameters, yield and yield attributes of chickpea. The result of the experiment indicate that dual inoculation of Rhizobium and PSB along with 60 kg P₂O₅/ha significantly enhanced plant height at harvest, branches (primary and secondary) per plant, number of viable root nodules per plant at flowering stage, number of pods per plant, number of pods per branch, seed yield (1770.46 kg/ha), straw yield (2360.46 kg/ha), biological yield (4130.92 kg/ha) and seed index over no inoculation and Rhizobium or PSB inoculation alone and control of phosphorus.

Keywords : Biofertilizers, rhizobium, PSB, phosphorus, chickpea.

Attempts were made during present investigation to identify most suitable combination of Biofertilizers (Rhizobium and PSB) and Phosphorus for better growth of chickpea crop. Chickpea variety RSG-945 was used as test crop. Area of adoption of this variety is Rajasthan. It is also known as 'Asha' and released in year 2005. It is suitable for late sown irrigated conditions. Growth habit is semi erect with profuse branching. Pod and seed size is medium bold, seed has reddish brown colour and shape is obviate. It matures in 125-130 days. It is moderately resistant to dry root rot and wilt. Rhizobium is unique in that they are the only nitrogen-fixing bacteria living in a symbiotic relationship with legumes. The symbiotic relationship implies a signal exchange between both partners that leads to mutual recognition and development of symbiotic structures. Rhizobium lives in the soil where they are able to sense flavonoides secreted by the roots of their host legume plant increases yield by 25-30% and 40-80 kg N is left over in field. Yield of fresh and dry fodder were significantly higher in inoculated plants as compared to uninoculated control plants (1). Increasing the moisture content from 15-35% doubled the frequency of nodulation. The frequency of nodulation increased from 6.5 nodules in winter to 15.3 nodules in summer. PSB have the capability to change the insoluble form of phosphorus into soluble form. It plays an important role in supplying phosphate to plants, in environment friendly and sustainable manner. They colonize the plant roots and promote growth to the plants. It promotes the plant growth, reduce diseases or insect damages. Phosphate solubilizing bacteria are also known to increase phosphorus uptake resulting in better growth and higher yield of crop plants. Soil microorganisms have enormous potential in providing soil phosphates for plant growth. Phosphorus biofertilizers in the form of microorganisms can help in increasing the

availability of accumulated phosphates for plant growth by solubilisation (2).

MATERIALS AND METHODS

The soil samples (0-15 cm) collected before the sowing of the crop and analysed for pH, organic carbon, available N, available P and available K according to the method given by (3, 4, 5, 6, 7) respectively. Plant stand, plant height (cm), number of branches (primary and secondary) per plant, number of pods per plant, number of pods per branch and number of seeds per pod recorded at harvest from randomly selected five plants of each treatment. At flowering stage viable root nodules per plant was recorded. The nodules of five plants were uprooted randomly from the outer rows of each plot without disturbing roots and their nodules. After thorough washing the roots along with nodules were dried in shade. Thereafter, nodules were separated from roots of each plant separately with the help of forceps and counted them. For seed index one hundred seeds were counted from each sample drawn from the produce of each plot and weighed. The weight was recorded as test weight in gram. After threshing, winnowing and cleaning, seed, straw and biological yield from each net plot was weighed and converted into kg/ha. The Harvest index was worked out by dividing the grain yield (economic yield) by grain + straw yield (biological yield) obtained from plot area and multiplies by 100 to express it in percent.

RESULTS AND DISCUSSION

A perusal of data presented in (Table-1) showed that plant height, number of branches, number of branches per plant and number of root nodules per plant was significantly higher due to seed inoculation with Rhizobium + PSB treatment over control and Rhizobium treatments. Dual inoculation of Rhizobium + PSB increased maximum

Table-1 : Effect of phosphorus, Rhizobium & PSB on growth and yield attributes traits of chickpea.

Treatments	Plant stand (per meter row length)	Plant height (cm)	No. of branches per plant		Viable root nodules per plant	No. of pods per plant	No. of pods per branch	No. of seeds per pod	Seed yield (kg ha)	Straw yield (kg/ ha)	Biological yield (kg/ ha)	Seed index (g)	Harvest index (%)
			Primary branches	Secondary branches									
Cultures													
C ₀	7.90	39.04	5.75	11.62	27.08	67.48	5.73	1.76	1333.00	1784.44	3117.44	13.32	42.75
C ₁	8.01	45.91	7.55	16.18	53.31	87.60	8.02	1.77	1593.38	2077.30	3670.68	15.24	43.37
C ₂	8.02	46.28	7.90	16.52	34.28	88.39	8.61	1.78	1636.86	2157.84	3794.71	16.32	43.11
C ₃	8.18	47.05	8.16	17.43	58.95	99.45	8.83	1.81	1770.46	2360.46	4130.92	18.40	42.89
S.E.m±	0.10	0.37	0.27	0.61	0.37	0.85	0.07	0.02	15.60	43.31	56.57	0.54	0.25
CD (P = 0.05)	NS	0.92	0.67	1.51	0.92	2.09	0.18	NS	38.17	105.98	138.42	1.33	NS
Phosphorus levels (kg P ₂ O ₅ /ha)													
P ₀	7.94	39.59	5.86	12.38	34.85	70.66	6.17	1.76	1336.67	1787.56	3124.23	13.77	42.77
P ₁	8.03	46.79	7.85	16.91	47.14	92.72	8.56	1.78	1703.13	2225.56	3928.70	16.48	43.33
P ₂	8.11	47.33	8.31	17.02	48.24	93.81	8.65	1.80	1710.47	2271.91	3982.39	17.21	42.98
S.E.m±	0.11	0.35	0.22	0.46	0.57	0.57	0.06	0.01	13.20	33.57	42.78	0.43	0.24
CD (P=0.05)	NS	0.74	0.47	0.99	1.22	1.21	0.13	NS	27.98	71.16	90.69	0.92	NS

Control (C₀), Rhizobium (C₁), PSB (C₂) and Rhizobium + PSB (C₃)

number of branches per plant but statistically at par with Rhizobium and PSB alone. Seed inoculation with Rhizobium + PSB recorded maximum number of root nodules per plant and produced significantly higher root nodules at flowering stage over control, Rhizobium and PSB alone. It is an essential fact that inoculation of leguminous crop with effective and appropriate Rhizobium strain plays a pivotal role in fixation of atmospheric nitrogen in association with the crop. On the other hand, nitrogen fixed by Rhizobium species is translocate to plant system through xylem vessels mainly in the form of aspergine and to some extent as glutathiamin. Thus, the results obtained in the investigation are in line with the findings of (8). Inoculation with PSB enhances availability of P through solubilization of insoluble phosphorus is attributed to excretion of organic acids like glutamic, succinic, lactic, oxalic, glyoxalic, malic, fumaric, tartaric, citric, á-ketobutyric, propionic, formic and 2-ketogluconic acids. All levels of phosphorus significantly increased number of primary branches per plant over control at harvest. Application of 60 kg P₂O₅/ha increased plant height, number of branches, number of branches per plant and number of root nodules per plant significantly over control but remained statistically at par with 80 kg P₂O₅/ha. A significant effect of increasing levels of phosphorus up to 60 kg P₂O₅/ha was observed over control on the plant height (at harvest), and number of branches (primary and secondary) per plant at harvest, viable root nodules per plant at flowering stage (Table-1). This increase in growth parameters may be attributed to better nutritional environment for plant growth and development not only due to increased availability of phosphorus in soil but of other nutrients too, which are considered vitally important for growth and development. It might be obvious since phosphorus has long been considered as an essential constituent of all living organisms which plays an important role in conservation and transfer of energy in metabolic reactions of living cells including biological energy transformations. Thus, phosphorus fertilization enhanced the photosynthesis and other metabolic processes in the plant which ultimately enhanced growth in terms of number of branches per plant and chlorophyll content. Similar results have also been reported by (9). Inoculation of seed with single or dual biofertilizers brought a significant improvement in seed yield, straw yield, biological yield and seed index of chickpea over control (Table-1). The maximum seed yield (1770.46 kg/ha) was obtained when chickpea seeds were inoculated with Rhizobium + PSB and produced significantly higher seed yield over control, Rhizobium and PSB alone. Inoculation with Rhizobium and PSB alone has also increased seed yield over control. This might be due to the fact that Rhizobium inoculation increased the root nodulation through better root development and more nutrient availability. This caused vigorous plant growth and dry matter production which resulted in better flowering, fruiting and pod formation. Ultimately there was

Table-2 : Interaction effect between phosphorus, Rhizobium and PSB on no. of viable root nodules per plant, no. of pods per plant, seed yield and straw yield of chickpea.

Phosphorus levels (kg P ₂ O ₅)	Root nodules per plant Cultures				Number of pods per plant Cultures			
	C ₀	C ₁	C ₂	C ₃	C ₀	C ₁	C ₂	C ₃
P ₀	25.66	40.40	27.13	46.20	61.00	72.72	73.20	75.75
P ₁	27.04	59.76	37.15	64.60	69.46	94.85	95.26	111.29
P ₂	28.55	59.78	38.58	66.05	72.00	95.23	96.71	111.32
S.E.m±	1.15				1.14			
CD (5%)	2.45				2.42			

Table-2 : Contd...

Phosphorus levels (kg P ₂ O ₅)	Seed yield Cultures				Straw yield Cultures			
	C ₀	C ₁	C ₂	C ₃	C ₀	C ₁	C ₂	C ₃
P ₀	1216.00	1350.80	1363.08	1416.80	1642.66	1801.06	1817.44	1889.06
P ₁	1387.64	1697.06	1783.41	1944.41	1850.18	2157.51	2340.43	2554.14
P ₂	1395.36	1732.28	1764.10	1950.17	1860.48	2273.33	2315.66	2638.19
S.E.m±	26.40				67.14			
CD (5%)	55.97				142.33			

Control (C₀), Rhizobium (C₁), PSB (C₂) and Rhizobium + PSB (C₃)

beneficial effect on seed yield. Since the available P was low in experiment field, PSB might have helped in reducing P fixation by its chelating effect and also solubilized the unavailable form of P leading to more uptakes of nutrients and reflected in better growth attributes viz., pods per plant. The increase in seed and straw yield is due to the cumulative effect of increased growth and yield attributes. The results obtained in the investigation are in line with the findings of (9). It increased significantly over control due to successive increase in varying levels of phosphorus. Application of 60 kg P₂O₅/ha produced seed yield of 1703.13 kg/ha which was significantly higher over control, but it remained at par with 80 kg P₂O₅/ha. Harvest index of chickpea was not significantly affected due to application of biofertilizers and phosphorus. The significant increase in seed yield of chickpea due to phosphorus application was largely a function of improved growth and the consequent increase in different yield attributes. The significant increase in straw yield due to application of phosphorus could be attributed due to the increased vegetative growth, possibly a result of the effective uptake and utilization of nutrients absorbed through its extensive root system development under phosphorus fertilization. The biological yield is a function of seed and straw yield. Thus, a significant increase in biological yield with the application of phosphorus could be attributed to the increased grain and straw yield. These results are in agreement to the findings of (10). Data pertaining to the effect of biofertilizers and phosphorus levels on no. of viable root nodules per plant, no. of pods per plant, seed yield and straw yield (Table-2) revealed that application of 60 kg P₂O₅/ha + seed inoculation with Rhizobium + PSB treatment combination produced significantly highest root nodules per plant, no. of pods per plant, seed yield and straw yield which was at par with treatment combination of 80 kg P₂O₅/ha + seed inoculation with Rhizobium + PSB. The minimum chickpea seed yield was recorded in the treatment combination P₀C₀ when neither phosphorus nor any culture was applied. The synergistic effect of Rhizobium and PSB

might have increased the growth, yield attributes and ultimately the yield in present investigation due to increased nitrogenase activity and available P status of soil. Similar findings were also reported by (1).

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ASSESSMENT OF GENETIC VARIABILITY AND TRAITS ASSOCIATION IN KABULI CHICKPEA (*Cicer arietinum* L.)

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ABSTRACT

This study was carried out to assess the genetic variability, correlation and path coefficient analysis of 68 kabuli chickpea (*Cicer arietinum* L.) genotypes during rabi 2013-14. Sixteen traits were observed viz, days to flower initiation, days to 50% flowering, days to pod initiation, days to maturity, plant height (cm), height of first fruiting node (cm), number of primary branches/plant, number of secondary branches/plant, total number of pods/plant, number of effective pods/plant, number of seeds per pods, number of seeds/plant, 100 seeds weight (g), biological yield/plant (g), Harvest index (%) and seed yield/plant (g). High phenotypic and genotypic coefficient of variation was observed for height of first fruiting node, number of effective pods/plant, number of seeds/plant and seed yield/plant. High heritability coupled with high genetic advance as percentage of mean was observed for height of first fruiting node, number of effective pods/plant and number of seeds/plant respectively. Significant and positive correlations were observed for seed yield/plant with seeds/plant, number of effective pods/plant, harvest index, total number of pods/plant, biological yield/plant, days to maturity, number of secondary branches/plant and number of primary branches/plant. Path coefficient revealed high positive direct effects for days to flower initiation, harvest index, biological yield/plant and number of effective pods/plant. Genotypes viz., HK10-109, PG 071, PG 95311, PKV 4, IPCK 2002-29, IPCK 2004-29-1, ICCV 13301, ICCV 13310, ICCV 13307, ICCV 13309, ICCV 13317, Flip 07-236C, JGK1 and KAK2 exhibited high values for different traits and may prove advantageous for kabuli chickpea breeding improvement programme.

Key words : Genetic variability, GCV, PCV, genetic advance, correlation, path coefficient analysis.

Pulses are the second most important group of crops after cereals. Among pulses; chickpea (*Cicer arietinum* L.) is a major crop widely grown during Rabi season. The genetic architecture of seed yield can be better resolved through component traits rather than yield per se, as yield is the end product of multiplicative interactions between various yield components. Therefore, genetic variability is essentially required for making genetic improvement in component traits. Correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for genetic improvement in yield. The path analysis helps in partitioning the correlation coefficient of yield components with seed yield into its direct and indirect effects to ensure the actual contribution of an attribute as well as its influence through other traits. The present investigation was undertaken to assess the genetic variability and association of different traits for appropriate breeding strategies and identification of promising genotypes for improvement of kabuli chickpea. Hence, available information will be very helpful for an efficient selection criterion in selecting the most desirable and high yielding genotypes of kabuli chickpea.

MATERIALS AND METHODS

A set of 68 diverse genotypes of kabuli chickpea including 3 checks viz., JGK1, JGK2 and KAK2 grown in a Randomized Complete Block Design with 3 replications at JNKVV, Jabalpur during rabi 2013-14 under irrigated

condition. Observations of days to flower initiation, days to 50% flowering, days to pod initiation, days to maturity, plant height (cm), height of first fruiting node (cm), number of primary branches/plant, number of secondary branches/plant, total number of pods/plant, number of effective pods/plant, number of seeds per pods, number of seeds/plant, 100 seeds weight (g), biological yield/plant (g), harvest index (%) and seed yield/plant (g) were recorded on five competitive plant basis. Mean data subjected to standard statistical analysis.

RESULTS AND DISCUSSION

The variance analysis revealed that genotypes differed significantly among themselves for all the characters under study (Table-1). The PCV estimates were invariably higher than their corresponding GCV estimates indicating high environmental influence Arshad, et al., (2002). (Table-2) The estimates of PCV and GCV indicated the existence of fairly high degree of genetic variability for height of first fruiting node (71.5%) followed by number of effective pods/plant (34.8%), number of seeds/plant (35.2%) and seed yield/plant (32.2%). The observations are well supported from the very high values of heritability with high genetic advance as percentages of mean recorded for these traits indicating ample scope for genetic improvement (1). Similar results were also reported by (1) for seeds/plant, (2, 3) for number of seeds/plant and seed yield/plant.

Table-1 : Mean values of selected kabuli chickpea genotypes for yield and yield contributing traits.

Genotypes	Quantitative Traits										
	DFI	50%F	DM	TP	EP	S/P	SPP	100 SW	BY	HI	SY
HK 10-109	42.0	50.7	120.0	36.8	30.9	1.7	31.6	32.0	53.9	21.8	11.7
PG 071	34.3	44.0	118.3	49.6	42.0	2.0	37.4	29.3	45.4	21.5	12.0
PG 95311	33.0	44.7	119.0	45.3	43.1	1.9	37.8	31.7	52.4	27.2	11.8
PKV 4	35.0	42.0	123.0	37.5	22.9	2.2	35.2	41.8	44.1	35.8	13.1
IPCK 2002-29	36.7	45.0	123.0	68.3	60.8	1.4	59.2	32.1	69.4	27.8	19.3
IPCK 2004-29-1	36.7	43.7	119.0	47.4	40.4	1.6	39.6	34.2	54.0	24.3	13.0
ICCV13301	35.3	42.0	118.3	36.9	28.9	2.0	35.1	36.9	38.3	34.3	12.6
ICCV13310	39.3	47.3	117.7	36.8	29.6	1.7	30.6	41.2	53.9	21.8	11.7
ICCV13307	41.3	47.3	117.0	27.6	21.3	1.8	29.4	36.2	37.8	28.1	10.8
ICCV13309	40.3	48.3	118.0	52.6	36.5	1.6	35.1	39.3	50.8	37.8	13.9
ICCV13317	36.0	42.7	115.3	42.8	36.4	1.7	29.9	40.5	35.6	35.8	12.7
FLIP-07-236C	71.0	77.0	119.3	45.0	17.3	2.1	27.4	31.1	37.7	31.7	14.2
JGK1	37.3	44.0	109.0	44.3	32.3	1.8	46.2	36.5	42.9	27.7	11.1
KAK 2	36.7	46.3	110.0	45.6	36.5	1.6	33.9	36.9	46.3	20.9	10.3

Table-2 : Analysis genetic variability for yield and yield contributing traits in chickpea.

Characters	GM	Range	GCV	PCV	ECV	h ² (bs)	GA at 5%	GA as % of Mean 5%	
		Min	Max						
DFI	42.9	32.6	73.3	28.3	28.5	3.5	98.5	24.8	57.9
DF 50%	50.8	42.6	81.3	23.3	23.5	3.1	98.2	24.2	47.6
DPI	59.5	47.6	88.6	19.0	19.1	2.3	98.5	23.1	38.8
DM	116.2	101.6	132.3	4.6	4.8	1.4	91.9	10.6	9.1
PH	62.6	46.6	83.5	12.7	13.1	3.4	93.3	15.8	25.2
HFN	7.8	3.5	27.4	71.5	71.8	6.6	99.2	11.4	64.7
PB	2.4	1.9	3.2	10.0	13.4	9.0	55.4	0.4	15.3
SB	8.2	4.2	14.9	24.2	27.8	13.6	75.9	3.6	43.5
TP	35.8	16.4	68.3	25.9	28.1	11.1	84.6	17.5	49.0
EP	25.0	9.5	60.8	34.9	37.9	14.8	84.7	16.5	66.1
SP	1.9	1.1	2.8	12.6	20.3	15.9	38.6	0.3	16.1
SPP	26.7	8.8	59.2	35.3	37.9	13.8	86.7	18.0	67.6
100 SW	35.4	24.5	49.5	14.3	15.0	4.4	91.5	10.0	28.2
BY	40.3	23.1	85.5	23.7	26.3	11.5	81.0	17.7	43.9
HI	22.4	10.3	37.8	26.8	31.3	16.1	73.4	10.6	47.3
SY	8.9	3.7	19.3	32.3	36.3	16.7	78.9	5.3	59.0

Where, GM = General mean, GCV = genotypic coefficient of variance, PCV = Phenotypic coefficient of variance, ECV = Environmental coefficient of variance, GA = genetic advance, h²(bs) = Heritability in broad sense
 DFI = days to flower initiation, DF50% = days to 50% flowering, DPI = days to pod initiation, DM = days to maturity, PH = plant height, HFN = height of first fruiting node, PB = number of primary branches/plant, SB = number of secondary branches/plant, TP = total number of pods/plant, EP = number of effective pods/plant, SP = number of seeds per pods, SPP = number of seeds/plant, 100SW = 100 seeds weight, BY = biological yield/plant, HI = Harvest index and SY = seed yield/plant

Correlation coefficients revealed that seed yield/plant was significant positively correlated with number of seeds/plant (0.787) followed by number of effective pods/plant (0.736), harvest index (0.714), total number of pods/plant (0.687), biological yield/plant (0.550), days to maturity (0.410), number of secondary branches/plant (0.246) and number of primary branches/plant (0.210) in accordance with those reported by (1) for all traits except harvest index and days to maturity (2, 4) for biological yield/plant. (Table-3). These results suggested that any

positive increase in such traits will accelerate the boost in seed yield per plant. Nevertheless; negative correlation was found with height of first fruiting node (-0.170) and 100 seeds weight (-0.138).

The path coefficient analysis appeared to provide a clue to the contribution of various components of yield to overall seed in the genotypes under study. It provides an effective way of finding out direct and indirect sources of correlation. In this study seed yield represented the dependent variable and other traits were the independent

Table-3 : Phenotypic correlation coefficient among yield contributing traits in chickpea.

		DFI	DF 50%	DPI	DM	PH	HFN	PB	SB	TP	EP	SP	SPP	100 SW	BY	HI	SY
DFI	G	1.00	0.982***	0.971***	0.231***	0.600***	0.855***	0.365***	0.528***	0.078	-0.2668***	0.319***	-0.267***	-0.239***	0.2174**	-0.222**	-0.083
	P	1.00	0.992	0.982	0.242	0.621	0.868	0.486	0.608	0.092	-0.293	0.536	-0.290	-0.251	0.239	-0.263	-0.099
DF 50%	G		1.000	0.977***	0.238***	0.59***	0.846***	0.367***	0.521***	0.103	-0.2345***	0.324***	-0.234 ***	-0.262***	0.238***	-0.222**	-0.074
	P		1.000	0.984	0.254	0.616	0.858	0.489	0.595	0.117	-0.254	0.534	-0.255	-0.272	0.261	-0.264	-0.088
DPI	G			1.000	0.258***	0.580***	0.848***	0.344 ***	0.489 ***	0.111	-0.2368***	0.335***	-0.231***	-0.235***	0.229***	-0.234***	-0.079
	P			1.000	0.272	0.606	0.858	0.464	0.560	0.116	-0.268	0.535	-0.255	-0.245	0.247	-0.283	-0.101
DM	G				1.000	0.227**	0.251***	0.365 ***	0.332 ***	0.351***	0.259***	0.177*	0.3809***	-0.042	0.402***	0.206**	0.410***
	P				1.000	0.244	0.260	0.480	0.377	0.398	0.282	0.301	0.410	-0.047	0.470	0.247	0.477
PH	G					1.000	0.591***	0.376 ***	0.332 ***	0.135	-0.1312	0.218**	-0.145*	-0.002	0.385***	-0.366***	-0.061
	P					1.000	0.616	0.515	0.387	0.149	-0.155	0.372	-0.172	-0.006	0.429	-0.427	-0.083
HFN	G						1.000	0.310***	0.488 ***	0.051	-0.254***	0.338***	-0.276***	-0.181**	0.198**	-0.317***	-0.170*
	P						1.000	0.413	0.561	0.059	-0.280	0.540	-0.293	-0.196	0.218	-0.364	-0.189
PB	G							1.000	0.566 ***	0.241***	0.1116	0.078	0.0606	0.0503	0.356***	0.0346	0.210 **
	P							1.000	0.753	0.283	0.076	0.464	0.075	0.082	0.459	0.086	0.285
SB	G								1.000	0.278***	0.1151	0.251***	0.0689	-0.165*	0.411***	0.0919	0.246 ***
	P								1.000	0.334	0.138	0.535	0.081	-0.187	0.456	0.166	0.316
TP	G									1.000	0.7835***	-0.068	0.649***	-0.319***	0.615***	0.355***	0.687***
	P									1.000	0.852	-0.087	0.719	-0.358	0.673	0.424	0.760
EP	G										1.000	-0.269***	0.724***	-0.184**	0.525***	0.440***	0.736***
	P										1.000	-0.269	0.795	-0.219	0.561	0.539	0.800
SP	G											1.000	-0.075	-0.087	0.0043	-0.11	-0.122
	P											1.000	-0.099	-0.150	0.079	-0.216	-0.114
SPP	G												1.000	-0.322***	0.453***	0.545***	0.787***
	P												1.000	-0.353	0.499	0.612	0.839
100 SW	G													1.000	-0.166*	-0.013	-0.138*
	P													1.000	-0.200	-0.008	-0.173
BY	G														1.000	-0.037	0.550***
	P														1.000	0.007	0.584
HI	G															1.000	0.714***
	P															1.000	0.771
SY	G																1.000
	P																1.000

*and ** significant at 5% probability level ***highly significant at 1% probability level

Table-4 : Path coefficient analysis among yield contributing traits in chickpea genotypes.

	DFI	DF 50%	DPI	DM	PH	HFN	PB	SB	TP	EP	SP	SPP	100 SW	BY	HI	SY
DFI	0.9697	0.9618	0.9526	0.2342	0.6025	0.8413	0.4715	0.5891	0.0888	-0.284	0.5193	-0.2814	-0.243	0.2315	-0.2545	-0.0993
DF 50%	-0.9007	-0.9081	-0.8936	-0.2309	-0.5596	-0.7793	-0.4441	-0.5402	-0.1061	0.2307	-0.4849	0.2317	0.2472	-0.2372	0.2396	-0.0883
DPI	0.0979	0.0981	0.0997	0.0271	0.0604	0.0856	0.0462	0.0558	0.0115	-0.0267	0.0533	-0.0254	-0.0244	0.0246	-0.0282	-0.1005
DM	0.0017	0.0018	0.002	0.0072	0.0018	0.0019	0.0035	0.0027	0.0029	0.002	0.0022	0.003	-0.0003	0.0034	0.0018	0.4773
PH	0.0212	0.021	0.0207	0.0083	0.0341	0.021	0.0175	0.0132	0.0051	-0.0053	0.0127	-0.0059	-0.0002	0.0146	-0.0145	-0.083
HFN	-0.0366	-0.0362	-0.0362	-0.011	-0.026	-0.0422	-0.0174	-0.0237	-0.0025	0.0118	-0.0228	0.0124	0.0083	-0.0092	0.0153	-0.1892
PB	0.0358	0.036	0.0341	0.0353	0.0378	0.0304	0.0736	0.0554	0.0208	0.0056	0.0341	0.0055	0.006	0.0338	0.0063	0.2854
SB	-0.1145	-0.1121	-0.1056	-0.071	-0.0729	-0.1057	-0.1419	-0.1884	-0.0629	-0.026	-0.1009	-0.0153	0.0353	-0.0859	-0.0312	0.316
TP	-0.0139	-0.0177	-0.0175	-0.0604	-0.0227	-0.0089	-0.0429	-0.0507	-0.1517	-0.1292	0.0132	-0.1091	0.0543	-0.1021	-0.0643	0.7599
EP	-0.09	-0.078	-0.0823	0.0868	-0.0477	-0.086	0.0234	0.0424	0.2616	0.3072	-0.0826	0.2444	-0.0674	0.1724	0.1656	0.8003
SP	0.0309	0.0308	0.0308	0.0173	0.0214	0.0311	0.0267	0.0308	-0.005	-0.0155	0.0576	-0.0057	-0.0087	0.0046	-0.0124	-0.1141
SPP	-0.0444	-0.0391	-0.039	0.0628	-0.0263	-0.0449	0.0115	0.0124	0.1101	0.1218	-0.0152	0.1531	-0.0541	0.0763	0.0937	0.8391
100 SW	0.0079	0.0086	0.0077	0.0015	0.0002	0.0062	-0.0026	0.0059	0.0113	0.0069	0.0047	0.0111	-0.0315	0.0063	0.0003	-0.173
BY	0.1065	0.1165	0.1102	0.2098	0.1915	0.0971	0.2047	0.2035	0.3003	0.2503	0.0353	0.2225	-0.0893	0.4462	0.0031	0.5837
HI	-0.1707	-0.1716	-0.1841	0.1603	-0.2775	-0.2365	0.0557	0.1078	0.2757	0.3505	-0.1402	0.3982	-0.0053	0.0045	0.6503	0.7708

R square=0.9636 Residual effect= 0.1908

ones. Direct and indirect effects of these components determined on grain yield and their contribution ratios are summarized in table 4. Analysis revealed that days to flower initiation depicted high and positive direct effects (0.9697) on seed yield/plant followed by harvest index (0.6503), biological yield/plant (0.4462) and number of effective pods/plant (0.3072) indicated the importance of these characters in selections of superior genotypes for economic return. Results were carried out by (4) for harvest index. Conversely; days to 50% flowering, number of secondary branches/plant, total number of pods/plant and 100 seeds weight depicted high negative direct effect on seed yield/plant. In this manner; selection of short duration flowering lines contributes to increasing seed yield per plant with an indirect effect via these traits.

For genetic improvement; a wide range of variability exhibited with regard to above objectives for the traits under study. Considering the correlation and path coefficient analysis for seed yield/plant and its component traits; an ideal plant type in kabuli chickpea would be one with more effective pods and more seeds of large size and having high harvest index. Therefore, more emphasis should be given to these components while making selection for higher seed yield in chickpea. Comprehensive examination of results revealed that the 14 most putative lines of buli chickpea i.e., HK10-109, PG 071, PG 95311, PKV 4, IPCK 2002-29, IPCK 2004-29-1, ICCV 13301, ICCV 13310, ICCV 13307, ICCV 13309, ICCV 13317, Flip 07-236C, JGK1 and KAK2. These genotypes exhibited high values regarding to above yield related traits. It may prove advantageous for improvement traits of economic importance in chickpea breeding programme.

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CHARACTER ASSOCIATION STUDIES IN BOTTLE GOURD [*Lagenaria siceraria* (Mol.) Standl.]

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ABSTRACT

Correlation and path analysis among different characters of twenty two bottle gourd genotypes were studied. Observations were recorded for the characters viz., days to first male and female flower appear, node number at which first male and female flower appear, days to 50% flowering, days to fruit set, number of branches per plant, days to first fruit harvest, fruit length (cm), average fruit weight (g), fruit girth (cm), number of fruits per plant, fruit yield (q/ha) and crop duration. Analysis of variance revealed that mean sum of squares due to genotypes was highly significant for all characters. Correlation studies revealed that fruit weight followed by number of fruits per plant had highest significant positive association with yield quintal per hectare. Path co-efficient analysis revealed maximum direct contribution towards yield quintal per hectare with of fruit weight followed by duration of crop, days to first female flower appears, number of fruits per plant, fruit girth.

Key words : Correlation, path co-efficient, character association, fruit weight, yield and bottle gourd.

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.], locally known as Lauki is an important home garden vegetable. It is a fast growing winter seasonal climbing annual, native to Africa. It is grown in both rainy and summer seasons and its fruits are available in the market throughout the year. Bottle gourd is the largest produced cucurbitaceous vegetables in the world preferred in both urban and rural population. National science depicted that bottle gourd occupies 78.47 thousand hectare area with 870.15 thousand metric tonnes production and having 11.05 mt/ha productivity whereas, in Chhattisgarh 11.63 thousand hectares area with 209.17 thousand metric tonnes production and having productivity of 17.98 mt/ha (1). Bottle gourd is a rich source of minerals and vitamins. In Chhattisgarh, no comprehensive systematic research has been done in this crop. The yield potentiality of this crop needs to be improved through an effective breeding programme. Studies on the variations of yield and yield contributing characters are of great importance before planning a breeding program. As the yield and its components are quantitative characters, careful assessments of the amount of variation and their association must be analyzed to gain insight into the complexity of the mechanism.

The efficiency of selection can be improved by using correlation between different characters. The phenotypic correlation indicates the extent of observed relationship between two characters and this includes both hereditary and environmental influences, while genotypic correlation coefficient provides a real association between two characters and is most useful in selection (2). Genetic correlation can result either from pleiotropy or from linkages. While phenotypic value is a non-additive combination of both genetic and environmental

correlation. This study merely indicates the nature of association and this alone does not provide the exact insight of the relative effect of each component character. A component character may have no direct effect on considerable economic trait but it may influence it via related characters. Hence knowledge of direct and indirect effects of different characters on desired traits are essential for selection to improve the population. The path coefficient divides the correlation into direct and indirect effects and thus determines the nature of association (3).

MATERIALS AND METHODS

The study was carried out during summer season (2013) at Horticulture Research cum Instructional farm at Department of Horticulture, IGKV, Raipur. The experiment comprised of twenty two genotypes of bottle gourd viz., 2012 BOG VAR 1, 2012 BOG VAR 2, 2012 BOG VAR 3, 2012 BOG VAR 4, 2012 BOG VAR 5, 2012 BOG VAR 6, 2012 BOG VAR 7, 2012 BOG VAR 8, 2011 BOG VAR 1, 2011 BOG VAR 2, 2011 BOG VAR 3, 2011 BOG VAR 4, 2011 BOG VAR 5, 2011 BOG VAR 6, 2011 BOG VAR 7, 2010 BOG VAR 1, 2010 BOG VAR 2, 2010 BOG VAR 3, 2010 BOG VAR 4, 2010 BOG VAR 5 along with two checks NDBG 104 and Pusa Naveen. The experiment was laid out in a Randomized Block Design with three replications at 3.0 × 0.5 m row to row and plant to plant spacing. All the recommended cultural practices were adopted to raise a healthy crop. Data were recorded on five randomly selected plants with respect to characters viz., days to first male and female flower appear, node number at which first male and female flower appear, days to 50% flowering, days to fruit set, number of branches per plant, days to first fruit harvest, fruit length (cm), average fruit weight (g), fruit girth (cm), number of fruits per plant,

Table-1 : Analysis of variance for fruit yield and its component characters in bottle gourd.

Character (df)	Mean sums of square		
	Replica- tion	Treat- ment	Error
	(2)	(21)	(42)
Node no. at which 1st male flower appears	5.16	2.23*	0.32
Node no. at which 1st female flower appears	0.018	6.91**	1.12
Days to first male flower appears	1.51	50.33**	3.50
Days to 1st female flower appears	2.3	38.7**	3.2
Days to 50% flowering	7.85	51.31**	4.67
Days to fruit set	4.2	30.8**	2.82
Days to 1st fruit harvest	75.75	53.64**	16.3
Fruit length (cm)	22.2	169.44*	9.1
Fruit girth (cm)	0.18	11.1**	0.2
Fruit weight (g)	2204.0	42854.4*	2591.65
No. of fruits per plant	0.19	10.76*	1.12
No. of branches per plant	0.018	2.41**	0.048
Duration of crop (sowing to last harvest)	66.3	204.45**	43.18
Yield (q/ha)	241.5	10986.10*	2021.6

*: Significant at 5%, ** : significant at 1%

fruit yield (q/ha) and crop duration. The data were subjected to statistical and biometrical analysis (4).

RESULTS AND DISCUSSION

The analysis of variance of all the characters under study is presented in Table-1. This analysis of variance revealed that mean sum of squares due to genotypes was highly significant for all characters. This is an indication of existence of sufficient variability among the genotypes for fruit yield and its components traits. Significant mean sum of squares due to fruit yield and attributing characters revealed existence of considerable variability in material studied for improvement for various traits. These findings are in general agreement with the findings of (5). Phenotypic and genotypic correlation co-efficient among different pairs of characters of bottle gourd are presented in Table-2. Correlation studies showed that genotypic correlation appeared to be higher than the corresponding phenotypic correlation (Table-2). These observations indicated that in majority of the cases, the expressions of characters associations. In the present finding, no. of fruits per plant and fruit weight (kg) showed positive and significant correlation with yield quintal per hectare at both genotypic and phenotypic level and highly significant influence on yield quintal per hectare.

Node number at which first female flower appears

had positive and significant correlation with days to first male flower appears, days to first female flower appears, days to 50% flowering and days to fruit set at both genotypic and phenotypic levels. It is also significant positively correlated with days to first fruit harvest at genotypic level. Node number at which first male flower appears had positive and significant correlation with duration of crop at genotypic level.

Days to first male flower appears had positive and significant correlation with days to first female flower appears, days to 50% flowering and days to fruit set at both genotypic and phenotypic levels. It is also significant positively correlated with days to first fruit harvest at genotypic level. Days to first female flower appears had positive and significant correlation with days to fruit set at both genotypic and phenotypic levels and it is also significant positively correlated with days to 50% flowering at phenotypic level and days to first fruit harvest at genotypic level.

Days to 50% flowering had positive and significant correlation with days to fruit set at both genotypic and phenotypic level. It is also showed positive and significant correlation with days to first fruit harvest at genotypic level. Days to fruit set showed positive and significant correlation with days to first fruit harvest and duration of crop at genotypic level.

The findings clearly indicated that genotypic correlations were of higher magnitude to the corresponding phenotypic ones, thereby establishing strong inherent relationship among the characters studied. The low phenotypic value might be due to appreciable interaction of the genotypes with the environments. An overall observation of correlation coefficient analysis revealed that fruit weight and number of fruits per plant exhibited the significant positive correlation with yield quintal per hectare. Hence, direct selection for these traits may lead to the development of high yielding genotypes of bottle gourd. The present findings are in conformity with (6) who reported that fruit yield per ha had strong positive association with number of fruits per vine, fruit weight, fruit length and fruit girth. Similar results were also reported by (5, 7).

The path coefficient analysis which splits total correlation coefficient of different characters into direct and indirect effects on fruit yield per plant in such a manner that the sum of direct and indirect effects is equal to total genotypic correlation as presented in table-3. The data revealed that fruit weight showed the highest positive direct effect (0.830) on fruit yield followed by duration of crop (0.722), days to first female flower appears (0.554), number of fruits per plant (0.253), fruit

Table-2 : Genotypic and phenotypic correlation coefficient between fruit yield and its component characters in bottle gourd.

[illegible]

Table-3 : Direct and indirect effect of component character on fruit yield in bottle gourd.

Characters	Node no. at which 1 st male flower appears	Node no. at which 1 st female flower appears	Days to 1 st male flower appears	Days to 1 st female flower appears	Days to 50% flowering	Days to fruit set	Days to 1 st fruit harvest	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	No. of fruits per plant	No. of branches per plant	Duration of crop (sowing to last harvest)	Yield (q/ha)
Node no. at which 1 st male flower appears	-0.356	0.128	-0.091	0.223	-0.087	-0.175	-0.058	-0.015	0.053	0.210	0.051	-0.007	0.434	0.310
Node no. at which 1 st female flower appears	-0.144	0.318	-0.284	0.507	-0.268	-0.308	-0.139	0.008	-0.073	0.000	-0.001	-0.005	0.168	-0.220
Days to 1 st male flower appears	-0.096	0.268	-0.337	0.550	-0.289	-0.267	-0.145	0.009	-0.007	-0.023	-0.067	-0.006	0.042	-0.369
Days to 1 st female flower appears	-0.143	0.291	-0.334	0.554	-0.304	-0.266	-0.132	0.003	-0.021	-0.128	-0.041	-0.003	0.103	-0.421
Days to 50% flowering	-0.106	0.292	-0.333	0.576	-0.292	-0.292	-0.168	0.001	-0.003	-0.147	-0.004	-0.001	0.158	-0.320
Days to fruit set	-0.145	0.228	-0.210	0.344	-0.199	-0.429	-0.167	0.017	0.005	0.188	-0.075	-0.004	0.343	-0.104
Days to 1 st fruit harvest	-0.085	0.184	-0.203	0.304	-0.203	-0.298	-0.241	0.001	-0.050	-0.158	-0.088	-0.005	0.316	-0.526
Fruit length (cm)	-0.103	-0.048	0.058	-0.038	0.007	0.141	0.006	-0.051	0.078	-0.304	0.156	0.004	0.322	0.228
Fruit girth (cm)	-0.076	-0.094	0.010	-0.047	0.003	-0.008	0.049	-0.016	0.248	0.224	0.056	-0.003	0.139	0.484
Fruit weight (g)	-0.090	0.000	0.009	-0.085	0.052	-0.097	0.046	0.019	0.067	0.830	-0.027	-0.018	-0.022	0.683
No. of fruits per plant	-0.072	-0.001	0.090	-0.090	0.005	0.126	0.084	-0.031	0.054	-0.088	0.253	0.011	0.306	0.647
No. of branches per plant	0.084	-0.054	0.062	-0.062	0.013	0.062	0.036	-0.007	-0.021	-0.474	0.093	0.031	0.112	-0.126
Duration of crop (sowing to last harvest)	-0.214	0.074	-0.019	0.079	-0.064	-0.204	-0.105	-0.023	0.048	-0.025	0.107	0.005	0.722	0.380

Residual value : 0.0854, Diagonal and bold underline figures shows direct effect on fruit yield.

girth (0.248) and number of branches per plant (0.031) whereas, days to fruit set (-0.429), days to first male flower appears (-0.337), node number at which first male flower appears (-0.356), node number at which first female flower appears (-0.318), days to first fruit harvest (-0.241) and fruit length (-0.051) showed negative direct effects on fruit yield quintal per ha.

In present investigation, fruit weight followed by number of fruits per plant showed high positive and direct effect had significant positive correlation with fruit yield quintal per hectare. Therefore, the fruits with higher weight and plant having more number of fruits should be considered in selection criteria for increasing fruit yield per plant. The present study suggested that more emphasis should be given to selecting genotypes with high fruit weight. Directly or indirectly all characters showed positive effect on fruit yield per plant, which is in confirmation to the finding of (6) who also reported that number of fruits per vine had maximum direct effect on fruit yield followed by fruit weight. (7) also reported that fruit weight, number of fruits per plant, fruit length had positive direct effect on fruit yield of bottle gourd. Similar results were obtained by.

The effect of residual factor (0.0854) on fruit yield per ha. was negligible, thereby, suggested that no other major yield component is left over. Overall the path analysis confined that direct effect of fruit weight, days to first female flower appears, number of fruits per plant and fruit girth whereas, indirect effect of node number at which first male flower appears, node number at which first female

flower appears, days to first male flower appears, days to 50% flowering, days to fruit set, fruit length, fruit weight and days to first fruit harvest should be considered simultaneously for amenability in fruit yield of bottle gourd.

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PATHOGENICITY TEST AND EFFICACY OF VARIOUS PLANT BASED EXTRACTS AGAINST DRY ROT PATHOGEN OF POTATO CAUSED BY *FUSARIUM* SP. UNDER IN VITRO TEST

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ABSTRACT

Potato (*Solanum tuberosum* L.) is one of the most nutritious sources of food in the world. In this experiment, Pathogenicity test with bioefficacy of phytoextracts of eleven plant species having medicinal values were tested in vitro by poisoned food technique against *Fusarium* sp. causing dry rot disease of potato. To manage these diseases effectively with safer approach, different concentration of phytoextracts were tested. Result revealed against *Fusarium* sp. that the Onion bulb @ 10 per cent showed maximum growth inhibition (63.52%) followed by extract of Garlic bulb (62.05%) and Ginger rhizome (59.70%) respectively.

Keywords : Phytoextracts, *Fusarium* sp., Dry rot, Pathogenicity test

Potato (*Solanum tuberosum* L.) is one of the most nutritious sources of food in the world. Besides cereals, potato is one of the crops, which can supplement food needs of a country. It has been recognized as a wholesome food and the richest source of energy in most of the countries of the world where, it forms an important part of the human diet. *Fusarium* dry rot is one of the most important diseases of potato, affecting tubers in storage and seed pieces after planting. *Fusarium* dry rot of seed tubers can reduce crop establishment by killing developing potato sprouts, and crop losses can be up to 25%, while more than 60% of tubers can be infected in storage. However, average annual crop losses attributed to dry rot have been estimated at 6 to 25 per cent (1) and found that more than 60 per cent of tubers in storage can be affected (2). *Fusarium* sp. that causes dry rot and spread readily among tubers during handling and planting which results in seed tuber rots and poor plants stand (3). However, other diseases as charcoal rot (*Macrophomina phaseolina*) may cause 10-70 per cent tuber rottage in eastern plains depending upon the period of harvest and presence of predisposing factors (4). The first symptoms of *Fusarium* dry rot are usually dark depressions on the surface of the tuber. In large lesions, the skin becomes wrinkled in concentric rings as the underlying dead tissue desiccates. Internal symptoms are characterized by necrotic areas shaded from light to dark brown or black in colour. This necrotic tissue is usually dry (hence the name given as dry rot) and may develop at an injury such as a cut or bruise. The pathogen enters the tuber, often rotting out in the center. *Fusarium* dry rot is caused by several fungal species in the genus *Fusarium*. *Fusarium sambucinum* (teleomorph *Giberella pulicaris*) is the most common pathogen causing dry rot of stored tubers, but

other *Fusarium* species are also known to cause dry rot, particularly *F. solani* var. *coeruleum* and *F. avenaceum*. However, *F. sambucinum* may be the probably the main causal agent of dry rot, but *F. solani* var. *coeruleum* may also be present and affect the potato crop. *Fusarium* dry rot is both seed and soil-borne and is present in most potato growing areas. Spread is associated with damage through seed cutting, grading or harvesting. Wounds created during these processes allow the *Fusarium* fungi to enter the tuber and spread. Temperatures of 15 to 20°C and high relative humidity aid the growth of *Fusarium* dry rot. Lower temperatures and humidity retard the fungus but dry rot development continues even at the lowest storage temperatures (As shown in photograph).

Investigations conducted on the use of plant extracts have opened a new avenue for the control of plant diseases. Looking to the importance and need, different phytoextracts have been studied under in vitro condition for the effective management of dry rot disease of potato.

MATERIALS AND METHODS

(A) Collection of potato tuber rot infected samples and isolation of pathogen

The naturally infected tubers showing the symptoms of dry rot disease was collected from the Potato Research Station, Deesa. On confirming the symptoms as well as presence of fungal pathogen on infected tubers, the samples were subjected to tissue isolation by cutting the infected tissue into small bits. The pieces were surface sterilized with 0.1 per cent mercuric chloride solution for one minute followed by subsequent three washings of sterile distilled water and then aseptically transferred to

Table-1 : Effect of unsterilized water based extract of different plant species on growth of *Fusarium* sp. in vitro test.

Sr. No.	Name of phytoextract	Plant part used	Per cent inhibition over control*
			<i>Fusarium</i> sp.
I	Ardusi	Leaves	41.71(43.81)**
II	Bhoyringni	Leaves	45.26(49.99)
III	Datura	Leaves	46.95(52.93)
IV	Eucalyptus	Leaves	46.78(52.64)
V	Garlic	Bulb	52.25(62.05)
VI	Ginger	Rhizome	50.87(59.70)
VII	Karanj	Leaves	36.55(34.99)
VIII	Mahendi	Leaves	46.78(52.64)
IX	Onion	Bulb	53.12(63.52)
X	Lantana	Leaves	45.60(50.58)
XI	Neem	Leaves	44.92(49.40)
XII	Control (Sterile distilled water)	-	4.05(00.00)
	S.E.m. $\pm$	-	0.487
	C.D. at 5%	-	1.390
in0	C.V. %	-	2.27

* Average of four replications

**Figures in the parenthesis are retransformed values

sterile Petri plate containing 20 ml of Potato Dextrose Agar (PDA) for fungal. Inoculated Petri plates were incubated at $28 \pm 2^\circ\text{C}$ for the growth of the fungal pathogen.

The respective pathogenic cultures were further purified and maintained on PDA slants for fungal pathogen. The periodical subculturing and multiplication were done on the same medium to keep the culture fresh.

(B) Pathogenicity test for Dry rot pathogen

(1) Pathogenicity test for dry rot under laboratory condition

The pathogenicity test of the dry rot pathogen (*Fusarium* sp.) was confirmed on ten freshly harvested healthy tubers of Kufri Badshah by inserting mycelium through minor injuries of 1-2 mm deep and the inoculated sites were sealed with wax. The inoculated tubers were incubated at $28 \pm 2^\circ\text{C}$ and were examined regularly for disease development. The pathogen was reisolated from diseased tubers after twelve days and compared with the original isolate of *Fusarium* sp. (5) while, ten potato tubers without inoculation were kept as control.

(2) Pathogenicity test for dry rot under pot culture

In order to confirm pathogenic nature of *Fusarium* sp. in pot, the inoculum of *Fusarium* sp. was multiplied in Petri plates on PDA medium, which was further, used for inoculation. These inoculated Petri plates were incubated at $28 \pm 2^\circ\text{C}$ temperature. The earthen pots of 45 cm diameter were sterilized by dipping them in two per cent formaldehyde solution for about one minute. The mixture containing soil, sand and farm yard manure in the ratio of 50:25:25 was filled in ten sterilized pots after autoclaving it

for two times at 1.045 kg/cm^2 pressure for an hour and allowed to kept for 10 days to expel out harmful gases.

The mycelial suspension of *Fusarium* sp. was used for inoculation at the rate of 4 Petri plates/pot. The inoculum of isolate was thoroughly mixed with the autoclaved soil mixture in eight pots and moistened with water before one week of planting for uniform spread of the inoculum. The remaining two pots were not inoculated with *Fusarium* sp. and kept as control for comparison. The potatoes of variety Kufri Badshah, weighing approximately 50 g, was surface sterilized with 2.5 per cent sodium hypochlorite solution for five minutes before planting. Three potato seed tubers were planted in each pot. All the pots including check were irrigated regularly to maintain soil moisture. The pots were kept in green house for occurrence of the disease. The observations on the occurrence of the dry rot disease were taken at the time of harvesting of potato. At the end, reisolation was made from dry rot infected potato tubers harvested from inoculated pots for comparing the pathogen with the original isolate.

Bioefficacy test : Bioefficacy of phytoextracts of eleven plant species having medicinal values was tested in vitro by poisoned food technique. Fresh and healthy 100g plant parts of each plant species as mentioned in Table-1 were thoroughly washed with tap water and then with sterile distilled water. These were crushed in grinder mixer by adding 100 ml distilled water to obtain 1:1 extract. The phytoextracts thus obtained were then filtered through double layered sterile muslin cloth in conical flasks and were used without sterilization. The flasks were labelled and stored in the refrigerator for further use.

100 ml of Potato Dextrose Agar (PDA) medium was taken repeatedly for fungal isolates in flasks of 150 ml capacity, plugged and sterilized by autoclaving at 1.045 kg/cm^2 for 20 minutes. After autoclaving and cooling to about 45°C , 10 ml of the respective extracts was mixed thoroughly in the flasks containing 100 ml of PDA medium. Medium without respective phytoextracts served as control. All these were poured aseptically into sterile Petri plates replicating four times per treatment. After solidification, the plates were inoculated separately with cultures of *Fusarium* sp. in the centre with the help of sterilized 5 mm cork borer and were incubated at $28 \pm 2^\circ\text{C}$ temperature for seven days. Observations on radial growth of *Fusarium* sp. was measured by averaging two diameters of colony at right angle to one another and the per cent growth inhibition (PGI) was calculated by the following equation (Asalmol et al., 1990).

$$\text{PGI} = \frac{C - T}{C} \times 100$$



Photographs showing the symptoms of dry rot of potatoes caused by *Fusarium* sp.

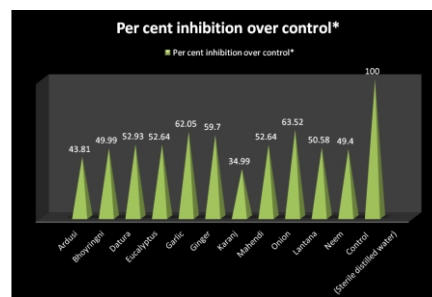
Where,

- PGI - Per cent Growth Inhibition
C - Growth in control (mm)
T - Growth in treatment (mm)

RESULTS AND DISCUSSION

Dry rot (*Fusarium* sp.) : The results presented in Table-1 and Graph-1 revealed that all the plant extracts inhibited the growth of pathogens significantly as compared to control. The extract of Onion bulb (*Allium cepa*) produced significantly maximum growth inhibition (63.52%) of *Fusarium* sp. followed by extract of Garlic bulb (*Allium sativum*) (62.05%) and extract of Ginger rhizome (59.70%). The next effective phytoextract in order of inhibition and at par were extracts of Datura leaves (52.93%), Eucalyptus leaves (52.64%) and Mahendi leaves (52.64%). Rest of the phytoextracts exhibited little inhibition on the growth of the pathogen and differed significantly among each other.

Research results of our study corroborate with the report of (6) found that allicin, a major constituent of *A. sativum* containing sulphur, has strong toxic properties against several bacteria and fungi. (7) found that oil of garlic (*Allium sativum* L.) in natural and synthetic forms has been reported to suppress the activity of many air and soil-borne fungi. (8) showed that the extract of garlic was more inhibitory than of onion on the growth of *Fusarium solani*. (9) found fungicidal properties of allicin, a constituent found in *Allium cepa*, against *Macrophomina phaseolina* at 0.1 per cent concentration. (10) reported that extract of *Allium sativum* was most effective in controlling *Macrophomina phaseolina* causing charcoal rot of sorghum followed by *Allium cepa*, *Curcuma longa* and *Zingiber officinale*. (11) reported that *Rhizoctonia solani* and *R. bataticola* causing root rot of chickpea, cotton and bhindi were more sensitive to extracts of *Allium cepa*, *Allium sativum*, *Zingiber officinale* and *Azadirachta indica* followed by *Mentha arvensis*, *E. globulus* and *Ocimum sanctum*. Thus, the present findings are in confirmation with the work of above research workers.



Graph-1 : Indicates the per cent growth inhibition over control.

CONCLUSION

From this experiment, it can be concluded that for *Fusarium* sp. the Onion bulb @ 10 per cent showed maximum growth inhibition (63.52%) followed by extract of Garlic bulb (62.05%). Further this extract can be effectively incorporated in different forms for the control of these fungi in the field condition.

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EVALUATION OF ALTERNATIVE BOTANICALS FOR NSKE IN THE MANAGEMENT OF POD PESTS COMPLEX ON PIGEONPEA

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ABSTRACT

Evaluation of certain alternative botanicals Neem Soap, Pongamia Soap, NSKE, including Indoxacarb were investigated in field against pod pest complex on long duration pigeonpea at Agricultural Research Farm, Banaras Hindu University, Varanasi during Kharif 2014-15. Three replication with eight treatments were: Neem Soap > Neem Soap > Neem Soap at 10g/lit; Pongamia Soap> Pongamia Soap> Pongamia Soap at 10g/lit; NSKE> NSKE> NSKE> at 50g/lit; Indoxacarb> Indoxacarb> Indoxacarb at 0.5ml/lit; Neem Soap > Indoxacarb> Indoxacarb at 10 > 0.5 > 0.5g/lit; Pongamia Soap> Indoxacarb> Indoxacarb at 10g > 0.5 > 0.5ml/lit; NSKE > Indoxacarb> Indoxacarb at 50 > 0.5 > 0.5 g /lit, Untreated Control water sprayed only. Three spraying were performed from flowering stage at 10-15 days interval. Treatment; Indoxacarb> Indoxacarb> Indoxacarb at 0.5 ml/lit; was found most effective followed by treatment NSKE> Indoxacarb> Indoxacarb 50g>0.5>0.5ml/lit; Neem Soap > Indoxacarb> Indoxacarb at 10 > 0.5 > 0.5g/lit; Pongamia Soap> Indoxacarb> Indoxacarb at 10g > 0.5 > 0.5g/lit; NSKE > NSKE > NSKE > at 50g/lit; Neem Soap > Neem Soap > Neem Soap at 10g/lit; Pongamia Soap> Pongamia Soap> Pongamia Soap at 10g/lit; Untreated control.

Key words : *Pigeonpea, pod pest complex, alternative botanicals, insecticides*

Pulses constitute an integral part of Indian Agriculture because they enrich human diet and soil fertility helping for high yields from succeeding crops. They also provide proteinaceous grains and nutritive fodder. Pulses contain at least two to three times higher in their proteins as compared to the protein of cereal grains. For vegetarian diet, pulses form the major source of protein. They are an economic source of not only protein but also carbohydrate, minerals and B-complex vitamins particularly in vegetarian diet. On an average, pulses contain 20-25 per cent of protein in their dry seeds. Thus, the pulses ensure nutritional security to the poor masses of country (1). Being more nutritive than any other cereals, they form the best utilization bridge between human food, industrial products and animal feeds. Besides being a rich source of protein, they maintain soil fertility through biological nitrogen fixation in soil and thus play a vital role in furthering sustainable agriculture (2).

Pigeonpea [*Cajanus cajan* (L) Millsp.] is one of the most important grain legume crops of tropical and subtropical environments, cultivated on almost 4.8 million hectares worldwide covering 22 countries in Asia, Africa and the Caribbean. India has virtual monopoly in pigeonpea production accounting to 90 per cent of world's total production. In India, it occupies an area of 3.88 million ha with a production of 3.17 million tonnes (E-Pulses data book IIPR, 2015). The productivity of pigeonpea has not increased considerably during last decade in India. The damage caused by insect pests is one of the major reasons of low productivity. Nearly 90 per cent of the crop is grown under rainfed conditions with medium and long duration cultivars. Short duration

varieties are suited for irrigated conditions. As the pigeonpea is grown under wide variety of agroclimatic conditions and under varied cropping systems of different maturity, it is vulnerable to many pests. (3) have reported that pigeonpea is attacked by nearly 250 species of insect worldwide belonging to 8 orders and 61 families though relatively few cause serious yield losses. The key pests of long duration pigeonpea include Tur pod fly *Melanagromyza obtusa* (Malloch), Gram pod borer *Helicoverpa armigera* (Hubner), others such as Tur pod bug *Clavigralla gibbosa* (Spinola), Blue butterfly *Lampides boeticus* (L.) Plume moth *Exelastis atomosa* (Walsingham) and Legume pod borer *Maruca vitrata* are also potential pests and occasionally cause significant grain yield losses in long duration pigeonpea. The early or vegetative stage pests are not causing economic damage. However, the pests of flowers and pods borers are the major and important pests.

The Podfly *Melanagromyza obtusa* (Malloch) is a widespread and major pest of pigeonpea in Asia. It has a narrow host range and only feeds on pigeonpea and closely related species. Pod fly infested pods do not show external evidence of damage until the fully grown larvae chew holes in the pod walls. This hole provides an emergence "window" through which the adults exit the pod. In a survey conducted by ICRISAT, *Melanagromyza obtusa* (Malloch) was reported to damage 22.5 per cent pigeon pea pods in north India, 21 per cent in central India and 13.2 per cent in South India (4), where as the pod borer damage was reported to be 29.7 per cent in North-West Zone, 13.2 per cent in Central zone and 36.4

Table-1 : Per cent pod and grain damage caused by pod pests complex on pigeonpea.

Treatments	Dose	% Damage by pod fly		% Damage by pod bug		% Damage by Helicoverpa		Yield (kg/ha)
		Pod	Grain	Pod	Grain	Pod	Grain	
NEEMSOAP>NEEMSOAP>NEEMSOAP	10g/lit	1.58 (35.42)	1.34 (22.57)	1.36 (18.66)	1.16 (12.75)	1.46 (13.62)	0.78 (7.23)	980
PONGAMIA SOAP> PONGAMIA SOAP> PONGAMIA SOAP	10g/lit	1.95 (29.01)	1.41 (21.93)	1.69 (21.86)	1.30 (12.90)	1.48 (14.43)	0.94 (6.88)	820
NSKE> NSKE > NSKE	50g/lit	0.91 (38.04)	1.21 (25.04)	1.20 (26.36)	0.79 (11.08)	1.17 (15.25)	0.77 (7.64)	1200
INDOXACARB> INDOXACARB> INDOXACARB	0.5 ml/lit	0.54 (34.64)	0.22 (23.24)	1.10 (21.36)	0.37 (9.87)	0.46 (12.45)	0.29 (6.62)	1600
NEEMSOAP > INDOXACARB> INDOXACARB	10>0.5 >0.5g/lit	0.55 (35.84)	0.67 (21.52)	1.18 (22.19)	0.27 (14.96)	0.88 (12.41)	0.75 (6.74)	1350
PONGAMIA SOAP > INDOXACARB> INDOXACARB	10>0.5 >0.5 g/lit	1.37 (38.42)	1.25 (21.72)	0.65 (25.33)	0.33 (12.60)	1.23 (16.34)	0.76 (8.73)	1300
NSKE >INDOXACARB> INDOXACARB	50>0.5 >0.5g/lit	0.40 (36.05)	0.12 (21.51)	1.11 (18.37)	0.77 (10.66)	0.81 (13.72)	0.63 (8.26)	1510
UNTREATED	-	2.17 (33.96)	1.63 (19.88)	1.71 (18.61)	1.78 (12.44)	1.99 (13.91)	1.79 (10.45)	590
SEm±	-	1.35	1.17	1.29	0.92	1.17	0.96	-
C.D at =5%	-	4.14	1.65	3.94	2.81	1.66	1.36	-

Figures in parentheses are angular transformed values.

per cent in South Zone (5). The annual loss of pigeonpea production due to podfly alone has been estimated to the extent of 25 to 30 per cent in U.P. (6). Besides pod fly and other insects, the damage caused by Pod sucking bugs, *Clavigralla gibbosa* (Spinola) is predominant in eastern U.P. and the total grain loss due to pod sucking bugs damage has been worked out to the tune of 50,000 tonnes annually for U.P. alone. Pod borer, *Helicoverpa armigera* (Hubner) is a cosmopolitan and highly polyphagous insect which attacks numerous crop plants of agricultural importance all over the world and is the major biotic constraint to increasing pigeon pea production (4). The key pest status of *H. armigera* is due to the larval preference for feeding on plant parts rich in nitrogen such as reproductive structure and growing tips. Annual pigeonpea losses due to *H. armigera* have been estimated more than 300 million dollar worldwide (7). It is estimated that the infestation of one larvae per plant on pigeonpea can cause yield loss of 1015 kg/ha (8). The pod damage is about is about 39 to 45 per cent caused by this pest.

MATERIALS AND METHODS

The present investigation were conducted at Agricultural Research Farm, Banaras Hindu University, Varanasi during Kharif 2013-14. The long duration pigeonpea variety BAHAR was grown in plot size of 15 m² (4 m × 3.75 m) in 5 rows, following row to row and plant to plant

spacing of 75 cm and 10 cm respectively, The crop was grown following the normal agronomic practices in Randomized Block Design with three replication and eight treatment including control. The first spraying at 50-80% flowering stage later at 10-15 days interval three spraying was performed in early hour of the day to avoid the threat of drift hazard. Mean populations was made a day after spray was worked out for which reduction in population over untreated control was calculated for each spray using following formula.

Percent Reduction in Larval Population

$$= \frac{\text{Larval population in control plot} - \text{Larval population untreated plot}}{\text{Larval population in control plot}} \times 100$$

The sampling for pod and seed damage assessment by insect pest was done at 80 percent maturity of the crops. Five plants from the three replications in five rows in each plot were selected randomly and all the pods from five plant were pooled together and finally 100 pods were picked up randomly for pod and grain damage assessment. The data on present pod and grain damage by pod fly, pod bug and *Helicoverpa* were recorded separately, during the investigation. The grain yield was also recorded for each plot after excluding the border rows the two side of the plot. The grain yield data for each plot was converted to grain yield in Kg/ha. All the data

were subjected to statistically analysed as per the Randomized Block Design.

RESULTS AND DISCUSSION

Effect of various treatment on percent pod damage by pod fly : The treatment applied showed significant differences in the per cent pod damage by tur pod fly and data are given in table. The percent pod damage ranged from 0.40% to 2.17%. All the treatments were found superior over control with respect to per cent pod damage. The relative performance of each was in following order, NSKE > Indoxacarb > Indoxacarb @ 50g > 0.5 > 0.5g/lit with 40% pod damage, Indoxacarb > Indoxacarb > Indoxacarb @ 0.5 ml/lit with 0.54% pod damage, Neem soap > Indoxacarb > Indoxacarb @ 10 > 0.5 > 0.5g/lit with 55.00% pod damage, NSKE > NSKE > NSKE @ 50g/lit with 91.00% pod damage, Pongamia soap > Indoxacarb > Indoxacarb @ 10g > 0.5 > 0.5g/lit with 1.37% pod damage, Neem soap > Neem soap > Neem soap @ 10g/lit with 1.58% pod damage, Pongamia soap > Pongamia soap > Pongamia soap @ 10g/lit with 1.95% pod damage, Where as in control plot per cent pod damage was 2.17%, respectively.

Effect of various treatment on percent pod damage by pod bug : The treatment applied showed significant differences in the per cent pod damage by tur pod bug and data are given in table . The percent pod damage ranged from 0.65% to 1.71%. The relative performance of each was in following order Pongamia soap > Indoxacarb > Indoxacarb @ 10 > 0.5 > 0.5g/lit with 0.65% pod damage, Indoxacarb > Indoxacarb > Indoxacarb @ 0.5 ml/lit with 1.10% pod damage, NSKE > Indoxacarb > Indoxacarb @ 50 > 0.5 > 0.5g/lit with 1.11% pod damage, Neem soap > Indoxacarb > Indoxacarb @ 10 > 0.5 > 0.5g/lit with 1.18% pod damage, NSKE > NSKE > NSKE @ 50g/lit with 1.20% pod damage, Neem soap > Neem soap > Neem soap @ 10g/lit with 1.36% pod damage, , Pongamia soap > Pongamia soap > Pongamia soap @ 10g/lit with 1.69% pod damage,. While in control the pod damage was 1.71% respectively.

Effect of various treatment on percent pod damage by Helicoverpa : The treatment applied showed significant differences in the per cent pod damage by Helicoverpa and data are given in table. The percent pod damage ranged from 0.46% to 1.99%. The relative performance of each was in following order Indoxacarb > Indoxacarb > Indoxacarb @ 0.5 ml/lit with 0.46% pod damage, NSKE > Indoxacarb > Indoxacarb @ 50 > 0.5 > 0.5g/lit with 0.81% pod damage, Neemsoap > Indoxacarb > Indoxacarb @ 10 > 0.5 > 0.5g/lit with 0.88% pod damage, , NSKE > NSKE > NSKE @ 50g/l with 1.17% pod damage, Pongamia soap > Indoxacarb > Indoxacarb @ 10 > 0.5 > 0.5g/lit with 1.23% pod damage, Neem soap > Neem soap > Neem soap @ 10g/lit with 1.46% pod damage, Pongamia soap >

Pongamia soap > Pongamia soap @ 10g/lit with 1.48% pod damage, While in control the pod damage was 1.99%, respectively.

Effect of various treatment on percent grain damage by pod fly : The difference in per cent grain damage due to treatments applied showed significant and data are given in table. The percent grain damage ranged from 0.12% to 1.63 %. All the treatment were found superior over control with respect to per cent grain damage. The relative performance of each was in following order NSKE > Indoxacarb > Indoxacarb @ 50 > 0.5 > 0.5g/lit with 0.12% grain damage, Indoxacarb > Indoxacarb > Indoxacarb @ 0.5 ml/lit with 0.22 % grain damage, Neem soap > Indoxacarb > Indoxacarb @ 10 > 0.5 > 0.5g/lit with 0.67% grain damage, NSKE > NSKE > NSKE @ 50g/lit with 1.21% grain damage, Pongamia soap > Indoxacarb > Indoxacarb @ 10g > 0.5 > 0.5g/lit with 1.25% grain damage, Neem soap > Neem soap > Neem soap @ 10g/lit with 1.34% grain damage, Pongamia soap > Pongamia soap > Pongamia soap @ 10g/lit with 1.41% grain damage, While in control the grain damage was 1.36%, respectively.

Effect of various treatment on percent grain damage by pod bug : The difference in per cent grain damage due to treatments applied showed significant and data are given in table. The percent grain damage ranged from 0.27% to 1.78%. The relative performance of each was in following order Neem soap > Indoxacarb > Indoxacarb @ 10 > 0.5 > 0.5g/lit with 0.27% grain damage, Pongamia soap > Indoxacarb > Indoxacarb @ 10 > 0.5 > 0.5g/lit with 0.33% grain damage, Indoxacarb > Indoxacarb > Indoxacarb @ 0.5 ml/lit with 0.37 % grain damage, NSKE > Indoxacarb > Indoxacarb @ 50 > 0.5 > 0.5g/lit with 0.77% grain damage, NSKE > NSKE > NSKE @ 50g/lit with 0.79% grain damage, Neem soap > Neem soap > Neem soap @ 10g/lit with 1.16% grain damage, Pongamia soap > Pongamia soap > Pongamia soap @ 10g/lit with 1.30% grain damage, While in control the grain damage was only 1.78%, respectively.

Effect of various treatment on percent grain damage by Helicoverpa : The difference in per cent grain damage due to treatments applied showed significant and data are given in table. The percent grain damage ranged from 0.29% to 1.79%. The relative performance of each was in following order Indoxacarb > Indoxacarb > Indoxacarb @ 0.5 ml/lit with 0.29 % grain damage, NSKE > Indoxacarb > Indoxacarb @ 50 > 0.5 > 0.5g/lit with 0.63% grain damage, Neem soap > Indoxacarb > Indoxacarb @ 10 > 0.5 > 0.5g/lit with 0.75% grain damage, Pongamia soap > Indoxacarb > Indoxacarb @ 10 > 0.5 > 0.5g/lit with 0.76% grain damage, NSKE > NSKE > NSKE @ 50g/lit with 0.77% grain damage, Neem soap > Neem soap > Neem soap @ 10g/lit with 0.78% grain damage, Pongamia soap > Pongamia soap > Pongamia soap @ 10g/lit with 0.94%

grain damage, While in control the grain damage was only 1.79%, respectively. The similar results have been reported by (9, 10, 11).

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RESPONSE OF PLANT BIOREGULATORS ON GROWTH, FLOWERING AND FRUITING OF BITTER GOURD (*Mimordica charantia* L.) UNDER NORTH KONKAN COASTAL ZONE OF MAHARASHTRA (INDIA)

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ABSTRACT

The present study on “Effect of paclobutrazol and triacontanol on growth; flowering and fruiting of bitter gourd (*Momordica charantia* L.) Cv. Konkan Tara under north Konkan coastal zone conditions of Maharashtra” was studied during rabi season at Roha (Raigad) condition. The weather of this region is hot and humid with temperature ranging from 15.60 OC to 43.0 OC. The annual rainfall varies from 2000 to 3000 mm. Soil strata are hilly to Deccan plateau below 300m height & developed from Deccan trap. The study revealed that in bitter gourd among all the treatments, the application of PBZ 100 ppm at 4 leaf stage + TRIA 4 ppm at flowering is one of the most prominent treatment which induce more number of nodes per vine, more number of female flowers, more fruit set and total yield.

Key words : Bitter gourd, Plant bioregulators, growth, flowering, fruiting.

Bitter gourd (*Mimordica charantia* L.) is one of the most important cucurbitaceous vegetable crop grown extensively throughout India. The total area under this crop during 2012-2013 was 78.89 thousand hectares and the production was about 807.47 thousand metric tonnes (1). In terms of area and production, Andhra Pradesh ranks first followed by Orissa, Bihar, Chhattisgarh, Madhya Pradesh, Assam, Mizoram respectively. In Maharashtra it is grown in Western part and Konkan region. Bitter gourd is a seasonal vegetable and as the name suggests, is very bitter in taste. It is a rich source of phosphorus. It purifies blood, activates spleen and liver and is highly beneficial in diabetes. Generally bitter gourd is grown in summer and rainy season. Non synchronization of male and female flowers and abortion of immature fruit are common problems in bitter gourd cultivation which consequently reduce the yield. Attempts have been made to overwhelm this problem. Application of IAA, GA and NAA increased yields in cucurbits through synchronized flowering (2, 3). But present experiment was undertaken to study the yield performance by the use of bioregulators like triacontanol and paclobutrazol in winter season. Application of triacontanol has reported to improve yield levels without morphological alterations whereas paclobutrazol have been proved to induce early flowering and dwarfness in many plants. Being very effective growth regulators, efficacy of these growth regulators was studied on highly priced cucurbitaceous crop, bitter gourd to observe their effect on growth, flowering behaviour, sex ratio and yield.

MATERIALS AND METHODS

This study was carried out under the agroclimatic conditions of the North Konkan Coastal Zone at Krishi Vigyan Kendra, Roha (Raigad) under Dr. Balasaheb

Sawant Konkan Krishi Vidyapeeth, Dapoli during the winter season. The experiment was laid out in Randomized block design with 10 treatments replicated three times. The experimental plot was brought to fine tilth by giving one ploughing, clod crushing, harrowing and levelling. The fertilizers were applied FYM (10 kg per hill) and 120 kg nitrogen, 60 kg phosphorus and 30 kg potassium per hectare. The healthy seeds of bitter gourd variety “Konkan Tara” were sown as per treatments. Stock solution of paclobutrazol (PBZ) and triacontanol (TRIA) were prepared in distilled water. The plant bioregulators viz., paclobutrazol and triacontanol were applied at 2 true leaf stage (2 L.S.) and 4 true leaf stage (4 L.S.). Fruits were harvested when they attained full growth but a tender and edible maturity. Growth, flowering and yield observations were recorded at different stages of plant growth. Length of vine were measured from cotyledonary node to the growing point i.e. growing tip. The number of functional leaves on the plant excluding dried and fallen leaves were counted at final harvest. Number of nodes present on main axis were counted starting from cotyledonary node upto the growing point at the time of final harvest. Number of days required for branching were recorded from date of sowing. Number of branches were recorded at the time of final harvest. The number of days required for the appearance of first male and female flower from date of sowing was counted and recorded separately. The days required for 50 per cent male and female flower initiation was counted considering total number of male and female flowers. The nodal number on the main axis at which first male flower and first female flower appeared was recorded separately. The ratio of male: female flower was recorded as sex ratio. The fruit yield mean number and weight per plant and yield t/ha was recorded in each plot and calculated as yield

Table-1 : Effect of plant bioregulators on vegetative growth of bitter gourd (*Mimordica charantia* L.).

Treatments	No. of branches	Days for branching (DAS)	Number of nodes	Number of leaves	Length of vine (cm)
T ₁ - Control (2 L.S.)	10.53	25.66	62.66	568.73	398.26
T ₂ - TRIA 4 ppm (2 L.S.)	10.00	24.33	58.32	639.93	446.66
T ₃ - PBZ 50 ppm (2 L.S.) + TRIA 4 ppm (flowering)	8.26	25.33	56.13	407.87	332.83
T ₄ - PBZ 100 ppm (2 L.S.) + TRIA 4 ppm (flowering)	9.26	24.00	47.39	283.88	332.66
T ₅ - PBZ 150 ppm (2 L.S.) + TRIA 4 ppm (flowering)	9.00	25.33	57.80	231.46	328.80
T ₆ - Control (4 L.S.)	8.93	25.00	60.00	600.00	397.13
T ₇ - TRIA 4 ppm (4 L.S.)	11.76	24.33	60.50	747.59	400.26
T ₈ - PBZ 50 ppm (4 L.S.) + TRIA 4 ppm (flowering)	8.66	23.67	64.73	543.00	371.66
T ₉ - PBZ 100 ppm (4 L.S.) + TRIA 4 ppm (flowering)	10.20	23.33	69.46	444.00	358.66
T ₁₀ - PBZ 150 ppm (4 L.S.) + TRIA 4 ppm (flowering)	11.26	25.33	60.53	414.60	337.26
Mean	9.75	24.63	58.89	488.13	370.20
SE.+	0.55	0.87	0.89	1.29	1.70
C.D. at 5%	1.65	N.S.	2.46	3.85	5.06

Note : 2 L.S. = 2 leaf stage 4 L.S. = 4 leaf stage PBZ = Paclobutrazol TRIA = Triacantanol DAS = Days after sowing.

parameter. Statistical analysis of the data was done by using standard methods described by (4).

RESULTS AND DISCUSSION

The effect of plant bioregulators on vegetative growth of bitter gourd are presented in Table 1. The data on effect of different plant bioregulators on number of branches varied significantly due to effect of different bioregulators (Table-1). Maximum number of branches were observed in TRIA 4 ppm applied at 4 leaf stage (11.76) which were significantly superior to all other treatments followed by paclobutrazol 150 ppm (at 4 leaf stage) + TRIA 4 ppm at flowering stage and which was significantly superior to control. In general it was observed that TRIA 4 ppm applied at 4 leaf stage and 2 leaf stage produced more number of branches. It was observed that, there was no significant effect of paclobutrazol in combination with TRIA on days required for branching in bitter gourd. In general, early branching was noticed in the treatment paclobutrazol 100 ppm applied at 4 leaf stage + TRIA 4 ppm applied at flowering (23.33 DAS) as compared to control T₁ (25.66 DAS). The data pertaining to effect of different plant bioregulators showed significant differences on number of nodes per vine (Table 1). The maximum number of nodes were observed in the application of paclobutrazol 100 ppm (4 leaf stage) + TRIA 4 ppm at flowering stage (69.46) and which were significantly superior over all other treatments. This was followed by application of paclobutrazol 50 ppm at 4 leaf stage + TRIA 4 ppm at flowering, which was at par with control. Significantly minimum number of nodes (47.33) were produced in the treatment of paclobutrazol 100 ppm at 2 leaf stage + TRIA 4 ppm at flowering. There was also significant variation in the number of leaves per vine (Table 1) due to effect and stage of application of bioregulators. Application of TRIA 4 ppm at 4 leaf stage produced the maximum leaves (747.59) per vine and which were significantly superior to all other treatments,

followed by application of TRIA 4 ppm at 2 leaf stage (639.97). The data on the effect of different plant bioregulators on mean vine length (cm) at final stage harvest indicate that the foliar sprays of TRIA 4 ppm at 2 leaf stage (T₂) exhibited maximum vine length (444.66 cm), which was significantly superior over all the other treatments under study. This was followed by foliar sprays of TRIA 4 ppm at 4 leaf stage (400.26 cm). It was further observed that all paclobutrazol treatment exhibited reduction in vine length. The minimum vine length was observed in the treatment of paclobutrazol 150 ppm at 2 L.S. and TRIA 4 ppm at flowering (328.80 cm). Similar results regarding growth observations were reported by (5, 6).

The data on effect on plant bioregulators on flowering and fruiting are presented in Table 2. The days required for appearance of first male flower and first female flower showed significant differences by application of different plant bioregulators (Table 2). It revealed that in control (4 L.S.) the duration required for the appearance of first male (55.33 days) and first female flower (58.66 days) was more than the rest of the treatments. Foliar application of triacantanol at 4 leaf stage produced early male (46 days) and female flowers (50.33 days), which was significantly superior to the control T₁. But there was delay in appearance of first male flower (53.33 days) and first female flower (57 days) by paclobutrazol 100 ppm applied at 2 leaf stage + TRIA 4 ppm at flowering. The earliest 50 per cent male flowering as well as 50 per cent female flowering (47 and 54.33 respectively) was indicated by application of TRIA 4 ppm at 4 leaf stage which was significantly superior over control. This treatment induced 50 per cent male flowers 14 days earlier and 50 per cent female flowers earlier by about 9 days than the control. Paclobutrazol

Table-2 : Effect of plant bioregulators on flowering and fruiting of bitter gourd (*Mimordica charantia* L.).

Treatments	Days required for appearance of flower (DAS)		Days required for 50 % flowering (DAS)		Average number of node for first flower		Sex ratio	Mean fruit yield per plant		Yield (t/ha)
	Male	Female	Male	Female	Male	Female		Number	Weight (g)	
T ₁ - Control (2 L.S.)	54.33	58.00	61.66	64.00	10.23	20.80	5.88	15.49	674.44	4.44
T ₂ - TRIA 4 ppm (2 L.S.)	52.66	56.00	55.66	63.66	8.46	20.30	5.33	18.38	810.83	5.68
T ₃ - PBZ 50 ppm (2 L.S.) + TRIA 4 ppm (flowering)	54.66	57.00	61.00	62.00	8.60	16.30	5.32	17.44	777.72	5.38
T ₄ - PBZ 100 ppm (2 L.S.) + TRIA 4 ppm (flowering)	53.33	57.00	58.00	62.33	8.73	13.90	5.63	21.66	930.55	6.26
T ₅ - PBZ 150 ppm (2 L.S.) + TRIA 4 ppm (flowering)	52.33	56.33	54.66	63.00	9.00	17.70	5.28	16.77	662.49	4.97
T ₆ - Control (4 L.S.)	55.33	58.66	57.00	62.33	10.60	20.73	5.71	17.55	808.60	5.73
T ₇ - TRIA 4 ppm (4 L.S.)	46.00	50.33	47.00	54.33	8.33	20.80	5.35	18.44	836.38	5.73
T ₈ - PBZ 50 ppm (4 L.S.) + TRIA 4 ppm (flowering)	46.33	50.66	49.66	54.33	8.70	16.33	4.72	21.27	920.80	6.67
T ₉ - PBZ 100 ppm (4 L.S.) + TRIA 4 ppm (flowering)	50.66	56.33	53.66	60.66	8.20	13.33	3.99	24.94	1186.66	7.44
T ₁₀ - PBZ 150 ppm (4 L.S.) + TRIA 4 ppm (flowering)	47.66	51.66	51.00	56.33	9.03	17.73	5.51	16.38	697.77	4.78
Mean	51.33	55.13	54.93	60.30	9.01	17.79	5.27	18.83	831.63	5.71
SE.+	2.32	2.24	2.47	2.13	0.11	0.14	0.19	0.92	24.87	0.17
C.D. at 5%	6.90	6.68	7.35	6.34	0.32	0.41	0.58	2.74	73.90	0.51

Note : 2 L.S. = 2 leaf stage 4 L.S. = 4 leaf stage PBZ = Paclobutrazol TRIA = Triacontanol DAS = Days after sowing

treatment at different concentrations (50,100,150 ppm) at 4 leaf stage + TRIA 4 ppm at flowering also produced early 50 per cent male and 50 per cent female flowering, which were at par with the treatment of TRIA 4 ppm applied at 4 leaf stage. Application of paclobutrazol 50, 100 and 150 ppm at 4 leaf stage + TRIA 4 ppm at flowering significantly induced early female flowering over the control. It is clearly indicated that paclobutrazol and triacontanol application had significance inducing early flowering especially that of female flowering than control by about more than 7 days. This had direct effect on early fruiting and harvesting. Similar results were reported by (7) with cycocel.

The effect of plant bioregulators on appearance of first male flower on particular node indicate that paclobutrazol 100 ppm at 4 leaf stage + TRIA 4 ppm at flowering induced male flowers at lowest node i.e. 8.2 which was significantly superior over control (Table 2). The appearance of female flower also indicated that paclobutrazol 50 ppm, 100 ppm and 150 ppm at 2 leaf and 4 leaf stage induced first female flower on earlier nodes with triacontanol and was superior over control. The study clearly indicated that paclobutrazol application induce flowering at earlier nodes, whether it has a male or female than the control T₆ (10.6 male, 20.73 female). This may be due to action of paclobutrazol by reducing gibberellins biosynthesis in the plant and bringing carbohydrate accumulation at nodal point near the node, thereby increasing C : N ratio which ultimately results in flowering at earlier nodes. The above results are confirmatory with earlier work done by Mishra et al. (1976) in cucumber and

Arora et al. (1989a) in summer squash by paclobutrazol. Different bioregulators had pronounced effect on male: female ratio in bitter gourd (Table-2). The lowest male: female sex ratio was observed in paclobutrazol 100 ppm applied at 4 leaf stage + TRIA 4 ppm at flowering (3.99), while highest number of male : female ratio was observed in the control (5.88). The application of TRIA 4 ppm at 2 leaf and 4 leaf stage produced lower male: female sex ratio (5.33 and 5.35) than the control, which was at par with control T₁ (5.88). The above findings indicated that application of paclobutrazol with TRIA produced less male and more female flowers and lower male: female ratio over rest of the treatments. However control plant produced more male and less female flowers and higher male: female ratio. The present findings are analogous with the findings of (9) in cucumber and (10) in bottle gourd. The yield per vine varied significantly by different plant bioregulators. The foliar sprays of paclobutrazol 100 ppm applied at 4 leaf stage + TRIA 4 ppm at flowering produced significantly superior fruit wt. (1186.66 g) and number of fruits per plant (24.94) over all other treatments.

Foliar spray of paclobutrazol 100 ppm at 4 leaf stage and TRIA 4 ppm at flowering produced significantly higher yield per hectare (7.44 t) than any other treatment which was followed by paclobutrazol 50 ppm applied at 4 leaf stage and paclobutrazol 100 ppm applied at 2 leaf stage which were at par with each other. The results indicate that moderate concentrations of paclobutrazol i.e. 100 ppm is beneficial for increasing yield (4 leaf and 2 leaf stage).

CONCLUSION

A field experiment was conducted in randomized block design, under the agroclimatic conditions of the North Konkan Coastal Zone at Krishi Vigyan Kendra, Roha (Raigad) under Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during the winter season to find out effect of paclobutrazol and triacontanol on growth, flowering and fruiting in bitter gourd. Foliar application of plant bio regulators showed a significant effect on plant growth characters. Foliar sprays of TRIA 4 ppm at 2 leaf stage and 4 leaf stage produced more vine length and number of leaves. Maximum number of nodes were observed in the application of paclobutrazol 100 ppm + TRIA 4 ppm at flowering (69.46). Significantly minimum number of nodes (47.39) were produced in the treatment of paclobutrazol 100 ppm at 2 leaf stage + TRIA 4 ppm at flowering. In general early branching was observed in treatment paclobutrazol 100 ppm applied at 4 leaf stage + TRIA 4 ppm applied at flowering (23.33 DAS) as compared to control T₁ (25.66 DAS). Minimum number of branches were produced by application of paclobutrazol 50 ppm at 2 leaf stage + TRIA 4 ppm at flowering. Foliar application of TRIA at 4 leaf stage produced early male and female flowers. The earliest 50 % male and 50% female flowering was noticed by application of TRIA 4 ppm at 4 leaf stage. Paclobutrazol 150 ppm at 4 leaf stage + TRIA 4 ppm at flowering induces male flower on earlier nodes i.e. 8.2. Paclobutrazol application along with TRIA 4 ppm at flowering at 2 and 4 leaf stages induces female flowers on earlier node than control plants. The treatment paclobutrazol 100 ppm at 4 leaf stage + TRIA 4 ppm at flowering produces lowest male : female sex ratio. Plants treated with paclobutrazol 100 ppm at 4 leaf stage + TRIA 4 ppm at flowering recorded highest yield per plant and yield per hectare.

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STUDY OF PHYSIOLOGICAL QUALITY OF SEED ON THE BASIS OF NON-GERMINATIVE PARAMETERS IN PEARLMILLET

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ABSTRACT

The investigation was carried out to study the physiological quality of seed on the basis of non-germinative parameters in pearl millet. A number of non-germinative parameters viz., electrical conductivity of seed leachate, pH of seed leachate, qualitative *tetrazolium* test, quantitative *tetrazolium* test and membrane permeability were recorded at bimonthly interval in the seed lots stored for a period of time till the germination level fell well below Indian Minimum Seed Certification Standard. Seeds of four hybrids of pearl millet viz., GHB 719, GHB 905, GHB 744 and GHB 732 along with their parental lines, in all total 10 entries, were stored and utilized for this study. Non-germinative parameters also differed significantly due to entries, but with increasing storage time i.e. ageing of the seed, the expression of various non-germinative parameters varied. Electrical conductivity of seed leachate and membrane permeability registered an increase with the storage time and loss of vigour and viability, but contrary to this, qualitative and quantitative tetrazolium test showed a decline with increasing storage period and loss in vigour and viability. pH of the seed leachate, however, could not show any distinct trend with respect to storage period.

Key words : Electrical conductivity, membrane permeability, pearl millet, pH, tetrazolium test.

Pearl millet is an important *Kharif* crop, which is known by various vernacular names such as *Bajra* (Hindi, Punjabi and Urdu), *Bajri* (Rajasthan, Marathi and Gujarati), *Sajje* (Kannada), *Gantilu* (Telugu) and *Kambu* (Tamil). It is well adapted to drought prone areas, low soil fertility, and high temperature situation. It also performs well in soils with high salinity or low pH. It can be grown in all those soil and climatic conditions where other cereal crops, such as maize or rice, would not even survive. India is the largest producer of pearl millet in the world. In 2013-14, it occupied an area of 7.95 million ha with the production of 8.79 million tons per year and average productivity of 1106 kg/ha (1). Rajasthan, Maharashtra, Gujarat and Uttar Pradesh are the major pearl millet growing states of India. Gujarat has an area of 0.872 million hectares under pearl millet cultivation and production of 1.50 million tons with 1720 kg/ha productivity (2).

Germination and seed vigor characteristics are the vital components of physiological quality of seed necessary to ensure optimum plant population with good vigour. However, the standard germination test (SGT) usually over predicts the field performance of a seed lot. Hence, importance of seed vigour as a quality parameter is emphasized (3). Aged seeds show decreased vigour and produce weak seedlings that are unable to survive once reintroduced into a habitat (4). As pearl millet is grown under hostile environment in marginal soils, the vigour aspects of seed quality become more important.

Present study was conducted to evaluate physiological quality of pearl millet seeds using non-germinative parameters. Non-germinative criteria of

physiological quality require a higher level of expertise and greater degree of sophistication. It is estimated through checking solute leakage from imbibed seed by electrical conductivity, red and pink stained color of embryo determining viability of seed quickly by Tetrazolium test method (5). If a feasible relationship is obtained between non-germinative criteria and physiological quality of seed, results in a quick assessment of physiological quality. This is helpful to farmers and seed producers to know well in advance the quality of seed and there by ensure good crop stand and good production.

MATERIALS AND METHODS

The experiment was conducted to study the physiological quality of seed on the basis of non-germinative parameters in pearl millet (*Pennisetum glaucum* (L.) R. Br.) during 2014, at the Department of Seed Science and Technology and Department of Biochemistry, College of Agriculture, Junagadh Agricultural University, Junagadh. The seeds of parents (95222A, J 2454, 04999 A, 98444 A, J 2340 and 96222) of pearl millet hybrids GHB 719, GHB 905, GHB 744 and GHB 732 were procured from Pearl Millet Research Station, Junagadh Agricultural University, Jamnagar and were multiplied as well as hybrids were produced in the *kharif* season of 2013 at Sagadividi farm of Department of Seed Science and Technology, J.A.U., Junagadh. The harvesting was done in the month of November 2013 and ear heads were kept for air-drying. Threshing was done in the month of January 2014. Since pearl millet seeds have time bound dormancy, the seeds

Table-1 : Electrical conductivity (mS/cm) and pH in seed leachates of pearl millet entries (four hybrids and their respective parents) after different periods of storage.

Treatment	Feb-14	Apr-14	June-14	Aug-14	Oct-14	Pooled	Feb-14	Apr-14	June-14	Aug-14	Oct-14	Pooled
	Electrical conductivity (mS/cm/g)						pH					
GHB 719	0.162	0.196	0.227	0.256	0.275	0.223	6.62	6.13	6.12	6.76	6.74	6.47
95222 A	0.263	0.294	0.325	0.353	0.358	0.319	6.51	5.92	5.92	5.90	5.89	6.03
J 2454	0.211	0.293	0.297	0.302	0.306	0.282	6.43	6.29	6.29	6.26	6.24	6.30
GHB 905	0.198	0.208	0.218	0.228	0.234	0.217	6.34	5.96	5.71	5.81	5.91	5.95
094999 A	0.283	0.335	0.390	0.395	0.400	0.361	6.48	5.96	5.96	5.94	5.92	6.05
GHB 744	0.134	0.139	0.146	0.153	0.158	0.146	6.60	5.62	5.59	5.55	5.53	5.78
98444 A	0.176	0.196	0.218	0.234	0.241	0.213	6.48	5.84	5.84	5.81	5.78	5.95
J 2340	0.332	0.337	0.341	0.346	0.351	0.341	6.94	5.85	5.84	5.82	5.80	6.05
GHB 732	0.185	0.226	0.277	0.303	0.315	0.261	6.63	5.94	5.94	5.92	5.90	6.07
96222 A	0.162	0.195	0.241	0.269	0.287	0.231	6.54	5.96	5.95	5.92	5.90	6.05
Mean	0.210	0.242	0.268	0.284	0.292		6.56	5.95	5.92	5.97	5.96	
S.Em.±	0.001	0.003	0.003	0.003	0.003	0.009	0.01	0.01	0.04	0.05	0.05	0.08
C.D. at 5%	0.003	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.13	0.14	0.09	0.22
C.V. %	1.32	2.23	1.91	2.16	3.14	2.35	0.26	0.30	1.50	1.62	1.01	1.08
D												
S.Em.±						0.006						0.06
C.D. at 5%						0.018						0.16
D×E												
S.Em.±						0.003						0.03
C.D. at 5%						0.009						0.09

were stored in the month of February 2014, once the dormancy was released (6).

The seeds of each entry were stored in plastic containers kept in the laboratory under ambient conditions. The samples were drawn for evaluation of various non-germinative parameters at two months interval till the seed germination declined considerably below the Indian Minimum Seed Certification Standard. A number of non-germinative parameters viz., electrical conductivity of seed leachate (7), pH (8), qualitative tetrazolium test (5), quantitative tetrazolium test (9) and membrane permeability (10) were evaluated in the dry seeds stored under ambient storage conditions employing CRD with four repetitions. The data were analyzed as per completely randomized design (11). Relative heterosis expressed as percent increase or decrease over mid parental value of respective parameter was calculated as per the procedure suggested by (12).

RESULTS AND DISCUSSION

Electrical conductivity of seed leachates : Seed ageing is characterized by oxidative degradation of unsaturated lipid fractions, rendering the cellular membranes “leaky” or more permeable. Thus, when imbibed in water, a deteriorated seed lot leaches out more water soluble compounds than a vigorous one. Taking this fact in account, a number of methods were developed to assess seed quality on the basis of solute leakage, in which the amount of sugars electrolytes or amino acids present in the leachates is correlated with seed quality (13). Analysis of

seed leachates for electrolytes in terms of the electrical conductance of the leachate has been by far the most popular (14). The electrical conductivity recorded in the present investigation in different entries of pearl millet as influenced by ageing *i.e.* storage period is presented in Table 1. The differences in the entries, storage period as well as interaction between entries and storage period were significant. The genotypic difference in the electrical conductivity was reported in soybean seed by (15) classified the seed lots based on the electrical conductivity of seed leachate. The increasing storage period in the present investigation resulted in the increase of electrical conductivity of the seed leachate indicating increase in membrane permeability in turn loss in seed vigour. Although, EC test is normally conducted by bulk method (17). (18) developed the adjusted model leakage curves along the time using individual seed to understand the vigour behavior of the soybean cultivar. There are a number of reports elucidating the increase in electrical conductivity of seed leachates with the advancement of the seed ageing (19). A distinct increase in leakage of electrolyte due to ageing in pearl millet seed used in the present investigation encourage to standardized a method to predict field performance in perl millet. The electrical conductivity (EC) and the accelerated ageing (AA) tests are valid to assess seed vigour of pea and soybean, respectively (20). Although these tests are internationally standardized for these two species, they continue to require adjustment of methodology for application to other species, their efficiency in determining seed vigour of other species also needs

Table-2: Qualitative TZ test and membrane permeability of pearl millet entries (four hybrids and their respective parents) after different periods of storage.

Treatment	Feb-14	Apr-14	June-14	Aug-14	Oct-14	Pool ed	Feb-14	Apr-14	June-14	Aug-14	Oct-14	Pool ed	Feb-14	Apr-14	June-14	Aug-14	Oct-14	Pool ed
	Qualitative TZ test						Quantitative TZ test						Membrane permeability (%)					
	93.25	82.25	67.50	61.50	54.25	71.75	0.43	0.41	0.53	0.49	0.41	0.45	32.40	34.98	36.53	37.74	38.84	36.10
GHB 719	93.00	82.75	72.25	63.25	54.25	73.10	0.54	0.44	0.60	0.39	0.31	0.45	33.46	38.12	40.95	42.45	43.32	39.66
95222 A	89.25	77.00	62.75	60.25	53.75	68.60	0.36	0.33	0.36	0.30	0.30	0.33	36.54	36.34	37.05	38.58	39.55	37.61
J 2454	91.00	75.50	69.50	62.75	53.25	70.40	0.50	0.37	0.39	0.40	0.39	0.41	32.35	39.15	39.49	40.82	41.88	38.74
GHB 905	93.75	70.75	64.50	60.50	52.50	68.40	0.48	0.37	0.40	0.31	0.30	0.37	34.04	35.08	31.83	35.19	36.12	34.45
094999 A	92.00	79.25	67.00	63.75	53.75	71.15	0.50	0.40	0.41	0.42	0.41	0.43	34.51	33.40	36.58	33.24	35.33	34.61
GHB 744	93.00	80.75	70.00	65.00	53.50	72.45	0.40	0.41	0.48	0.39	0.30	0.40	34.85	37.55	39.69	39.18	39.32	38.12
98444 A	86.00	76.75	64.00	57.25	51.00	67.00	0.32	0.26	0.24	0.21	0.20	0.25	33.12	34.48	36.52	38.24	39.32	36.34
J 2340	96.25	83.25	71.50	67.25	54.50	74.55	0.54	0.58	0.55	0.51	0.50	0.54	37.44	36.80	39.39	40.37	41.20	39.04
GHB 732	93.50	82.75	69.50	65.25	53.50	72.90	0.31	0.30	0.30	0.31	0.30	0.30	32.66	34.55	36.26	39.10	39.86	36.49
96222 A	92.10	79.10	67.85	62.68	53.43		0.44	0.39	0.43	0.37	0.34		34.14	36.04	37.43	38.49	39.47	
Mean	1.28	0.81	1.03	1.01	1.01	0.88	0.003	0.014	0.023	0.002	0.002	0.020	0.59	0.63	0.74	0.81	0.81	0.70
S.Em.±	3.71	2.34	2.96	2.93	NS	2.54	0.009	0.042	0.066	0.006	0.002	0.058	1.72	1.82	2.14	2.34	2.64	2.01
C.D. at 5 %	2.79	2.05	3.03	3.23	2.89	2.81	1.35	7.47	10.78	1.07	0.35	6.24	3.48	3.50	3.95	4.22	4.63	4.03
C.V. %																		
D																		
S.Em.±						0.63						0.01						0.50
C.D. at 5 %						1.79						0.04						1.42
DxE																		
S.Em.±						1.00						0.01						0.75
C.D. at 5 %						2.80						0.03						2.09

additional research (21). (22) reported that the effect of aging on EC was more pronounced in the small than large and medium seed. In pearl millet, being a small seed, electrical conductivity of seed leachate can serve as a very good criterion of seed vigour prediction and in turn, field performance. Negative heterosis is desirable in electrical conductivity of seed leachates. Although, all the hybrids displayed negative heterosis in electrical conductivity, significance was exhibited only in GHB 744 (Table-3).

pH of seed leachates : The pH in seed leachates as influenced by entries and storage period are presented in Table-1. The differences among the entries and storage period were significant along with interaction. The pH of seed exudates was recommended as a rapid physiological quality test by (23). In the current investigation, though differences among storage periods were significant only because of higher pH values observed up to Feb-2014 as compared to subsequent storage periods, which did not differ significantly at all. In the present investigation, the evaluation was based on seed as a bulk and not the individual seed. (8) reported that individual seed exudates performed better than the bulk seed exudates. Even heterosis did not show a common trend in the hybrids. GHB 719 recorded positive heterosis, GHB 905 and GHB 744 recorded significant negative heterosis, while GHB 732 did not record any heterosis and strictly followed the mid parent (Table-3).

Qualitative TZ test (% stained seeds) : Qualitative tetrazolium test refers to spectrum of colour development or topography of colour developed by 2, 3, 5 triphenyl tetrazolium chloride reduction into formazan in the individual seed. The qualitative tetrazolium (TZ) test requires highly skilled assessment of the individual seed to predict its vigour and viability. Kittock and Law (1968) were first to find relationship of seedling vigour to respiration and tetrazolium chloride reduction by the germinating wheat seeds. Although Lakon (1942) already demonstrated the reduction of 2, 3, 5 triphenyl tetrazolium chloride in to red coloured formazan by the activity of dehydrogenases present in the living cells. Moore (1985) edited the hand book on tetrazolium testing for International Seed Testing Association (ISTA). In the present

Table-3 : Mid-parental heterosis (%) for various non-germinative parameters of four pearl millet hybrids after different periods of storage.

Hybrids	Date of sampling									
	Feb-14	Apr-14	June-14	Aug-14	Oct-14	Feb-14	Apr-14	June-14	Aug-14	Oct-14
	Electrical conductivity (mS/cm/g)					pH				
GHB 719	-31.75	-33.42	-27.14	-21.77	-17.23	2.32*	0.41	0.25	11.21**	11.09**
GHB 905	-20.04	-33.94	-36.66*	-34.72*	-33.71	-1.8	-2.73**	-6.82**	-4.7**	-2.71**
GHB 744	-47.29	-47.75*	-47.65*	-47.13*	-46.64*	-1.64	-3.87**	-4.2**	-4.54**	-4.45**
GHB 732	-25.13	-14.94	-4.9	-1.38	-1.41	-1.63	0.68	0.87	0.92	0.94
S.Em. $\pm$	0.06	0.09	0.11	0.06	0.09	0.06	0.06	0.12	0.14	0.14
Calculated 't' value										
GHB 719	1.23	1.60	1.38	1.16	0.93	2.45	0.41	0.24	11.12	10.98
GHB 905	0.81	1.74	2.06	1.98	1.94	1.90	2.74	6.82	4.67	2.69
GHB 744	1.96	2.08	2.17	2.23	2.25	1.80	3.69	4.00	4.31	4.20
GHB 732	1.01	0.65	0.23	0.07	0.07	1.80	0.65	0.84	0.88	0.90
	Feb-14	Apr-14	June-14	Aug-14	Oct-14	Feb-14	Apr-14	June-14	Aug-14	Oct-14
	Qualitative TZ test					Quantitative TZ test				
GHB 719	2.33**	2.97**	0.00	-0.4	0.46	-3.41	-60.00**	11.87	41.35*	35.87
GHB 905	-0.55	2.20*	9.23**	3.93**	0.24	19.30	0.00	3.54	29.98	33.28
GHB 744	2.79**	0.63	0.00	4.29**	2.87*	37.84*	-20**	15.08	38.92	63.32**
GHB 732	7.24**	4.39**	7.12**	9.80**	4.31**	71.77**	0.00	103.4**	98.34**	101.83**
S.Em. $\pm$	0.69	0.55	0.62	0.62	0.62	0.06	0.06	0.09	0.00	0.00
Calculated 't' value										
GHB 719	3.07	3.43	0.00	0.36	0.36	0.25	6.12	0.92	2.34	1.77
GHB 905	0.72	2.35	8.48	3.43	0.18	1.32	0.00	0.22	1.50	1.61
GHB 744	3.61	0.72	0.00	3.79	2.17	2.23	6.12	0.88	1.91	2.59
GHB 732	9.38	5.05	6.86	8.66	3.25	3.69	0.00	4.59	4.12	4.09
	Feb-14	Apr-14	June-14	Aug-14	Oct-14					
Membrane permeability (%)										
GHB 719	-7.43**	-6.05**	-6.33**	-6.85**	-6.27**					
GHB 905	-8.33**	9.65**	14.66**	10.67**	10.71**					
GHB 744	1.53	-7.27**	-4**	-14.14**	-10.14**					
GHB 732	13.85**	6.61**	8.25**	4.38**	4.08**					
S.Em. $\pm$	0.47	0.49	0.53	0.55	0.55					
Calculated 't' value										
GHB 719	5.53	4.79	5.25	5.90	5.52					
GHB 905	6.25	7.33	10.73	8.37	8.62					
GHB 744	1.11	5.57	3.24	11.64	8.48					
GHB 732	9.68	4.85	6.38	3.60	3.43					

*Heterotic value significant at 5% levels of significance (Table 't' value = 2.04),

**Heterotic value significant at 1% levels of significance (Table 't' value = 2.75)

investigation, qualitative TZ test depicting per cent stained seeds revealed significant differences due to entries, storage period and interaction effects (Table-2). Looking to individual storage period i.e. Oct-2014, the end of the experiment, the differences among the entries were not significant and the seeds almost reached deterioration to the level of 52-54 per cent. Even with the advancement of storage period and ageing of the pearl millet seed, there was a consistent decline in the percentage of seed stained by the tetrazolium. Hence, it clearly appeared that qualitative tetrazolium (TZ) test can certainly serve as a good prediction criterion of vigour, viability and ultimately

the field performance of a seed lot in pearl millet. Literature documents the availability of procedures to estimate seed viability and vigour by the tetrazolium test in maize (24), garden bean (25), peanut (26), pumpkin (27) and tomato (28). GHB 732 registered significant positive heterosis throughout, while other hybrids also recorded significant positive heterosis at a number of storage intervals (Table 3). The pattern of heterosis also closely resembled that obtained in field emergence.

Quantitative TZ test (Absorbance) : Quantitative tetrazolium test of the physiological quality of the seed

refers to bulk seed mass instead of individual seed though the basic procedure of the test is similar to that of qualitative tetrazolium test, but for the sake of taking observation individual seeds are not considered, but the total seeds utilized for the purpose are exposed to methyl cellosolve and the formazan colour eluted as a whole is used for recording the optical density. The colour intensity represented the sum total of the viability and vigour level of the seed lot. The quantitative tetrazolium test of seed vigour was first developed by (9). In the present investigation, the entries as well as the period of storage differed significantly of which the later showed more or less decreasing trend (Table-2). Quantitative tetrazolium test has an advantage over qualitative tetrazolium test in the sense that it is neither cumbersome nor arbitrary because in qualitative TZ test, an arbitrary evaluation of colour development in the individual seed is to be performed which is very cumbersome and required great skill and experience. So far as heterosis is concerned, only GHB 732 registered a significant positive heterosis. In other hybrids, sometimes it was negative and sometimes no heterosis (Table-3).

Membrane permeability (%) : Membrane permeability presented here is a relative term and expressed as the solute leached out in comparison to total amount of solute present (13). The data on percentage of solute leached out representing the membrane permeability are presented in Table-2. The entries as well as storage period differed significantly along with the interaction between them. There was an increase in the membrane permeability with the advancement of ageing. The results are corroborated with the report of (29). Heterosis in membrane permeability showed mixed trends. That means some hybrids had greater values of permeability than their respective parents while other had lower values (Table-3). The hybrid GHB 732 and GHB 905 mostly recorded the significant positive heterosis in membrane permeability as influenced by ageing which is not desirable, while hybrids GHB 719 and GHB 744 mostly recorded significant negative heterosis which is desirable.

CONCLUSION

Non-germinative parameters also differed significantly due to entries, but with increasing storage time i.e. ageing of the seed, the expression of various non-germinative parameters varied. Electrical conductivity of seed leachate and membrane permeability registered an increase with the storage time and loss of vigour and viability, but contrary to this qualitative and quantitative tetrazolium test showed a decline with increasing storage period and loss in vigour and viability. pH of the seed leachate, however, could not show any distinct trend with respect to storage period.

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PERFORMANCE OF WHEAT (*Triticum aestivum* L.) UNDER DIFFERENT CROP ESTABLISHMENT METHOD AND IRRIGATION SCHEDULE

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ABSTRACT

A field experiment was conducted during the winter season of 2003-04 and 2004-05 to find out the effect of crop establishment method and irrigation schedule on yield of wheat and its economics. All the yield attributes increased significantly due to bed planting as compared to conventional (drill) and zero tillage method of crop establishment. Highest grain and straw yield and net monetary return were recorded under bed planting of wheat alongwith 5 cm irrigation at 1.0 IW: CPE. While, benefit cost ratio was recorded highest in rota till drill with 5 cm irrigation at 1.0 IW:CPE. Among different irrigation schedule, 5 cm irrigation 1.0 IW:CPE was found to be best in respect of yield and yield attributing characters.

Key words : Bed planting, Irrigation schedule, rota till drill, test weight, zero tillage.

Wheat (*Triticum aestivum* L.) is a prime cereal crop and traditionally believed to require fine tilth for good yields. Existing farmers practices for wheat are multiple tillage operations with various implements, especially after harvest of rice spending a huge amount of energy and time and increases the cost of production. In order to compete in international market and also to stabilize the support price, cost of production to be reduced. Due to single tractor pass sowing, zero and rotary tillage reduce the cost of land preparation (1). The technologies developed, tested and validated are zero tillage, bed planting and rotary tillage technology that sow the crop in single pass, maintain the optimum plant population and save the cost of production. It is also well known fact that water management is one of the major factors responsible for achieving better harvest in crop production. Judicious use of water is of paramount importance because it is a precious and scarce input during winter and its excess or deficit amount is harmful for growth. Therefore, present study was carried out to determine the effect of crop establishment method and irrigation schedule on yield, yield attributes and economics of wheat crop.

MATERIALS AND METHODS

A field experiment was conducted during winter season of two consecutive years to study the Performance of wheat under different crop establishment methods and irrigation scheduling at the farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, U.P. located at 26° 47'-N latitude and 82° 12'-E longitude and an altitude of 113 meter above mean sea level. The soil was silt loam with pH 8.2, organic carbon 0.39 %, available N 169.8 kg/ha, P₂O₅ 14.9 kg/ ha and K₂O 258.4 kg/ha before starting the experiment. The experiment was laid out in strip plot design comprising 4 crop establishment method viz. sowing of wheat by zero tillage machine (M₁),

sowing of wheat by rota till drill (M₂), bed planting (M₃) and conventional drill (M₄) and three irrigation schedule viz., 4 cm irrigation at 0.8 IW : CPE (I₁), 5 cm irrigation at 1.0 IW:CPE (I₂) and 6 cm irrigation at 1.2 IW : CPE (I₃). Wheat variety UP 2425 was sown @ 125 kg/ha seed on second to third week of December during both the years. Irrigation treatments (table-1) were imposed after common irrigation applied at crown root initiation stage. The total seasonal rainfall was 49.2 mm. Recommended dose of fertilizer was used i.e. 120: 60: 60 kg/ha N, P and K. Half of N and full P and K were applied in the form of urea, single super phosphate and murate of potash as basal dose at time of sowing. Remaining nitrogen was applied at tillering after first irrigation. The mean meteorological data were recorded during the cropping period. The crop was raised using recommended cultural practices during both the years.

RESULTS AND DISCUSSION

Yield attributes : Bed planting method of crop establishment was recorded the maximum number of spike, spike length and grains/spike which were at par with rota till drill method of crop establishment but significantly higher over conventional drill and zero tillage except the number of spike (Table-2) during both years. The test weight recorded under different crop establishment was non significant. Higher values of all the yield attributes was recorded under bed planting might be due to favourable vegetative growth and development because it received adequate moisture and nutrient during entire period of growth. As under bed planting number of shoots, plant height, LAI and dry matter accumulation was higher which contributes to highest yield attributes through increased photosynthesis activity of leaves. The results are in close conformity to those of (2). The lower values of all the yield attributes was recorded under zero tillage during both the years because plants were not able to extract moisture

Table-1 : Irrigation details in wheat

Treatment	No. of irrigation	Depth of irrigation (cm)	Total water applied (cm)	Effective rainfall (cm)	Total water received (cm)
First year					
I ₁	CRI+3	4	24	5.66	29.66
I ₂	CRI+3	5	29	5.66	34.66
I ₃	CRI+3	6	36	5.66	39.66
Second year					
I ₁	CRI+3	4	16	4.28	20.28
I ₂	CRI+3	5	19	4.28	20.28
I ₃	CRI+3	6	22	4.28	20.28

Table-2 : Effect of crop establishment method and irrigation schedule on yield and yield attributes of wheat (Pooled mean of 2 seasons)

Treatment	No. of spike/ meter row length	Length of spike (cm)	No. of grains/spi ke	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)
Crop Establishment Method						
M ₁ - Sowing of wheat by zero tillage machine	70.7	11.2	46.9	44.2	34.2	50.8
M ₂ - Sowing of wheat by rota till drill	79.1	12.2	49.6	45.4	37.5	56.2
M ₃ - Bed planting	90.6	12.8	51.2	46.4	39.8	58.4
M ₄ - Conventional drill	75.9	11.7	47.8	44.6	36.2	54.3
SEm ±	1.19	0.21	0.54	0.72	0.75	0.81
CD at 5%	3.8	0.69	1.78	NS	2.46	2.55
Irrigation Schedule						
I ₁ - 4 cm irrigation at 0.8 IW:CPE	72.2	11.0	45.9	44.6	34.1	51.02
I ₂ - 5 cm irrigation at 1.0 IW:CPE	81.3	12.3	49.9	45.2	38.0	55.77
I ₃ - 6 cm irrigation at 1.2 IW:CPE	83.4	12.9	50.5	45.6	38.7	57.985
SEm±	1.16	0.21	0.52	0.55	0.79	1.13
CD at 5%	3.7	0.68	1.64	NS	2.51	3.42

and nutrient from deeper layer due to poor development of root system and lower values of vegetative characters which finally affected the yield of crop (3) reported similar results.

Different irrigation schedule influenced the yield attributes viz., number of spike, grains/spike and spike length significantly (Table-2). The highest values of all the yield attributes obtained under 6 cm irrigation at 1.2 IW : CPE which was at par with 5 cm irrigation at 1.0 IW : CPE during both the years. This might be due to favourable vegetative growth and development obtained under adequate moisture availability. Translocation of photosynthates from source to sink also increased under wettest regime through higher uptake of potassium which led to better yield attributes. The lowest values of yield attributes were recorded under 4 cm irrigation at 0.8 IW : CPE in both years because plants were unable to extract more water and nutrients under moisture deficit condition which resulted in poor growth and yield attributes under the treatment. The results confirm the findings of (4).

Grain and straw Yield : Maximum grain and straw yield were recorded under bed planting method of crop establishment which was significantly higher over conventional and zero tillage sowing method and at par with rota till drill method of crop establishment. Bed planting method of crop establishment was produced 16.4 and 9.9% higher grain yield as compare to zero tillage and conventional sowing method, respectively. Higher dry matter accumulation and higher yield attributes recorded under bed planting might be the reason for higher grain and straw yield. The lowest value of grain and straw yield during both the years was recorded under zero tillage due to poor growth and yield attributes. The results are in close conformity to those of (5, 6).

Increasing levels of irrigation depth increased the grain and straw yield significantly and the highest grain yield and straw yield was recorded under 6 cm irrigation at 1.2 IW : CPE which at par with 5 cm irrigation at 1.0 IW : CPE during both the years. Productivity of a crop is collectively determined by vigour of growth and yield

Table 3 : Effect of crop establishment method and irrigation scheduling on economics of wheat (Pooled mean of 2 seasons)

Treatment combination	Cost of cultivation (x 103 /ha)	Gross return (x 103/ha)	Net return (x 103/ha)	Benefit : Cost ratio
M ₁ I ₁	13.67	25.14	11.46	0.84
M ₁ I ₂	14.52	26.74	12.22	0.85
M ₁ I ₃	15.34	29.01	13.67	0.90
M ₂ I ₁	13.87	27.44	13.57	0.98
M ₂ I ₂	14.72	30.08	15.37	1.05
M ₂ I ₃	15.54	31.36	15.83	1.03
M ₃ I ₁	16.94	28.68	11.74	0.70
M ₃ I ₂	17.78	33.94	16.15	0.91
M ₃ I ₃	18.61	31.37	12.76	0.70
M ₄ I ₁	16.52	26.46	9.94	0.61
M ₄ I ₂	17.37	28.77	11.40	0.66
M ₄ I ₃	18.19	30.56	12.37	0.69

attributes. Better vegetative growth coupled with higher yield attributes resulted in higher grain and straw yield. The driest moisture regime of 4 cm irrigation at 0.8 IW: CPE recorded the lowest grain and straw yield due to poor growth and yield attributing characters. These findings are in agreement with those of (4, 7).

Economics : The maximum cost of cultivation (Rs. 18,605 per ha) was obtained in bed planting method of crop establishment with 6 cm irrigation at 1.2 IW : CPE (Table-3) due to increased additional cost of land preparation and sowing and irrigation cost. The lowest cost of cultivation (Rs. 13,674 per ha) was obtained under zero tillage method of crop establishment with lowest amount of water application as 4 cm irrigation at 0.8 IW: CPE. This might be due to no field preparation charge incurred under zero tillage and low irrigation cost.

Highest net return of Rs. 16,153 per ha was recorded under the treatment combination of bed planting method of crop establishment and irrigated with 5 cm irrigation at 1.0 IW : CPE. This might be due to fact that

higher grains and straw yield were recorded under this treatment. However, higher benefit cost ratio (1.05) under the rota till drill method of crop establishment with 5 cm irrigation at 1.0 IW : CPE and followed by M₂I₃ and M₂I₁. This was due to higher increase in output in comparison to input.

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EVALUATION OF SUMMER GREENGRAM (*Vigna radiata* L.) FOR THEIR ECONOMIC FEASIBILITY, YIELD AND NUTRIENT CONTENT

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ABSTRACT

A field experiment was conducted during 2010 at the student instructional farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) India to study summer greengram for their economic feasibility, nutrient content and soil fertility. The twelve treatments were laid out in randomized block design with three replications. The application of 60 kg P₂O₅/ha with VAM was more effective in increasing all the yield characters like pods plant⁻¹, test weight, seeds/pod, test weight, grain and straw yield, protein content, nitrogen and phosphorus uptake and content in seed and stover were increased significantly with 60 kg P₂O₅/ha with VAM and which was statistically at par with 60 kg P₂O₅/ha with PSB and significantly superior with uninoculated biofertilizers. With regards to production economics 60 kg P₂O₅/ha with VAM recording maximum net return and benefit cost ratio proved to be more remunerative and economical.

Keywords : Economics, nutrient accumulation, nutrient availability, summer greengram.

Mungbean (*Vigna radiata* L.) is commonly known as greengram and is an important conventional pulse crop in India. It has an edge over other pulses because of high nutritive value, digestibility and non-flatulent behavior. Mungbean being a leguminous crop, its productivity can be increased with the application of phosphorus, which enhances the nitrogen nutrition of the crop through symbiotic fixation of atmospheric nitrogen. Mungbean has established itself as a highly valuable short duration grain legume crop having many desirable characteristics like wider adaptability low input requirement and ability to improve the soil fertility by fixing atmospheric nitrogen with the help of symbiotic bacteria present in root nodules. Phosphorus plays an important role in the nutrition of legumes and improves biological nitrogen fixation. Phosphorus fix more nitrogen through increased number of nodules but the protein content and seed yield of various pulse crops also increased to considerable extent. (1) concluded that application of 60 kg P₂O₅/ha to mungbean gave seed yield of 31.3 % higher as compared to control. Biofertilizers are low cost and ecofriendly inputs have tremendous potential of supplying nutrients, which can reduce the chemical fertilizer dose by 25–50 % (2). Vesicular Arbuscular Mycorrhiza (VAM) increases phosphorus uptake by the plant. The combination of VAM fungi and phosphate greatly increases the nodulation and nitrogen fixation rate in addition to phosphorus uptake and growth. Phosphorus Solubilizing Bacteria (PSB) are known to have the ability to solubilize and transfer inorganic sources through secretion of various organic acids and other means (3) reported that the practice of seed inoculation with PSB showed a significant increase in seed yield and its attributes.

MATERIALS AND METHODS

The field experiment was conducted during summer season 2010 at Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) India. The twelve treatments comprised four levels of phosphorus i.e. 0, 20, 40, and 60 kg ha⁻¹ in combination with biofertilizers viz. PSB and VAM along with control was evaluated in randomized block design (RBD), replicated three times. The variety Narendra Mung-1 (NDM-1) was taken as the test crop under study. The recommended dose of nitrogen and phosphorus were applied as per treatment in the plot basis before sowing. Biofertilizers were applied through seed inoculation just prior to sowing. Seed treatment was done by PSB (premium phosphofix) @ 500 ml/acre thereafter; the seeds were sown in the plot of (2.40 m × 3.0 m) for each treatment. VAM fungi were used as soil inoculants at the time of seed sowing. Soil based VAM spores was tablet form with the species of (glomus intraradices) and then were applied 1 tablet plant⁻¹ just sowing of the crop. Greengram was sown during april 2010 using seed rate of 25 kg/ha. Row to row distance was kept at 30 cm and plant to plant distance was 10 cm with the depth of sowing 4-5 cm. Mungbean was harvested at 65 days after sowing. Observations on yield, nutrient content, and uptake were recorded economics of different treatments were calculated.

RESULTS AND DISCUSSION

Yield : Yield contributing traits like number of pod/plant, number of seed/pod and test weight showed significant increase with the application of 60 kg P₂O₅/ha with VAM over un-inoculated and was at par with 60 kg P₂O₅/ha with PSB (Table-1). This increase might be due to well-developed root

Table-1: Effect of biofertilizers and phosphorus levels on yield parameters and yield of greengram.

Treatments		Yield attributes		Yield (q/ha)		Net return (/ha)	Benefit cost ratio
	Pods/plant	Seeds/pod	Test weight (g)	Seed	Stover		
Phosphorus levels (Kg/ha)							
0	22.47	7.49	34.66	10.52	29.04	23220.1	1.46
20	24.64	8.04	35.41	11.89	29.59	27496.9	1.62
40	26.64	8.69	36.77	13.17	32.05	31879.5	1.76
60	27.58	9.29	37.59	13.73	34.05	33886.7	1.77
SEm ±	0.19	0.10	0.18	0.08	0.14	-	-
CD (0.05)	0.56	0.30	0.53	0.23	0.41	-	-
Biofertilizes							
Control	24.12	7.88	34.52	11.81	30.15	27281.7	1.68
PSB	25.72	8.45	36.56	12.46	31.47	35082.8	1.81
VAM	26.17	8.80	37.25	12.72	31.94	35643.7	1.83
SEm ±	0.16	0.08	0.15	0.07	0.12	-	-
CD (0.05)	0.48	0.26	0.46	0.20	0.35	-	-

Table-2: Effect of biofertilizers and phosphorus levels on nutrient content, uptake and quality of greengram.

Treatments	N content (%)		P content (%)		N uptake (kg/ha)		P uptake (kg/ha)		Protein content in seed (%)
	Seed	Stover	Seed	Stover	Seed	Stover	Seed	Sover	
Phosphorus levels (Kg/ha)									
0	3.48	1.41	0.41	0.19	36.63	40.92	4.34	5.44	21.73
20	3.50	1.43	0.43	0.21	41.64	42.30	5.14	6.14	21.85
40	3.52	1.45	0.45	0.23	46.38	46.40	5.95	7.27	21.98
60	3.54	1.48	0.48	0.26	48.66	50.33	6.60	8.75	22.15
SEm ±	0.01	0.01	0.01	0.01	0.34	0.40	0.04	0.05	0.11
CD (0.05)	0.05	0.03	NS	NS	1.02	1.18	0.13	0.17	0.33
Biofertilizers									
Control	3.31	1.34	0.37	0.19	39.15	40.54	4.43	5.86	20.70
PSB	3.57	1.46	0.46	0.22	44.49	46.07	5.79	7.05	22.31
VAM	3.64	1.51	0.49	0.24	46.35	48.35	6.29	7.79	22.77
SEm ±	0.01	0.01	0.01	0.01	0.30	0.34	0.03	0.05	0.09
CD (0.05)	0.04	0.02	NS	NS	0.88	1.02	0.11	0.15	0.28

system, water use efficiency and increased nitrogen fixation and availability of other nutrient in adequate quantity (4).

Such increases in yield attributing characters might be due to the fact that VAM inoculation increased the root nodulation through better root development and more nutrient availability, resulting in vigorous plant growth and dry matter production which resulted in better flowering, fruiting and pod formation and ultimately there was beneficial effect on seed yield (5). According to (6) biofertilizers *i.e.* VAM increased the test weight over the untreated control.

Inoculation of seed with single or dual biofertilizers brought a significant improvement in seed and stover yield of mungbean over control (Table-2). The effect of VAM and PSB might have increased the yield due to increased nitrogenase activity and available phosphorus status of soil (7). The increase in number of pods/plant, Seeds/pod

and test weight due to fertilization might have increased seed yield could be attributed to the increased vegetative growth possibly a result of effective utilization of nutrients absorbed through extensive root system developed under phosphate fertilization (8).

Nutrient Content, Uptake and Quality : Seed inoculation with 60 kg P_2O_5 /ha with VAM significantly enhanced the Nitrogen and Phosphorus contents and their uptake by seed and stover and protein content in seed over control (Table-2). The combined inoculation of 60 kg P_2O_5 /ha + VAM was more beneficial in enhancing Nitrogen and Phosphorus contents due to more nitrogen fixation by VAM and solubilizing native phosphorus by PSB and thus making the nutrients available to plants. The uptake of Nitrogen and Phosphorus might have increased content and biological yield with the use of biofertilizers, similar findings were reported by (9). Another reason for higher nitrogen content might be due

to increased activity of nitrate reductase in synthesis of protein in seeds because it is a primary component of amino acids which are the building blocks of protein molecules (10). Since uptake of nutrient is a function of their content and yield along with higher content of nitrogen and phosphorus might have resulted in higher uptake of these nutrients in the crop (11). The maximum protein content was recorded with the inoculation VAM that was significantly superior over un-inoculated and at par with PSB. This might be fact that the adequate supply of phosphorus accelerated the synthesis of nitrogen also reported by (10).

Economics : Among the different treatments 60 kg P_2O_5 /ha with VAM recorded highest value of net profit (35643.7/ha) and benefit cost ratio (1.83/rupee invested) followed by 60 kg P_2O_5 /ha with PSB (35082.8/ha and 1.81) and significantly superior with uninoculated treatment. These results are in conformity with those observed by Kumpawat (2006) who reported increased benefit cost ratio and net income with increasing levels of phosphorus.

CONCLUSION

On the basis of above cited discussion, it can be documented that the combination of 60 Kg P_2O_5 /ha with VAM increased the yield, uptake and nutrients of greengram crop over all the treatments and also proved to be economical for obtaining the maximum amount. Thus, recommendation of 60 kg P_2O_5 /ha along with VAM may be suggest for the higher yield and profitability of farmers to cultivate greengram in summer season.

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HETEROBELTIOSIS AND STANDARD HETEROSIS FOR YIELD AND YIELD CONTRIBUTING TRAITS IN BREAD WHEAT (*Triticum aestivum* L.)

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ABSTRACT

A line x tester analysis was conducted in bread wheat to estimate the magnitude of heterobeltiosis and standard heterosis for grain yield and its twelve yield components. 32 F_1 hybrids were derived from crosses between eight female lines and four testers using line x tester mating design and these F_1 s along with 12 parents and 1 commercial check (GW 11) varieties were evaluated during Rabi 2014-15 using Randomized Block Design. Highly significant differences were observed among the genotypes for all the traits studied. The cross VW 20106 x GW 366 was recognized as the best heterotic cross for grain yield as it exhibited highly significant positive heterosis over the better parent and standard check for grain yield followed by Raj 4238 x GW 366 and VW 20106 x LOK 1. The present study reveals good scope for isolation of pure lines from the progenies of heterotic F_1 s as well as commercial exploitation of heterosis in bread wheat. The highest heterotic genotypes can be exploited in future breeding programs to attain self-sufficiency in food grains. However, comprehensive field evaluation over locations and years is advocated for the crosses having significant heterosis before their commercial exploitation.

Key words : Heterobeltiosis, heterosis, yield contributing traits, bred wheat.

Being a staple food, an increase in wheat production is very much desirable to feed the world population at large and in India in particular. India accounts an area, production and a productivity of 29.9 million hectares, 93.9 million metric tonnes and 3140 kg/ha, respectively (1). Globally, demand for wheat by the year 2020 is forecast at around 950 million tonnes per year. This target will be achieved only, if global wheat production is increased by 2.5% per annum. The option for increasing wheat production by expanding area under its cultivation has already been exploited to almost to its maximum and therefore increase per unit area production through genetic improvement of wheat plant is greatly needed. The use of heterosis for getting high yield with improved quality has been largely used in cross-pollinated crops. Term heterosis was coined by (2), who defined it as the development stimulus resulting from the union of different gametes and hybrid vigour as “the manifestation of heterosis”. In self-pollinated crops evidences are available to confirm the potential use of heterosis (3), suggesting the easiest ways of the possibility of commercial exploitation of genetic potential in wheat crop. Keeping in view the general rule of breeding and the necessity of finding out superior heterotic crosses, we, therefore conducted this study with the objective of estimating the extent of heterosis in various wheat crosses obtained through line x tester mating scheme.

MATERIALS AND METHODS

Thirty two crosses were obtained by crossing 8 lines (females) namely, DL 1012, GW 450, GW 2011-347, HD 2982, HI 1569, J 07-40, RAJ 4238, VW 20106 and 4 testers (males) i.e. GW 273, GW 366, GW 496 and LOK 1 of bread wheat (*Triticum aestivum* L.) were selected on

the basis of their phenotypic variability. The genotypes which were collected from Wheat Research Station, Junagadh Agricultural University, Junagadh. Thus, the Thirty-two crosses along with their 12 parents and one check variety (GW 11) consisted the experimental material for the present study. The experimental material consisting of 45 entries, including 12 parents, one check and 32 crosses were tested in a Randomized Block Design with three replications during Rabi 2014-15. A single row plot of 2.5 meters was allotted randomly to each entry. The row-to-row and plant-to-plant distance were kept 22.5 cm and 10 cm, respectively. All the recommended cultural practices and plant protection measures were followed uniformly to grow healthy crop. The observations were recorded on five randomly selected plants from parents and crosses for twelve characters viz., days to heading, days to maturity, plant height (cm), number of effective tillers per plant, length of main spike (cm), number of spikelets per main spike, grain filling period (days), number of grains per main spike, 100-grain weight (g), grain yield per plant (g), biological yield per plant (g) and harvest index (%).

Estimation of heterosis : Heterosis, expressed as per cent increase or decrease in the performance of F_1 hybrid over the better parent (heterobeltiosis) and check parent (standard heterosis) was computed for each character and was expressed in percentage.

RESULTS AND DISCUSSION

Exploitation of heterosis in cultivated plants is one of the most important accomplishments of the science of genetics in agriculture. Although production of hybrids may be the best to exploit the heterosis in F_1 S but in Indian

Table-1 : Percent heterosis over better parent (H₁) and standard check GW 11 (H₂) for Days to heading days to maturity, Plant height and Number of effective tillers per plant in bread wheat.

Sr. No	Hybrids	Days to heading		Days to maturity		Plant height		No. of effective tillers per plant	
		H ₁	H ₂	H ₁	H ₂	H ₁	H ₂	H ₁	H ₂
1	DL 1012 X GW 273	-6.06**	-1.90	-2.05	1.06	-9.28**	10.81**	16.78	23.70
2	DL 1012 X GW 366	-1.82	2.53	-3.81*	-1.77	4.36	11.38**	7.64	25.19
3	DL 1012 X GW 496	-1.21	3.16	0.71	0.35	-5.47	3.07	9.42	11.85
4	DL 1012 X LOK 1	-0.61	3.80	1.42	1.06	-11.29**	-6.98	10.53	24.44
5	GW 450 X GW 273	7.95**	20.25**	-0.68	2.47	-1.19	20.70**	-13.29	-8.15
6	GW 450 X GW 366	-17.61**	-8.23**	-1.38	0.71	-6.04	0.27	10.83	28.89*
7	GW 450 X GW 496	-2.27	8.86**	-3.56*	-4.24**	-1.06	7.88*	32.61*	35.56**
8	GW 450 X LOK 1	-5.68**	5.06**	1.42	0.71	-7.54*	-2.15	2.63	15.56
9	GW 2011-347 X GW 273	0.00	17.72**	1.32	8.48**	-3.64	17.70**	9.66	17.78
10	GW 2011-347 X GW 366	-0.54	17.09**	-3.96**	2.83	0.59	8.61*	9.87	27.78*
11	GW 2011-347 X GW 496	-6.99**	9.49**	-5.94**	0.71	-5.57	2.96	-5.52	1.48
12	GW 2011-347 X LOK 1	-7.53**	8.86**	-0.66	6.36**	-10.40**	-3.25	32.89**	49.63**
13	HD 2982 X GW 273	-4.71**	2.53	0.34	3.89*	-7.53*	12.95**	4.90	11.11
14	HD 2982 X GW 366	-2.35	5.06**	-1.71	1.77	-1.50	5.12	2.55	19.26
15	HD 2982 X GW 496	-14.12**	-7.59**	0.00	3.53*	1.35	10.50**	-1.45	0.74
16	HD 2982 X LOK 1	-5.29**	-1.90	1.37	4.95**	-1.74	4.00	19.74	34.81**
17	HI 1569 X GW 273	-1.23	-1.90	-4.11**	-1.06	-4.33	16.86**	14.46	40.74**
18	HI 1569 X GW 366	-2.58	-4.43*	-2.77	-0.71	-16.24**	-3.78	18.07	45.19**
19	HI 1569 X GW 496	8.39**	6.33	0.70	1.77	-5.10	9.02*	3.01	26.67*
20	HI 1569 X LOK 1	-3.23	-5.06**	2.80	3.89*	-9.77*	3.66	-16.27	2.96
21	J 07-40 X GW 273	-1.14	10.13**	1.03	4.24**	-7.02*	13.57**	3.50	9.63
22	J 07-40 X GW 366	-11.93**	-1.90	0.69	2.83	3.12	10.05**	2.55	19.26
23	J 07-40 X GW 496	-17.05**	-7.59**	3.53*	3.53*	-1.27	7.65*	17.48	24.44
24	J 07-40 X LOK 1	-12.50**	-2.53	6.36**	6.36**	-3.75	-2.31	22.70	38.15**
25	Raj 4238 X GW 273	-6.75**	-3.80*	0.34	3.53*	-3.85	17.44**	17.01	27.41*
26	Raj 4238 X GW 366	5.81**	3.8 0*	2.42	4.59**	-8.64**	0.18	19.75	39.26**
27	Raj 4238 X GW 496	7.79**	5.06**	-3.89*	-3.89*	3.07	13.02**	20.41	31.11*
28	Raj 4238 X LOK 1	-2.60	-5.06**	4.24**	4.24**	-13.66**	-5.32	40.13**	57.78**
29	VW 20106 X GW 273	8.24**	16.46**	-1.03	2.12	2.80	27.94**	-4.90	0.74
30	VW 20106 X GW 366	-7.06**	0.00	-1.73	0.35	-4.97	18.27**	10.83	28.89*
31	VW 20106 X GW 496	-9.41**	-2.53	-3.21*	-4.24**	-7.33**	15.33**	30.94*	34.81**
32	VW 20106 X LOK 1	-6.47**	0.63	-2.88	-4.59**	-11.61**	10.02**	23.03	38.52**
	SE±	0.89	0.89	1.40	1.40	2.39	2.39	1.17	1.17

*,** Significant at 5% and 1% levels, respectively.

conditions, such attempts have not met with success due to problems of instability of male sterility, pollen fertility, free pollen dispersal and seed setting. It is therefore, necessary to see heterotic combinations in the first filial generation (F₁) in respect of yield and its components. Although production of hybrids may be the best exploitation of heterosis, however desired success has not been met in wheat because of several associated problems such as fertility restoration, pollination and seed setting. However, such heterotic F₁ combinations, which in F₂ and subsequent generations show a considerable

measure of residual heterotic effects, can be exploited to isolate transgressive segregants.

Days to heading : Now a day's development of early and extra early genotypes seems to be a priority to fit the wheat variety in intensive cropping systems and in this context, negative heterotic response for heading is desirable. Negative heterotic response in a cross is generally important for the development of short duration wheat varieties (4). Heterobeltiosis for days to heading ranged from -17.61 per cent (GW 450 x GW 366) to 8.39 per cent (HI 1569 x GW 496) and Standard heterosis ranged from -8.23 per cent (GW 450 x GW 366) to 20.25

Table-2 : Percent heterosis over better parent (H₁) and standard check GW 11 (H₂) for Length of main spike, Number of spikelets per main spike, Grain filling period and Number of grains per main spike in bread wheat.

Sr. No	Hybrids	Days to heading		Days to maturity		Plant height		No. of effective tillers per plant	
		H ₁	H ₂	H ₁	H ₂	H ₁	H ₂	H ₁	H ₂
1	DL 1012 X GW 273	-9.29	4.28	-2.87	1.12	-3.36	-1.71	-21.48**	-12.77
2	DL 1012 X GW 366	-4.31	-0.93	12.11**	7.09	-4.03	1.71	17.88*	0.72
3	DL 1012 X GW 496	-5.90	3.98	9.35*	0.37	-11.76	-10.26	3.69	-11.22
4	DL 1012 X LOK 1	-13.56*	-10.50	1.26	-9.70*	-10.92**	-9.40	-9.50	-22.67**
5	GW 450 X GW 273	20.69**	38.76**	7.89	12.31**	2.65	-0.85	2.04	13.37*
6	GW 450 X GW 366	-2.72	2.57	7.42	2.61	-3.23	2.56	-7.46	-8.23
7	GW 450 X GW 496	1.75	12.43*	5.51	0.00	-7.02**	-9.40**	3.25	2.39
8	GW 450 X LOK 1	-5.30	-0.15	-7.09	-11.94**	-6.42*	-12.82**	17.45**	-18.14**
9	GW 2011-347 X GW 273	-2.81	19.62**	2.87	7.09	-0.84	0.85	5.69	17.42**
10	GW 2011-347 X GW 366	-12.37**	7.86	3.80	1.87	-1.61	4.27	-10.14	-1.67
11	GW 2011-347 X GW 496	-21.96**	-3.95	-13.69**	-15.30**	-5.04*	-3.42	-18.43**	-10.74
12	GW 2011-347 X LOK 1	-9.86*	10.95	-2.28	-4.10	0.00	1.71	-28.57**	-21.84**
13	HD 2982 X GW 273	-20.50**	-8.60	-5.02	-1.12	-5.26*	-7.69**	-4.08	6.56
14	HD 2982 X GW 366	12.18	-2.61	4.69	0.00	-1.61	4.27	7.55	-6.56
15	HD 2982 X GW 496	-1.18	9.20	7.66	-0.37	7.02**	4.27	14.42	-0.60
16	HD 2982 X LOK 1	4.70	-10.35	2.02	-5.60	0.88	-1.71	-1.51	-14.44*
17	HI 1569 X GW 273	-0.36	14.56*	-0.72	3.36	-1.63	3.42	5.05	16.71**
18	HI 1569 X GW 366	-0.33	1.82	2.34	-2.24	5.65*	11.97**	2.34	-11.34
19	HI 1569 X GW 496	10.11*	21.67**	9.76*	0.75	-4.88*	0.00	-5.23	-17.90
20	HI 1569 X LOK 1	-12.32*	-10.42	2.99	-10.07*	-4.07	0.85	-8.26	-20.53**
21	J 07-40 X GW 273	7.80	26.58**	-1.79	2.24	-1.77	5.13*	-3.87	6.80
22	J 07-40 X GW 366	-9.58*	6.18	0.38	-1.49	-5.65	0.00	-0.87	-4.30
23	J 07-40 X GW 496	4.91	23.19**	2.66	0.75	0.88	-1.71	-0.37	-3.82
24	J 07-40 X LOK 1	-11.70*	3.69	-9.13*	-10.82*	1.83	-5.13*	-9.89	-13.01*
25	Raj 4238 X GW 273	-23.32**	-11.84*	-2.51	1.49	1.77	-1.71	4.51	16.11*
26	Raj 4238 X GW 366	11.96	-2.79	0.00	-3.73	-2.42	3.42	17.43*	1.91
27	Raj 4238 X GW 496	-1.99	8.30	0.78	-2.99	2.63	0.00	4.11	-10.86
28	Raj 4238 X LOK 1	6.60	-13.96*	-6.59	-10.07*	4.59	-2.56	4.14	-13.01*
29	VW 20106 X GW 273	-0.99	33.51**	8.71*	16.42**	4.24	5.13*	1.26	24.82**
30	VW 20106 X GW 366	-5.00	28.11**	1.05	8.21	6.45**	12.82**	-6.49	15.27*
31	VW 20106 X GW 496	-2.65	31.27**	2.79	10.07*	-5.63*	-5.13*	-3.87	18.50**
32	VW 20106 X LOK 1	-16.95**	11.99*	-10.45*	-4.10	-7.63**	-6.84**	-20.72**	-2.27
	SE±	0.49	0.49	0.76	0.76	0.98	0.98	3.40	3.40

*,** Significant at 5% and 1% levels, respectively.

per cent GW 450 x GW 273. Perusal of the results reveals that the cross GW 450 x GW 366 (17.61% and -8.23%), respectively showed significant negative heterobeltiosis and standard heterosis for early heading, followed by J 07-40 x GW 496 (-17.05% and -7.59%) and HD 2982 x GW 496 (-14.12% and -7.59%) The importance of negative heterosis for this trait has been highlighted by.

Days to maturity : Heterosis over better parent recorded from -5.94 per cent (GW 2011-347 x GW 496) to 6.36 per cent (J 07-40 x LOK 1). The highest and significant heterobeltiosis in desirable direction was recorded by the cross GW 2011-347 x GW 496 (-5.94%) followed by HI

1569 x GW 273 (-4.11%) and GW 2011-347 x GW 366 (-3.96%). The heterosis over standard check ranged from -4.59 per cent (VW 20106 x LOK 1) to 8.48 per cent (GW 2011-347 x GW 273). The cross VW 20106 x LOK 1 (-4.59%) exhibited the highest heterosis over standard check in desired negative direction. The importance of negative heterosis for this trait has been highlighted by (6).

Plant height (cm) : Short statured cultivars of wheat became much more popular after the commencement of green revolution in 1960s which drew the attention and attempts of plant breeders to breed for reduced plant height. In this regard in our study we identified heterosis

Table-3 : Percent heterosis over better parent (H₁) and standard check GW 11 (H₂) for 100-grain weight, Grain yield per plant, Biological yield per plant and Harvest index in bread wheat.

Sr. No	Hybrids	Days to heading		Days to maturity		Plant height		No. of effective tillers per plant	
		H ₁	H ₂	H ₁	H ₂	H ₁	H ₂	H ₁	H ₂
1	DL 1012 X GW 273	-1.01	-7.13**	-15.21*	-15.30*	-0.61	-0.73	-14.74	-14.68*
2	DL 1012 X GW 366	-5.81**	10.99**	6.45	33.27**	0.71	32.92**	5.74	0.53
3	DL 1012 X GW 496	-9.96**	-7.28**	12.50	-3.96	7.99	9.28	3.08	-12.08
4	DL 1012 X LOK 1	-7.70**	9.02**	7.39	19.67*	-2.50	5.26	9.93	13.72*
5	GW 450 X GW 273	-1.25	-2.18	-22.74**	-22.83**	-7.11	-7.22	0.49	0.56
6	GW 450 X GW 366	-3.83*	13.32**	-2.61	21.93**	-1.92	29.44**	-0.88	-5.76
7	GW 450 X GW 496	-10.53**	-7.86**	12.08	4.32	-0.89	0.29	13.15	-4.47
8	GW 450 X LOK 1	5.98**	25.18**	-21.02**	-11.99	-1.08	6.80	-20.14	-17.39**
9	GW 2011-347 X GW 273	-3.34	-9.32**	-3.31	8.61	-0.11	20.45**	-9.91	-9.84
10	GW 2011-347 X GW 366	-13.03**	2.47	-1.15	23.75**	-1.24	30.35**	2.78	-2.28
11	GW 2011-347 X GW 496	-6.22**	-3.42	-12.14	-1.30	-2.40	17.70**	-10.16	-16.21*
12	GW 2011-347 X LOK 1	-4.19*	13.17**	-8.59	2.69	-3.76	16.06**	-9.99	-6.89
13	HD 2982 X GW 273	-12.49**	-17.90**	0.11	0.00	-5.26	-5.38	5.69	5.77
14	HD 2982 X GW 366	-10.25**	5.75**	3.14	29.13**	-6.17	23.83**	9.94	4.53
15	HD 2982 X GW 496	0.64	3.64	7.30	-8.40	1.99	3.21	-3.76	-11.08
16	HD 2982 X LOK 1	-0.80	17.18**	-4.78	6.10	-3.41	4.27	-1.48	1.91
17	HI 1569 X GW 273	-11.40**	-16.89**	10.85	10.73	5.79	6.31	3.91	3.98
18	HI 1569 X GW 366	-6.98**	9.61**	16.56**	45.93**	-4.73	25.74**	17.62*	11.83
19	HI 1569 X GW 496	-9.47**	-6.77**	7.39	-1.55	12.93*	14.28*	-5.66	-13.91*
20	HI 1569 X LOK 1	-3.76*	13.68**	-11.60	-1.50	-0.87	7.02	-11.20	-8.14
21	J 07-40 X GW 273	-6.25**	4.80*	2.98	2.87	-0.82	-0.94	3.93	4.00
22	J 07-40 X GW 366	2.72	21.03**	8.25	35.52**	-10.04*	18.53**	20.20**	14.28*
23	J 07-40 X GW 496	-1.56	10.04**	10.39	-5.20	4.55	5.80	1.58	-10.57
24	J 07-40 X LOK 1	8.13**	27.73**	-3.08	8.00	0.80	8.83	-4.07	-0.77
25	Raj 4238 X GW 273	-19.23**	-8.30**	-4.91	11.11	5.39	11.27*	-9.83	-0.23
26	Raj 4238 X GW 366	-0.49	17.25**	23.14**	54.16**	-2.94	28.10**	8.87	20.46**
27	Raj 4238 X GW 496	-0.38	13.10**	7.40	25.50**	5.86	11.76*	1.60	12.42
28	Raj 4238 X LOK 1	7.58**	27.07**	14.93*	34.30**	2.81	11.00*	9.34	20.98**
29	VW 20106 X GW 273	10.71**	3.86	-14.13*	7.71	-10.68*	-1.10	-3.78	9.00
30	VW 20106 X GW 366	-5.06**	11.86**	24.55**	56.22**	-2.21	29.06**	6.86	21.05**
31	VW 20106 X GW 496	-1.84	1.09	1.37	27.14**	-0.67	9.98	2.44	16.04*
32	VW 20106 X LOK 1	-5.79**	11.28**	18.92**	49.16**	6.43	17.84**	11.99*	26.86**
	SE±	0.09	0.09	1.37	1.37	2.38	2.38	2.63	2.63

*,** Significant at 5% and 1% levels, respectively

over better parent ranged from -16.24 per cent (HI 1569 x GW 366) to 4.36 per cent (DL 1012 x GW 366). The highest desirable heterobeltiosis was recorded by the cross HI 1569 x GW 366(-16.24%) followed by Raj 4238 x LOK 1 (-13.66%) and VW 20106 x LOK 1 (-11.61%) where as Heterosis over standard check ranged from -6.98 per cent (DL 1012 x LOK 1) to 27.94 per cent (VW 20106 x GW 273) and none of the hybrids exhibited desirable significant negative heterosis over standard check. The importance of negative heterosis for this trait has been highlighted by (5).

Number of effective tillers per plant : For number of effective tillers per plant heterosis over better parent ranged from -16.27 per cent (HI 1569 x LOK 1) to 40.13 per cent (Raj 4238 x LOK 1). The highest significant positive heterosis over better parent was expressed by the hybrid Raj 4238 x LOK 1 (40.13%) followed by GW 2011-347 x LOK 1 (32.89%) and GW 450 x GW 496 (32.61%). Heterosis over standard check ranged from -8.15 per cent (GW 450 x GW 273) to 57.78 per cent (Raj 4238 x LOK 1). The cross Raj 4238 x LOK 1 (57.78%) exhibited the highest significant positive heterosis over standard check

followed by the cross GW 2011-347 x LOK 1 (49.63%) and HI 1569 x GW 366 (45.19%). These crosses may prove to be the best source for tillers number per plant, an important yield contributing traits. The same hybrid may be advanced and utilized for single plant selection. Similar findings were also reported by (7).

Length of main Spike (cm)

Spike length can be considered as one of the most important yield components during selection, which contributes towards productivity. In the present study range of heterosis over better parent was recorded from -23.32 per cent (Raj 4238 x GW 273) to 20.69 per cent (GW 450 x GW 273). The highest desirable heterosis was recorded by the hybrid GW 450 x GW 273 (20.69%) followed by HI 1569 x GW 496 (10.11%). Heterosis over standard check ranged from -13.96 per cent (Raj 4238 x LOK 1) to 38.76 per cent (GW 450 x GW 273). The cross GW 450 x GW 273 (38.76%) expressed the highest, significant positive heterosis over standard check followed by VW 20106 x GW 273 (33.51%) and VW 20106 x GW 496 (31.27%). Similar findings were also reported by (7).

Number of spikelets per main spike

The magnitude of heterosis over better parent ranged from -13.69 per cent (GW 2011-347 x GW 496) to 12.11 per cent (DL 1012 x GW 366). The highest heterobeltiosis was expressed by the cross DL 1012 x GW 366 (12.11%) followed by HI 1569 x GW 496 (9.76%) and DL 1012 x GW 496 (9.35%). Heterosis over standard check ranged from -15.30 per cent (GW 2011-347 x GW 496) to 16.42 per cent (VW 20106 x GW 273). The cross VW 20106 x GW 273 (16.42%) exhibited the highest significant positive heterosis over standard check. Similar findings were also reported by (8).

Grain filling period (Days) : The range of heterosis over better parent for grain filling period was recorded from -11.76 per cent (DL 1012 x GW 496) to 7.02 per cent (HD 2982 x GW 496). The highest desirable heterosis was recorded by the hybrid DL 1012 x GW 496 (-11.76%) followed by DL 1012 x LOK 1 (-10.92%) and VW 20106 x LOK 1 (-7.63%). Heterosis over standard check ranged from -12.82 per cent (GW 450 x LOK 1) to 12.82 per cent (VW 20106 x GW 366). The cross GW 450 x LOK 1 (-12.82%) exhibited the highest desirable significant heterosis over standard check. Similar findings were also reported by (8).

Number of grains per main spike : More number of grains per main spike is directly responsible for high grain yield and hence, their positive values are always beneficial in wheat. The range of heterosis over better parent recorded from -28.57 per cent (GW 2011-347 x LOK 1) to 17.88 per cent (DL 1012 x GW 366). The highest heterosis over better parent in desirable direction was recorded by the cross DL 1012 x GW 366 (17.88%) followed by GW

450 x LOK 1 (17.45%), Raj 4238 x GW 366 (17.43%) and HD 2982 x GW 496 (14.42%). The range of standard heterosis for this trait varied from -22.67 per cent (DL 1012 x LOK 1) to 24.82 per cent (VW 20106 x GW 273). The cross VW 20106 x GW 273 (24.82%) exhibited the highest heterosis over standard check in desired direction. Similar findings were also reported by (6).

100-grain weight (g) : Heterosis over better parent, ranged from -19.23 per cent (Raj 4238 x GW 273) to 10.71 per cent (VW 20106 x GW 273). Out of 32 hybrids, 4 hybrids expressed significant positive heterosis over better parent (Table 4.6). The highest significant and positive desirable heterosis was recorded by the cross VW 20106 x GW 273 (10.71%) followed by J 07-40 x LOK 1 (8.13%) and Raj 4238 x LOK 1 (7.58%). Heterosis over standard check ranged from -17.90 per cent (HD 2982 x GW 273) to 27.73 per cent (J 07-40 x LOK 1). The cross J 07-40 x LOK 1 (27.73%) exhibited the highest significant and positive heterosis over standard check. Similar findings were also reported by (10).

Grain yield per plant (g) : Exploitation of heterosis for increased yield was largely attributed to cross-pollinated crops. Evidences are now available to confirm the presence of heterotic effects in self pollinated crops like wheat (Freeman, 1919). The range of heterosis over better parent was recorded from -22.74 per cent (GW 450 x GW 273) to 24.55 per cent (VW 20106 x GW 366). The cross VW 20106 x GW 366 (24.55%) exhibited the highest desirable heterosis over better parent followed by Raj 4238 x GW 366 (23.14%) and VW 20106 x LOK 1 (18.92%). Heterosis over standard check ranged from -22.83 per cent (GW 450 x GW 273) to 56.22 per cent (VW 20106 x GW 366). The cross VW 20106 x GW 366 (56.22%) exhibited the highest significant heterosis towards positive direction over standard check GW 11 which was followed by Raj 4238 x GW 366 (54.16%), VW 20106 x LOK 1 (49.16%), HI 1569 x GW 366 (45.93%) and J 07-40 x GW 366 (35.52%). Similar findings were also reported by.

Biological yield per plant (g) : For biological yield per plant the range of heterosis over better parent was recorded from -10.68 per cent (VW 20106 x GW 273) to 12.93 per cent (HI 1569 x GW 496). The highest heterobeltiosis was recorded by the hybrid HI 1569 x GW 496 (12.93%) for biological yield per plant. Heterosis over standard check ranged from -7.22 per cent (GW 450 x GW 273) to 32.92 per cent (DL 1012 x GW 366). The cross DL 1012 x GW 366 (32.92%) exhibited the highest significant and positive heterosis over standard check followed by GW 2011-347 x GW 366 (30.35%) and GW 450 x GW 366 (29.44%). Similar findings were also reported by.

Harvest index (%) : In breeding programmes, harvest index is generally estimated for the evaluation of the genotypes as it is one of the important agronomic traits

deciding the yield potential of the cultivar. In our study maximum positive heterosis for harvest index over better parent ranged from -20.14 per cent (GW 450 x LOK 1) to 20.20 per cent (J 07-40 x GW 366). The highest significant and desirable heterosis over better parent was recorded by the cross J 07-40 x GW 366 (20.20%) followed by HI 1569 x GW 366 (17.62%) and VW 20106 x LOK 1 (11.99%). Heterosis over standard check ranged from -17.39 per cent (GW 450 x LOK 1) to 26.86 per cent (VW 20106 x LOK 1). The cross VW 20106 x LOK 1 (26.86%) exhibited the highest significant and positive heterosis over standard check for harvest index followed by VW 20106 x GW 366 (21.05%) and Raj 4238 x LOK 1 (20.98%). Similar findings were also reported by.

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IMPACT ANALYSIS OF FRONT LINE DEMONSTRATIONS ON MUSTARD IN TRIBAL AREA OF M.P.

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ABSTRACT

The study was carried out during Rabi season in three tribal districts; Jhabua, Dhar and Badwani, of Madhya Pradesh during the year 2013-14 under TSP project in collaboration with DRMR (ICAR) Bharatpur with the objective of introducing improved and hybrid varieties and applying scientific package of practices in covering 40 hectare area. The improved technologies consisted use of new variety, seed treatment with PSB culture, balanced fertilizer application on the basis of soil test value and pest management. The productivity and economic performance of Mustard in improved technologies were calculated and compared with the corresponding farmer's practices as local checks. The result showed that mustard cultivar Bharat Sarso (NRCHB-101) gave average increase of 38.13% in yield over local variety and agronomic practices with an average B : C ratio of 2.52. The crop recorded higher gross returns, net return and benefit cost ratio in improved technologies as compared to the plots where farmers were using traditional practices of cultivation. It is suggested that location-specific integrated approaches would be needed to bridge the productivity gap of the crop grown in the districts.

Key words : *Technology gaps, technology index, improved technologies, economics.*

Madhya Pradesh, with its large area, enjoys diverse climatic and soil conditions suitable for a broad range of agricultural products. Agriculture sector in Madhya Pradesh forms the backbone of its economy. It contributes almost one-fourth of the Gross State Domestic Product (GSDP) and is the main source of employment for over 70 percent of the population and constitutes about 60- 75 percent of the rural income. In the agriculture sector as a whole, progress has been impressive. Through irrigation facilities, improved technologies and farm-practices, the state has achieved a growth rate of 18.96% during 2011-12 with efficient utilization of rain-fed areas. Production of cereals went up by 43%, of pulses by 54% and of cotton by 10%, oilseeds production grew up by 143% (from 2.24 million tonnes to 5.45 million tonnes). The state is also a major producer of Linseed, Mustard, Sunflower, Safflower and Niger. Agro-climatic diversity and topographical variations enable the state to grow a wide range of cereals, pulses, oilseeds and cash crops, besides being home to myriad varieties of plant species, both in forest areas and outside. The western Madhya Pradesh region in which the Bhil adivasis reside stretches across the seven districts of Jhabua, Dhar, Badwani, West Nimar, East Nimar, Dewas, Indore and Ratlam. There is no perennial source of surface water and ground water table is very low. Most of the land in the district is rocky. Because of lack of irrigation facilities, most of the farmers are able to raise only one crop. The major crops in the district include maize, rice, wheat, oilseeds and cotton. Most of the farmers own small land holdings. Decreasing margins in agriculture sector is forcing many farmers to join wage labour. After raising rain crop, many people migrate to other States between October and June. Large scale seasonal migration is affecting education of children

and because of this the district is educationally very backward. Migration of tribal's is not for any benefit, but a tool of poor for saving himself.

Interventions in the agriculture sector emanate from the noted fact over the years that though per unit agricultural yield are increasing; soil health is going down because of excessive use of chemical fertilizers in agricultural operations. Also, reliance over chemical fertilizers is increasingly making agriculture an unviable proposition. A way out to counter this is to use organic manures in place of chemical fertilizers. Training is being imparted to residents of villages and hamlets for organic manure production so as to decrease dependence on chemical fertilizers, maintain soil fertility and moisture, conserve environment and increase nutritive value of the crops. As a result of these training and also as a result of awareness drives on the benefits of organic manures, many farmers are switching over to them. There is very less ingenuity, innovation and adaptability to market as far as the selection of crop is concerned. The reasons are related to knowledge management, lack of extension services and lack of infrastructure (water, markets, etc).

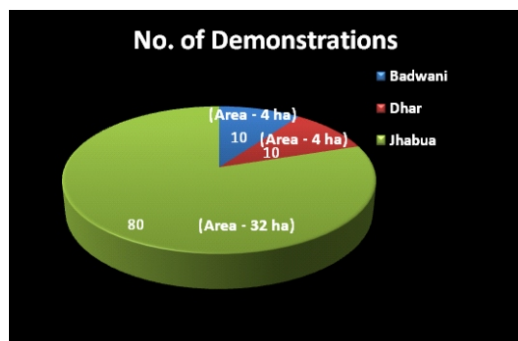
After 25 years of independence, and successful completion of four five year and three annual plan, it was realized by policy makers that the Scheduled Tribes are still way behind the mainstream development process. Apart from this, it was also been realized that the general plan schemes and programmes designed for the overall development of the economy hardly improved their socio-economic status. Similarly, the benefit of such general welfare schemes did not percolate down towards the development of STs Population of the country in any

Crop Name	Indian Rapeseed and Mustard (Yellow Sarson)
Variety Name	NRCHB 101
Average Yield	35-45 X 15
Maturity	Medium
Characteristics	Recommended for release and cultivation in the States of Rajasthan, Madhya Pradesh and Uttar Pradesh under irrigated late sown conditions. Medium maturity 135 days. Tolerance to rust. Higher oil content. (a) Plant height: 170-200 cm (b) Distinguishing morphological Characters: Growth habit: Semi prostrate, Medium plant height; - Leaf characters: - Simple or compound: Simple; - Shape of the pinnae: Elliptical; - Colour: Green; - Pubescent/Glabrous: Pubescent; - Stem colour: Green; - Flower colour: Yellow; - Siliqua: Long; - Seed: Brown in colour, medium size seeds, 1000, - Agronomic traits: Seeds weight 4.7 g;

Table-1 : Critical Input Used in the demonstration.

Name of KVK	Input distributed				
	Seed (Kg)	12:32:16 (Kg)	PSB (kg)	Fungicide (g)	Insecticide (lit)
Badwani	20	500	2.0	50	1.0
Dhar	20	500	2.0	50	1.0
Jhabua	160	4000	16.0	400	8.0
Total	200	5000	20.0	500	10.0

Vitavax, PSB, NPK 12:32:16+Betonite S, Carbendazim, Trizophos, Imidachloprid 17.8 SL (100 ml)



significant manner. In order to eradicate these issues, the Tribal Sub-Plan was initiated during Fifth Five Year Plan) for socioeconomic amelioration of the tribal communities. Tribal Sub Plan (TSP) is a programme funded by Government of India to uplift the economic condition of tribal farmers.

RESEARCH METHODOLOGY

The study was carried out in three tribal districts; Jhabua, Dhar and Badwani, of Madhya Pradesh during the year 2013-14 under TSP project in collaboration with DRMR (ICAR) Bharatpur with the objective of introducing improved and hybrid varieties and applying scientific package of practices in covering 40 hectare area. The improved technologies consisted use of new variety, seed treatment with PSB culture, balanced fertilizer application on the basis of soil test value and pest management. The productivity and economic performance of Mustard in improved technologies were calculated and compared with the corresponding farmer's practices as local checks.

Mustard is an annual herb cultivated as oil seed crop or as vegetable or as fodder, of which, 3 species are known for its condiment value. They are pale yellow or

white mustard (*Brassica hirta*), brown mustard (*Brassica juncea*) and black mustard (*Brassica nigra*). The leaves of the plant are alternate, long, bristly branched, petiolate, hairy on both sides. Flowers are small, yellow with 4 petals, cruciform. Seeds are 1.5-3mm. Mustard prefers loamy or clayey loam soil. It is grown as rabbi crop in North India. It is raised during rainy season from July to November in South India.

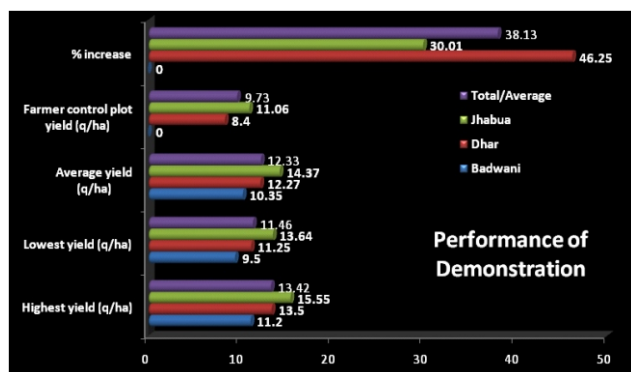
NRCHB-101 is an improved variety of Indian mustard (*B. juncea*) suitable for late sown conditions in Uttar Pradesh, Madhya Pradesh, parts of Rajasthan.

In demonstration plots, critical inputs in the form of quality seed (variety), manures and fertilizers, and agrochemicals etc were provided and non-monitory inputs likely timely sowing, sowing direction, sowing in rows and timely weeding were also provided to the farmers through training. Under the FLD, recommended mustard variety was demonstrated with full package and practices (production technology), seed treatment (fungicides, insecticides and bio fertilizers), fertilizer management and integrated nutrient management (INM) components under irrigated conditions. The critical inputs used in the demonstrations are as follows : (Table-1)

RESULTS AND DISCUSSION

Performance of Demonstration : Mustard variety namely NRCHB-101 was evaluated on the 3 KVKs of Madhya Pradesh under irrigated conditions with full package and practices during rabi 2013-14 for their yield and net return (Table-2 and 3). The improved variety demonstrated recorded maximum yield (13.42 q/ha) as well as, net return (Rs.22563/ha) (Table-2 and 3). However, the percent increase in the productivity with

Name of KVK	No. of Demo	Area (ha)	Highest yield (q/ha)	Lowest yield (q/ha)	Average yield (q/ha)	Farmer control plot yield (q/ha)	% increase
Badwani	10	4.0	11.20	9.50	10.35	-	-
Dhar	10	4.0	13.50	11.25	12.27	8.4	46.25
Jhabua	80	32.0	15.55	13.64	14.37	11.06	30.01
Total/Average	100	40.0	13.42	11.46	12.33	9.73	38.13



demonstrated variety was higher (38.13%) over Farmers Practice (FP).

The factors responsible for low yield were poor soil, outdated varieties and lack of modern technologies used for cropping. Newly introduced variety may excel over the outdated or old local variety in terms of yield per unit area (1). Similar studies have been reported by (2).

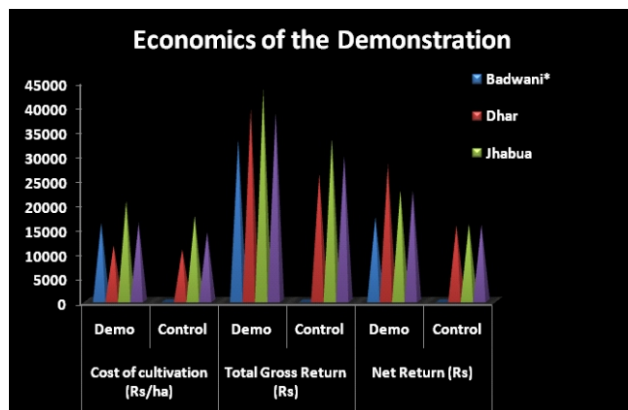
CONCLUSION

It is inferred that mustard variety NRCHB-101 performed

Economics of Demonstration

Name of KVK	No. of Demo	Cost of cultivation (Rs/ha)		Total Gross Return (Rs)		Net Return (Rs)		B : C ratio	
		Demo	Control	Demo	Control	Demo	Control	Demo	Control
Badwani*	10	15980	-	33120	-	17140	-	2.07	-
Dhar	10	11402	10590	39280	26040	27878	15450	3.4	2.5
Jhabua	80	20425	17450	43096	33182	22671	15732	2.11	1.90
Total/ Average	100	15935	14020	38498	29611	22563	15591	2.52	2.2

* Since mustard is not cultivated by farmers in Badwani so no control plot is available.



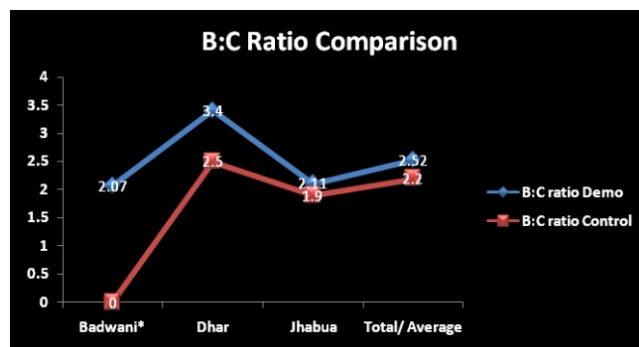
well with all the components of production and soils of Madhya Pradesh and might be distributed in the state at larger scales for improvement of mustard production in the zone. The crop recorded higher gross returns, net return and benefit cost ratio in improved technologies as compared to the plots where farmers were using traditional practices of cultivation. It is suggested that location-specific integrated approaches would be needed to bridge the productivity gap of the crop grown in the districts.

ACKNOWLEDGEMENT

The authors are grateful to ICAR-DRMR, Bharatpur and Programme Coordinator with staff and farmers who were instrumental in carrying out the TSP (Mustard) Programme.

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EFFECT OF MICRO AND MACRO CLIMATE ON THE POPULATION DYNAMICS OF *SCIRTOTHRIPS DORSALIS* IN GROUNDNUT

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ABSTRACT

The effect of four sowing dates on the population dynamics of *Scirtothrips dorsalis* on groundnut sown during the kharif season of 2010 was studied in ARI, Hyderabad. Maximum population is found at the early stage of the crop growth period i.e. from 20 to 34 days age of the crop. Correlation studies conducted between population dynamics of *Scirtothrips* with preceding one and two weeks micro and macro weather indicated that among the weather parameters evening relative humidity, wind speed showed significant positive correlation, while sunshine hours and minimum temperature played a significant negative role.

Key words : Micro and macro climate, population dynamics, groundnut.

Groundnut (*Arachis hypogaea* L.), a principal oilseed crop of the world is cultivated in about 12.29 million hectares in Asia. In India, it is grown in an area of 6.16 m. ha. (1). India and China are the largest producers of the crop. China leads in production of groundnut having a share of about 41.5% of overall world production, followed by India (18.2%). In Andhra Pradesh it is cultivated in an area of 1.77 m. ha. with an annual production of 1.55 million tones (1).

Pests and diseases are the major biotic stresses affecting the groundnut yield. Groundnut crop is attacked by lepidopteran as well as sucking pests. Among the sucking pests attacking the groundnut crop, thrips species occur as a complex, starting from vegetative stage till the harvest of the crop. Both nymphs and adults inhabit the leaf terminals and flowers and cause irregular streaks on the opened leaves, distortion and some times contamination of the foliage with fecal matter.

In groundnut, different species of thrips attack different parts of the plant during different stages of the crop growth period and cause significant yield loss. The earlier studies made on species composition of groundnut thrips indicated *Scirtothrips dorsalis* as the predominant species of foliage (2). The present study was taken up to determine the influence of abiotic factors on population dynamics of *Scirtothrips dorsalis* in groundnut.

MATERIALS AND METHODS

The field experiment was conducted at Agricultural Research Institute, Rajendranagar, Hyderabad during kharif, 2010. The popular groundnut variety Narayani was used for the study. The experiment was laid out in a randomized block design (RBD) with four sowing dates and five replications in a gross plot size of 175 square meters with a spacing of 30 x 10 cm with a seed rate of 60 kg acre⁻¹. The first date of sowing was taken up immediately after the receipt of the first monsoon showers

i.e on 19th June 2010 and the remaining three sowings (D₂, D₃ and D₄) were taken up at 15 days interval i.e on 3rd July, 19th July and 4th August. All the recommended routine agronomic practices except plant protection were followed for raising the crop. The whole experimental plot was divided into four equal sub plots of 7.2 x 6.0 m. with a gap of 5 m between each sub plot for sowing the crop with four dates of sowing. Five replications were maintained for each sowing date. For recording population dynamics of thrips in groundnut, the groundnut leaves were collected in plastic containers containing 30 % ethyl alcohol and later identified in the laboratory. The thrips species were collected by plucking 25 leaf terminals from one sq. m area of each replication and placed in 250 ml plastic containers (7 x 6 cm) containing 30 % ethyl alcohol filled to half of its capacity. Thus 5 samples (25 terminals / sample) from each sowing date and a total samples of 20 from all the four sowing dates were collected at weekly intervals for identification of thrips species starting from 20 DAS till the harvest of the crop. After collection of samples thrips were separated from samples by transferred the leaf samples to 500 ml beaker and 20 % ethyl alcohol was added to the sample till they immerse completely, then washed gently three to four times and thrips species collected in the ethyl alcohol solution were placed in a big Petri dish (13 cm diameter). The thrips collected in the alcohol were picked up with the help of the Pauster pipette and they were transferred to glass vial (5x1 cm) containing 80 % ethyl alcohol, after that the thrips species present in the groundnut leaflets were identified under stereoscopic binocular microscope by using the key developed by the (3).

To determine the effect of various weather parameters on the population dynamics of *Scirtothrips dorsalis* infesting groundnut weather data were collected from the weather station located adjacent to the experimental field at Agricultural Research Institute, Rajendranagar, Hyderabad . Along with observatory

Table 1 : Population dynamics of *Scirtothrips dorsalis* in groundnut leaves as influenced by dates of sowing and age of the crop during *kharif*, 2010.

Age of the Crop (days)	Thrips population/26 terminals								Means
	D ₁		D ₂		D ₃		D ₄		
	Std. week	Population	Std. week	Population	Std. week	Population	Std. week	Population	
20	27 (2-8 July)	10.00 (3.21)	30 (23-29 July)	29.80 (5.46)	32 (6-12 Aug.)	27.40 (5.19)	34 (20-26 Aug.)	20.20 (4.51)	21.85
27	28 (9.15 July)	15.80 (4.00)	31 (3-5 Aug)	17.80 (4.22)	33 (13-19 Aug.)	27.80 (5.23)	35 (27-2 Sept.)	17.20 (4.15)	19.65
34	29 (16-22 July)	46.00 (6.72)	32 (6-12 Aug)	14.40 (3.70)	34 (20-26 Aug.)	20.20 (4.36)	36 (3-9 Sept.)	41.20 (6.42)	30.45
41	31 (3-5 Aug.)	26.80 (5.17)	33 (13-19 Aug)	7.20 (2.72)	35 (27-02 Sept.)	7.80 (2.75)	37 (10-16 Sept.)	14.20 (3.81)	14.00
48	32 (6-12 Aug.)	9.40 (3.04)	34 (20-26 Aug)	4.20 (2.03)	36 (3-9 Sept.)	16.40 (4.05)	38 (17-23 Sept.)	6.60 (2.46)	9.15
55	33 (13-19 Aug.)	19.40 (4.27)	35 (27-2 Aug)	12.60 (3.51)	37 (10-16 Sept.)	19.80 (4.44)	39 (24-30 Sept.)	8.20 (2.85)	15.00
62	34 (20-26 Aug.)	1.60 (1.26)	36 (3-9 Sept.)	11.80 (3.42)	38 (17-23 Sept.)	14.00 (3.77)	40 (1-7 Oct.)	20.40 (4.49)	11.95
69	35 (27-2 Sept.)	9.20 (2.95)	37 (10-16 Sept.)	10.80 (3.42)	39 (24-30 Sept.)	17.40 (4.15)	41 (8-14 Oct.)	2.60 (1.47)	10.00
76	36 (3-9 Sept.)	3.20 (1.82)	38 (17-23 Sept)	9.40 (3.10)	40 (1-7 Oct.)	4.20 (1.91)	42 (Oct.)	12.00 (3.49)	7.20
83	37 (10-16 Sept.)	4.60 (1.98)	39 (24-30 Sept.)	8.20 (2.93)	41 (8-41 Oct.)	15.00 (3.82)	43 (22-28 Oct.)	14.80 (3.85)	10.65
Mean		14.6		12.62		17.00		15.74	
F ₁ (Date)	S.Em		CD at 5%						
F ₂ (Age)	0.17		0.35						
F ₁ * F ₂	0.28		0.55						
(Date* Age)	0.56		1.11						
Values in the parenthese are square root transformed values.									

Values in the parenthese are square root transformed values.

weather parameters (Macro climate), crop weather parameters like maximum, minimum temperatures, morning and evening relative humidities and leaf wetness (micro climate) were recorded by using wireless sensor net work (WSN) developed by Indian Institute of Technology, Bombay. The data was analyzed statistically in RBD with factorial concept to find out the effect of sowing dates on thrips population and to find out the effect of micro and macro climate on thrips abundance simple correlation coefficients were worked out by using indo stat software.

RESULTS AND DISCUSSION

The population dynamics of *Scirtothrips dorsalis* observed in groundnut sown with different dates of sowing (Table-1) ranged from 1.60 to 46.00 in D₁ and 4.20 to 29.8 in D₁ and D₂ plots, respectively. The population of thrips recorded in D₃ plot ranged from 4.20 to 27.80 and in D₄, it ranged from 2.6 to 41.20 / 25 leaf terminals. Though significantly high population of *S. dorsalis* were recorded in D₁ (46.00) and D₄ (41.20) plots, the mean population recorded in D₃ plot was significantly high (17.00) while significantly lowest mean population was recorded in D₂ plot (12.62).

The age of the crop also significantly influenced *S. dorsalis* population. The initial population of thrips (21.85 /

25 leaf terminals) was observed at 20 days age of the crop and it reached to a peak (30.45) at 34 days age.

The interaction effect of dates and age of the crop also showed significant influence on *S. dorsalis* population. Significantly high population of thrips was recorded in D₁ (46.00) and D₄ plots (41.20) at 34 days age of the crop while in D₂ and D₃ plots, *S. dorsalis* was more in the beginning of the crop growth stage *i.e.* at 20 and 27 days after sowing by recording 29.8 and 27.4 thrips / 25 leaf terminals at 20 days age and 17.8 and 27.8 at 27 days after sowing and recorded 29.8 and 27.4 thrips/25 leaf terminals at 20 days age and 17.8 and 27.8 at 27 days, respectively. Among the different dates, significantly lowest population of 1.6 and 2.6 thrips / 25 leaf terminals were recorded in D₁ and D₄ plot at 62 and 69 days age of the crop, respectively while in D₂ and D₃ plots, lowest population of 4.2 and 4.2 thrips were recorded at 48 and 76 days age of the crop, respectively.

(4) reported the peak incidence of *S. dorsalis* during 3rd week of August and 4th week of September in chilli. (5) also reported the maximum thrips population from 30th June to 30th August. (6) reported the peak population of *Caliothrips indicus* in groundnut leaves reached to peak during *kharif*, at 32nd standard week.

Table-2 : Correlation coefficients between population dynamics of *Scirtothrips dorsalis* and observatory weather parameters (Preceding one week) in groundnut during kharif, 2010

Observatory weather parameters	D ₁	D ₂	D ₃	D ₄
Maximum temperature	0.09	-0.47	-0.21	-0.37
Minimum temperature	0.41	-0.50	0.28	0.34
Morning relative humidity (RH I %)	-0.20	-0.22	0.23	0.30
Evening relative humidity (RH II %)	0.10	-0.16	0.18	0.67*
Rainfall (mm)	0.19	-0.17	-0.22	-0.05
Rainy days (R.D)	0.14	-0.24	0.07	0.63*
Sunshine hours (S.S.H)	0.11	-0.48	-0.25	-0.52
Wind speed (W.S) Km/h	0.25	0.36	0.37	0.75**
Evaporation (E. pan) (mm)	0.22	-0.45	0.63*	0.03
Mean temperature	0.20	-0.50	-0.07	-0.15
Age of the crop	-0.52	-0.30	-0.65*	-0.44

*Significant at 5% level.

**Significant at 1% level.

Table-3 : Correlation coefficients between population dynamics of *Scirtothrips dorsalis* and observatory weather parameters (Preceding two weeks) in groundnut during kharif, 2010.

Observatory weather parameters	D ₁	D ₂	D ₃	D ₄
Maximum temperature	-0.03	-0.45	-0.50	-0.38
Minimum temperature	-0.05	-0.32	0.22	0.30
Morning relative humidity (RH I %)	-0.24	-0.17	0.19	0.30
Evening relative humidity (RH II %)	-0.08	0.28	0.23	0.71*
Rainfall (mm)	0.44	-0.34	-0.39	0.29
Rainy days (R.D)	0.46	-0.40	-0.04	0.44
Sunshine hours (S.S.H)	-0.10	-0.57	-0.52	-0.70*
Wind speed (W.S) Km/h	0.23	0.46	0.71*	0.65*
Evaporation (E. pan) (mm)	0.30	-0.35	0.31	-0.08
Mean temperature	-0.05	-0.44	-0.38	-0.10
Age of the crop	-0.52	-0.03	-0.65*	-0.44

*Significant at 5% level.

**Significant at 1% level.

Table-4 : Correlation coefficients between population dynamics of *Scirtothrips dorsalis* and crop weather parameters (Preceding one week) in groundnut during kharif, 2010

Weather parameters	D ₁	D ₂	D ₃	D ₄
Maximum temperature	0.41	-0.48	-0.30	-0.33
Minimum temperature	0.35	-0.55	-0.67*	-0.02
Morning relative humidity (RH I %)	-0.24	-0.15	0.38	0.34
Evening relative humidity (RH II %)	-0.01	-0.08	0.29	0.63*
Leaf wetness (h)	0.19	-0.01	-0.43	-0.25
Age of the crop	-0.52	-0.03	-0.65*	-0.44

*Significant at 5% level.

**Significant at 1% level

Table-5 : Correlation coefficients between population dynamics of *Scirtothrips dorsalis* and crop weather parameters (Preceding two weeks) in groundnut during kharif, 2010

Weather parameters	D ₁	D ₂	D ₃	D ₄
Maximum temperature	0.32	-0.52	-0.63*	-0.20
Minimum temperatures	-0.21	-0.50	-0.76**	-0.27
Morning relative humidity (RH I %)	-0.19	-0.16	0.33	0.32
Evening relative humidity (RH II %)	-0.19	0.39	0.31	0.63*
Leaf wetness (h)	0.59	-0.15	-0.51	-0.41
Age of the crop	-0.52	-0.03	-0.65*	-0.44

*Significant at 5% level.

**Significant at 1% level

The relationship between the population dynamics of *S. dorsalis* with preceding one week (one week lag) observatory weather data indicated that in D₁ plot and D₂ plot, weather parameters did not show any significant influence on thrips population. In D₃ plot evaporation (0.63) showed significant positive correlation and age of the crop (-0.65) showed significant negative correlation. In D₄ plot evening relative humidity (0.67), rainy days (0.63) and wind speed (0.75) had significant positive correlation with *S. dorsalis* population (Table-2).

The correlation studies carried out with preceding two weeks observatory weather data (two weeks lag) indicated that as observed in preceding one week weather in D₁ and D₂ plots the weather parameters did not play any significant relation. In D₃ plot, wind speed (0.71) had significant positive correlation and age of the crop (-0.65) had significant negative correlation with *Scirtothrips*. In D₄ plot evening relative humidity (0.71) and wind speed (0.65) had significant positive correlation, sunshine hours (-0.70) showed significant negative correlation (Table-3).

Correlation coefficients worked out between thrips population and preceding one week micro climate weather data (Table-4) indicated that thrips population in D₁ and D₂ plots was not influenced by weather parameters. In D₃ plot, minimum temperature (-0.67) and age of the crop (-0.65) had significant negative correlation. In D₄ plot, evening relative humidity (0.63) had significant positive correlation with *Scirtothrips dorsalis* population.

Correlation studies carried out with preceding two weeks crop weather data (Table-5) also showed the similar trend where D₁ and D₂ plots the micro climate weather did not influence the thrips population. In D₃ plot maximum (-0.63) and minimum temperature (-0.76) and age of the crop (-0.65) showed significant and negative correlation while in D₄ plot evening relative humidity (0.63) were significantly and negatively correlated with thrips population. The results are in agreement with the findings of (7) who reported that *C. indicus* in groundnut had a positive correlation with sunshine hours and morning relative humidity. (8) also reported the positive correlation of thrips incidence in sunflower with maximum, minimum temperatures and bright sunshine hours. (9) reported a strong positive relation of sunflower thrips with relative humidity while rainfall showed negative correlation. (10) reported the significant positive influence of morning and evening relative humidity with thrips incidence in groundnut.

The over all results obtained from the studies clearly indicated that maximum infestation of thrips on groundnut crop was observed during early stage of the crop growth period during 20-34 days age of the crop and among the different sowing dates, the crop sown during late july to early august months recorded more infestation than the crop sown during middle june to early july months. The relationship between thrips population and weather parameters showed that better correlation coefficients were obtained when the weather parameters of preceding two weeks were correlated with thrips population than with preceding one week weather. Among the micro and macro weather parameters, micro climatic factors showed more influence on population dynamics of thrips than observatory weather parameters.

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IMPACT OF IRRIGATION LEVELS ON PHYSIOLOGICAL TRAITS OF WHEAT (*Triticum aestivum*) UNDER HEAT STRESS

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ABSTRACT

The present experiment was conducted with three levels of irrigation viz, I₀ irrigation (No irrigation), I₁ one irrigation (CRI) and I₂ two irrigations (CRI + Flowering) with 10 wheat genotypes i.e. K7903, K9162, K9351, K9465, K8962, K9423, K0307, NW1014, K9533 and HD2733. Results of Plant height (cm) higher in K0307 but low in K7903 at 30 DAS, 60 DAS and 90 DAS, Days to 75% anthesis (days) higher in K9351 and lower in K9533 as well as same in K7903, Leaf area index higher and same in two genotypes viz K0307 and NW1014 while lower in K7903 at both stages, Grain Growth Duration (day) higher in K9351 but low in NW1014, Productive tillers higher in K0307 while lower in K7903 and Test weight higher in K8962 as well as lower in K7903 were recorded as compared to other genotypes under all levels of irrigation. Irrigation levels i.e. I₀ (No irrigation) had deleterious effect on almost all the above mentioned traits as compared to I₁, one irrigation (CRI stage) and I₂, two irrigations (CRI and Flowering stage). Thus, these traits which are simple and easily measurable can be used for screening of wheat genotypes for drought and heat tolerance. Genotypes such as K9351, K8962, K9465, K0307, K9162 and NW1014 were found better performer in respect of above traits, under different levels of irrigation as compared to other genotypes.

Key words : Wheat, irrigation levels, heat tolerance, plant height, Leaf area index.

Bread wheat (*Triticum aestivum* L.) is the major staple food source for a large part of global population. India is the largest wheat producing country in the world after China. Wheat is basically a rabi crop that needs cool winter and hot summers for its better growth and development, it is extensively grown in countries with tropical and subtropical climates. Spring bread wheat has become adapted to a large range of environment in terms of soil climatic conditions. Around the time of planting and early vegetative growth the conditions are typically cool with little chance of heat or drought stress. One of the major effects of moisture and high temperature on the vegetative stage of crop leading damage to components of leaf, photosynthesis, reducing carbon dioxide assimilation rates compared with environment having more optimal temperatures. Drought, cold, high-salinity and heat are major abiotic stress that severely reduces the yield of food crop worldwide. Under changing ambient temperatures, plant water status is the most important variable (1).

High moisture and temperature affect plant production through several mechanisms. They accelerate phenology (reducing the potential production), and have direct effect on the physiology of photosynthesis and processes of the setting, fertilization and filling of grains. An additional major effect of high temperature on plants is via an increase in the vapor pressure deficit between leaves and the air. Heat stress is often defined as the rise in temperature beyond a threshold level for a period of time sufficient to cause irreversible damage to plant growth and development. Drought and heat stress is a

complex function of intensity, duration and rate of increase in temperature (2).

MATERIALS AND METHODS

The investigation done under three levels of irrigation i.e. I₀ (No irrigation) I₁ one irrigation (CRI stage) and I₂ two irrigation (CRI + Flowering stage) involving 10 wheat genotypes viz, K7903, K9162, K9351, K9465, K8962, K9423, K0307, NW1014, K9533 and HD2733 was conducted for two consecutive years i.e. 2011-12 and 2012-13 at Experiment Research Farm Nawabganj, C. S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh under different irrigation levels. Geographically, Kanpur is located at 26.300 N Longitude of 80.150 E and above 127.0 meters sea level. It lies in the sub-tropical regions, where wheat is grown in the Rabi seasons. The temperature was cool during vegetative growth stage while it was hot during grain filling stage in both the years of experimentation.

Plant height (cm) : Data pertaining on plant height at 30 days revealed that it varied significantly due to genotypes, irrigation levels and their interaction. Irrigation levels i.e. I₂ (CRI + Flowering) (9.76 cm) and I₁ (CRI) (9.80 cm) had significantly higher plant height over I₀ (No irrigation) (8.80 cm), respectively. Wheat genotypes viz., K0307 (10.5 cm) followed by K9351 (10.29 cm), K9162 (9.73 cm), NW1014 (9.60cm), K8962 (9.51cm) and K9533 (9.28 cm) recorded significantly higher plant height measured at 30 days over K7903 (8.85cm). Likewise, 30 days plant height measured at 60 days Table-significantly due to genotypes, irrigation levels and their interaction. Irrigation levels i.e. I₂ (CRI +

Table-1 : Effect of irrigation levels on Plant height (cm) at 30 DAS, 60 DAS and 90 DAS in wheat genotypes.

Genotype	Plant height (cm)											
	At 30 DAS in wheat genotypes				At 60 DAS in wheat genotypes				At 90 DAS in wheat genotypes			
	Pooled over two years			Mean	Pooled over two years			Mean	Pooled over two years			Mean
	I ₀	I ₁	I ₂		I ₀	I ₁	I ₂		I ₀	I ₁	I ₂	
K7903	8.1	9.2	9.1	8.8	51.1	61.5	65.7	59.4	60.3	65.0	83.8	69.7
K9162	8.8	10.1	10.2	9.7	53.8	62.9	69.2	62.0	61.4	63.9	88.6	71.3
K9351	9.5	10.6	10.6	10.2	60.1	69.3	73.1	67.5	74.7	75.0	91.4	80.4
K9465	8.3	9.3	9.2	8.9	56.5	68.7	71.8	65.7	64.0	71.3	90.1	75.1
K8962	8.8	9.8	9.8	9.5	55.1	65.2	70.0	63.4	76.8	80.5	69.8	84.7
K9423	8.2	9.1	9.2	8.8	52.3	62.9	69.7	61.6	68.5	71.4	86.7	75.5
K0307	9.7	10.8	10.9	10.5	63.1	73.3	73.8	70.1	77.1	86.9	102.5	88.5
NW1014	9.0	9.8	9.8	9.6	62.4	72.2	73.3	69.3	69.1	73.2	93.2	78.5
K9533	8.7	9.6	9.5	9.2	55.9	67.0	69.5	64.1	73.1	81.0	95.7	83.3
HD2733	8.4	8.9	9.4	8.9	57.1	67.3	64.8	63.1	72.8	80.7	84.0	79.1
Mean	8.80	9.7	9.8		56.7	67.0	70.1		69.8	74.9	91.3	
	CD at 5%			SE (d)	CD at 5%			SE (d)	CD at 5%			SE (d)
Irrigation (I)	0.092			0.040	0.714			0.310	0.765			0.331
Variety (V)	0.086			0.043	0.660			0.333	0.733			0.374
I x V	0.149			0.075	1.143			0.577	1.037			0.530

Note : I₀ – No Irrigation, I₁ – One Irrigation (CRI) and I₂ - Two Irrigation (CRI + Flowering)

Flowering) (70.13cm) and I₁ (CRI) (67.08cm) recorded significantly higher plant height as compared to I₀ (No irrigation) (56.79cm) and vice-versa. Wheat genotypes viz., K0307 (70.13cm) followed by NW1014 (69.34cm), K9351 (67.52cm), K9465 (65.71cm) and K9533 (64.17cm) recorded significantly higher plant height over other genotypes. Significantly minimum plant height was recorded in K7903 (59.4cm). Plant height at 90 days indicated that it varied significantly due to genotypes, irrigation levels and their interaction. Irrigation levels i.e. I₂ (CRI + Flowering) (91.33cm) and I₁ (CRI) (74.94cm) recorded significantly higher plant height as compared to I₀ (No irrigation) (69.82cm), respectively. At 90 days, significantly maximum plant height was recorded in K0307 (88.56cm) followed by K8962 (84.75cm), K9533 (83.32cm), K9351 (80.43cm), NW1014 (79.19cm) etc. From the results, it was inferred that genotypes behaved differently for plant height under different irrigation levels. The adverse effect of moisture caused by I₀ (No irrigation) was found on almost all genotypes under deferential response of environment. Earlier reports by (3,4,5) support these observations.

Leaf area index : Data pertaining on leaf area index recorded on 30 and 90 days Table no. revealed that it varied significantly due to genotypes, irrigation levels and their interaction at all stage of crop growth. Irrigation levels i.e. I₂ (CRI + Flowering) and I₁ (CRI) recorded significantly higher leaf area index at all crop growth stages i.e. 30 and 90 over I₀ (No irrigation). Wheat genotypes viz., K0307

(0.42 and 3.86), NW1014 (0.42 and 3.65), K8962 (0.40 and 3.58), K9351 (0.38 and 3.61) recorded significantly higher leaf area index at 30 and 90 days of crop growth stages over other genotypes. The minimum leaf area index was recorded in K7903 and HD2733 at all crop growth stages. It was observed that the initial moisture and heat stress had adversely affected leaf area expansion and thereby reduces solar interception, which, in turns, results in poor crop growth rate. The higher leaf area index indicates greater ability of genotypes to intercepts more radiation and it's used to CO₂ fixation by their canopies. Thus genotypes viz., K307, NW1014, K8962 and K9351 which maintained higher leaf area index under all levels of irrigation proved to be more drought and heat tolerant over other genotypes. A similar result was also corroborated by (6, 7).

Days to anthesis (days) : Data pertaining to days to anthesis as presented in Table-revealed that it varied significantly due to genotypes, irrigation levels and their interaction. Irrigation levels i.e. I₂ (CRI + Flowering) (77.4 days) and I₁ (CRI) (75.5 days) took significantly maximum days to anthesis over I₀ (No irrigation) (73.1 days). Genotypes viz., HD2733 (80.8 days), K9351 (78.1 days), K0307 (77.5 days), K9533 (76.3 days) and K9162 (74.8 days) took longer days for anthesis. Significantly minimum days was taken in K7903 (71.1 days) followed by K9465 (73.1 days) and K8962 (73.0 days) over other genotypes. From the results, initial stress caused by I₀ (No irrigation) hasten early anthesis than I₂ (CRI +

Table-2 : Effect of irrigation levels on Leaf Area Index at 30 DAS and 90 DAS and Days to 75% Anthesis (DAS) in wheat genotypes.

Genotype	Leaf Area Index								Days to 75% Anthesis (DAS)			
	At 30 DAS in wheat genotypes				At 90 DAS in wheat genotypes				Pooled over two years			Mean
	Pooled over two years			Mean	Pooled over two years			Mean				
	l ₀	l ₁	l ₂		l ₀	l ₁	l ₂					
K7903	0.32	0.36	0.42	0.37	2.19	3.11	4.25	3.18	67.5	70.5	75.5	71.1
K9162	0.36	0.40	0.42	0.40	2.65	3.64	4.62	3.63	72.5	74.5	77.5	74.8
K9351	0.35	0.38	0.40	0.38	2.62	3.58	4.63	3.58	76.5	78.5	79.5	78.1
K9465	0.38	0.41	0.42	0.40	2.46	3.60	4.37	3.48	69.0	75.0	75.5	73.1
K8962	0.37	0.41	0.43	0.40	2.63	3.45	4.65	3.61	69.5	73.5	76.5	73.0
K9423	0.37	0.42	0.43	0.40	2.49	3.57	4.46	3.51	69.5	75.0	77.5	74.0
K0307	0.41	0.42	0.44	0.42	2.87	3.85	4.86	3.86	76.5	78.5	77.5	77.5
NW1014	0.41	0.43	0.43	0.42	2.75	3.55	4.66	3.65	73.5	72.5	76.5	74.1
K9533	0.37	0.40	0.42	0.39	2.46	3.46	4.37	3.43	75.0	78.5	75.5	76.3
HD2733	0.36	0.39	0.41	0.38	2.27	3.34	4.23	3.28	73.5	76.5	78.5	80.8
Mean	0.37	0.40	0.42		2.54	3.51	4.51		73.1	75.5	77.4	
	CD at 5%			SE (d)	CD at 5%			SE (d)	CD at 5%			SE (d)
Irrigation (I)	0.0040			0.0017	0.035			0.015	0.476			0.207
Variety (V)	0.0108			0.0055	0.088			0.045	0.751			0.379
I x V	0.0188			0.0095	0.153			0.077	1.302			0.657

Note : l₀ – No Irrigation, l₁ – One Irrigation (CRI) and l₂ - Two Irrigation (CRI + Flowering)

Table-3 : Effect of irrigation levels on Grain Growth Rate (g/m²/day) Productive tillers /m² and Test Weight (g) in wheat genotypes.

Genotype	Grain Growth Duration (day)				Productive tillers/m ²				Test Weight (g)			
	Pooled over two years			Mean	Pooled over two years			Mean	Pooled over two years			Mean
	l ₀	l ₁	l ₂		l ₀	l ₁	l ₂		l ₀	l ₁	l ₂	
K7903	31.35	36.00	36.50	34.62	51.1	61.5	65.7	59.4	32.48	34.4	35.93	34.27
K9162	31.50	36.20	36.50	34.73	53.8	62.9	69.2	62.0	35.06	36.85	40.90	37.60
K9351	34.00	36.85	38.35	36.40	60.1	69.3	73.1	67.5	33.83	35.21	40.00	36.35
K9465	32.15	36.30	37.00	35.15	56.5	68.7	71.8	65.7	34.11	35.00	36.88	35.33
K8962	31.65	36.50	37.50	35.22	55.1	65.2	70.0	63.4	35.73	37.10	42.13	38.32
K9423	31.50	36.15	37.00	34.88	52.3	62.9	69.7	61.6	34.51	35.48	38.30	36.10
K0307	33.65	37.15	37.85	36.22	63.1	73.3	73.8	70.1	34.13	35.68	39.31	36.37
NW1014	32.00	35.50	36.15	34.55	62.4	72.2	73.3	69.3	34.41	36.00	38.31	36.24
K9533	31.50	36.20	36.50	34.73	55.9	67.0	69.5	64.1	32.83	35.06	36.36	34.75
HD2733	33.50	36.35	37.50	35.78	57.1	67.3	64.8	63.1	33.25	34.65	37.03	34.97
Mean	32.28	36.32	37.08		56.7	67.0	70.1		34.03	35.54	38.51	
	CD at 5%			SE (d)	CD at 5%			SE (d)	CD at 5%			SE (d)
Irrigation (I)	0.593			0.256	0.714			0.310	0.451			0.196
Variety (V)	0.755			0.382	0.660			0.333	0.418			0.418
I x V	N.S.			0.661	1.143			0.577	0.724			0.724

Note : l₀ – No Irrigation, l₁ – One Irrigation (CRI) and l₂ - Two Irrigation (CRI + Flowering)

Flowering) and l₁ (CRI) irrigations. Thus, earliness is directly linked with abiotic stress which seems to be inherent characteristics of genotypes. A similar result was observed by (8).

Grain Growth Duration (days) : Data on grain growth duration in Table-revealed that it varied significantly due to genotypes, irrigation levels and their interaction. Irrigation levels i.e. l₂ (CRI + Flowering) (37.08 days) and l₁ (CRI) (36.32 days) had a significantly longer grain growth

duration over I₀ (No Irrigation) (32.28 days). Wheat genotypes viz., K9351 (36.40 days), K0307 (36.22 days), HD2733 (35.78 days), K8962 (35.22 days) and K9465 (35.15 days) had significantly higher grain growth duration under all levels of irrigation over other genotypes. Wheat genotypes viz., K8962, K7903, K9465, K9423, K9162, K9465 and K9533 had higher per cent of increase under I₂ (CRI+ flowering) (37.08) over I₀ (No irrigation) (32.28) from 15.00 to 30.11 over other genotypes. Result indicates that wheat genotypes which had longer grain growth duration facilitate smooth grain filling under different levels of irrigation. Earlier reported by (9).

Productive Tillers/m² : Data on productive tillers as presented in Table-2 revealed that it varied significantly due to genotypes, irrigation levels and their interaction. Irrigation levels i.e. I₂ (CRI + Flowering) (369.4) and I₁ (CRI) (234.4) resulted in significantly higher value of productive tiller over I₀ (No Irrigation) (182.4). Wheat genotypes viz., K0307 (277.5), K8962 (276.0), K9351 (273.1), NW1014 (264.3) and K9423 (262.6) had a significantly higher productive tillers over other genotypes under all levels of irrigation. From the results, genotypes which showed higher productive tillers indicates their ability to maintained maximum productive tillers, which, in turns, to helped in stabilising grain yield under different levels of irrigation. A similar finding was corroborated by(10).

Test Weight (g) : Data pertaining to test weight as presented in Table No.-3 revealed that it varied significantly due to genotypes, irrigation levels and their interaction. Irrigation levels i.e. I₂ (CRI + Flowering) (38.51 g) and I₁ (CRI) (35.54 g) recorded significantly higher test weight as compared to I₀ (No Irrigation) (34.03 g) and vice-versa. Genotypes viz., K8962 (38.32 g), K9162 (37.60 g), K0307 (36.37 g), K9351 (36.35 g) and NW1014 (36.24 g) resulted in significantly higher test weight under all levels of Irrigation. From the results, it was deduced that genotypes which had higher test weight indicates their ability for better source sink relationship under both

drought and heat stress caused by different levels of irrigation, thereby proved to be more drought and heat tolerant under drought and heat stress.

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EFFECT OF SPACING AND NITROGEN ON GROWTH, FLOWERING AND YIELD OF GLADIOLUS (*Gladiolus grandiflorus* L.) Cv. AMERICAN BEAUTY

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ABSTRACT

A multifactor experiment on effect of different plant spacing and nitrogen levels on growth, yield and quality of gladiolus (*Gladiolus grandiflorus* L.) cv. "American Beauty" was conducted at during winter season (2014-15) at the Fruit Research Station, Jambuvadi Farm, College of Agriculture, Junagadh Agricultural University, Junagadh. The treatments comprised of three levels of spacing (40 x 15 cm, 40 x 20 cm and 40 x 25 cm) and four levels of nitrogen (150, 200, 250 and 300 kg/ha) in a factorial randomized block design and replicated thrice. The result revealed that higher plant height was obtained at a closer spacing of 40 x 15 cm and fertilized with 250 kg nitrogen per hectare and wider spacing of 40 x 25 cm and fertilized with 250 kg nitrogen per hectare recorded maximum vegetative and flowering characters viz., number of tillers per plant, fresh weight of plant (g), dry weight of plant (g), days required for opening of first spike emergence, number of spike per plant, number of spike per plot and number of spike per hectare.

Key words : *Gladiolus, plant spacing, nitrogen levels.*

Gladiolus is known as queen of the bulbous plants, which is valued for its beautiful flower spikes. It (from Latin, the diminutive of gladius, a sword) is a genus of perennial bulbous flowering plants in the iris family (Iridaceae) also known as sword lily. The most widely used English common name for these plants is simply gladiolus (plural gladioli, gladioluses or sometimes gladiolas). The gladiolus thus became a symbol for force and victory. Centuries of hybridization and selection have resulted in today's many varieties that display a wide range of flower shapes, flower colours and growth and flowering habits

Optimum plant spacing is an important practice for providing better light interception, which is one of the most important factor besides moisture and nutrients which are vital for successful crop production and quality. Plant spacing affects yield, quality of spikes and corms production.

Gladiolus cultivars respond differently to nitrogen. Nitrogen enhances the growth, yield and quality of cut flowers (1, 2). Application of nitrogen with phosphorus can also enhance florets, corms, cormlets and spike length. Inadequate plant nutrition causes serious disorders and may eventually lead to decline of plant vigor and yield. Fertilizer application also affects flower color of gladiolus but not in a systematic manner. The requirement of fertilizers for gladiolus, like other crops has vital role in growth, quality of flowers, corm and cormel production.

MATERIALS AND METHODS

The experiment was conducted during winter season of 2011-2012 at the Fruit Research Station, Jambuvadi Farm, College of Agriculture, Junagadh Agricultural University, Junagadh. The 'Junagadh region' is included in the 'West-Coast-Kathiawar Peninsula' of Gujarat state

and under the South Saurashtra Agro Climatic Zone –VII of Gujarat state. The soils of this region is classified as Vertic Ustochrepts.

Physical and chemical properties of the soil of the experimental field were determined with pH-7.85 and The experiment was conducted in a factorial randomized block design involving three levels of spacing i.e. S₁ (40 x 15 cm), S₂ (40 x 20 cm) and S₃ (40 x 25 cm) and four levels of nitrogen doses viz. N₁ (150 kg/ha) N₂ (200 kg/ha), N₃ (250 kg/ha) and N₄ (300 kg/ha). Thus total 12 treatment combinations were included with three replications. Gladiolus Corms having uniform size (4.5-5.0 cm) were dipped in Bavistin 0.1 percent solution for 20 minutes, a day before planting and allowed to dry overnight in shade on gunny cloth.

The half-dose of nitrogen along with full dose of phosphorus and potassium was thoroughly mixed in experimental plots before planting. Remaining half-dose of nitrogen applied at 30 days after transplanting as top dressing in circular band of about 3-4 cm away from each plant. The observations on growth parameters were recorded at initial and final stage; five plants were randomly selected from net plot area and tagged. The data collected for all the characters studied were subjected to statistical analysis by adopting 'Analysis of Variance' (ANOVA) technique using factorial randomized block design described by (3).

RESULTS AND DISCUSSION

Vegetative growth parameters : Plant height at 30, 60 and 90 DAS, number of tillers per plant, fresh weight of plant (g), dry weight of plant (g) are the important parameters to assess the vigor of the plant. Increasing spacing has significant reduction in plant height. (Table-1).

Table-1 : Effect of spacing and nitrogen on vegetative parameters in gladiolus cv. 'American Beauty'.

Treatments	Plant height (cm)			No. of tillers per plant	Fresh weight of plant (g)	Dry weight of plant (g)
	30 DAS	60 DAS	90 DAS			
Spacing (S)						
S ₁ (40 x 15 cm)	34.14	58.09	82.73	1.77	45.26	12.90
S ₂ (40 x 20 cm)	32.46	56.46	80.86	1.87	47.73	13.33
S ₃ (40 x 25 cm)	29.08	53.05	75.73	2.07	51.27	14.96
S.Em.±	0.68	1.20	1.64	0.06	1.18	0.36
C.D. at 5%	2.00	3.51	4.80	0.17	3.45	1.05
Nitrogen Kg/ha (N)						
N ₁ (150 Kg/ha)	29.31	53.42	75.99	1.78	45.90	13.01
N ₂ (200 Kg/ha)	31.95	56.67	81.31	1.91	48.23	13.74
N ₃ (250 Kg/ha)	34.25	58.93	83.66	2.09	51.60	15.03
N ₄ (300 Kg/ha)	32.31	54.44	77.81	1.82	46.62	13.14
S.Em.±	0.79	1.38	1.89	0.07	1.36	0.41
C.D. at 5%	2.31	4.05	5.54	0.20	3.99	1.21
Interaction (N x S)						
S.Em.±	1.37	2.39	3.2	0.11	2.3	0.71
C.D. at 5%	NS	NS	NS	NS	NS	NS
C.V. %	7.50	7.42	7.11	10.57	8.48	9.00

Table-2 : Effect of spacing and nitrogen on flowering and yield of gladiolus cv. 'American Beauty'.

Treatments	Minimum days required for opening of first spike emergence	Number of spike per plant	Number of spike per plot	Number of spike per hectare (Yield)
Factor–Spacing (S)				
S ₁ (40 x 15 cm)	67.65	1.75	24.75	275000.00
S ₂ (40 x 20 cm)	67.58	1.85	15.43	216665.62
S ₃ (40 x 25 cm)	62.66	2.00	11.98	199999.94
S.Em. ±	1.28	0.05	0.66	8036.48
C.D. at 5%	3.75	0.15	1.94	23571.63
Factor–Nitrogen (N)				
N ₁ (150 Kg/ha)	61.82	1.77	15.42	209626.31
N ₂ (200 Kg/ha)	65.40	1.91	18.02	239815.27
N ₃ (250 Kg/ha)	67.68	2.01	19.93	261113.61
N ₄ (300 Kg/ha)	68.96	1.78	16.17	211665.55
S.Em. ±	1.48	0.06	0.76	9279.73
C.D. at 5%	4.33	0.17	2.24	27218.17
Interaction (N x S)				
S.Em.±	2.55	0.10	1.3	16072.96
C.D. at 5%	NS	NS	NS	NS
C.V. %	6.71	9.29	13.17	12.07

The closer spacing S₁ (40 x 15 cm) recorded maximum plant height at 30, 60 and 90 DAS (34.14, 58.09 and 82.73 cm) while, number of tillers per plant (2.07), fresh weight (g) (51.27) and dry weight (g) (14.96) recorded wider spacing of S₃ (40 x 25 cm), which was recorded minimum plant height (29.08, 53.05 and 75.73 cm) and number of tillers per plant (1.77), fresh weight (g) (45.26) and dry weight (g) (12.90) were recorded at 40 x

25 cm spacing. The more plant height and number of tillers per plant be due to heavy competition between plants for light resulted in elongation of main stem and also might be due to the fact that the plants tend to grow vertically when they are crowded owing to shadowing effect of the plants on one another. Similar observations were recorded by (4) in gladiolus.

Wider spacing *i.e.*, S (40 x 25 cm) produced

significantly maximum fresh and dry weight (g) of plant more observed due to sowing of corm in wider spacing (Table-1). The reasons to increase in vegetative growth components in wider spacing may be attributed to less competition among the plants which facilitated better growth. The results are in conformity with the findings of (5, 6, 7) in gladiolus.

All the growth parameters differed significantly among various nitrogen levels (Table-1). The plant height at 30, 60 and 90 DAS (34.25, 58.93 and 75.99 cm) number of tillers per plant (2.09) and fresh weight (g) (51.60) and dry weight (g) (14.03) were recorded maximum at upto level of fertilizer *i.e.*, N (250 kg/ha). This increase in vegetative growth might be due to greater uptake of nutrients into the plant system which involved in cell division, cell elongation as well as protein synthesis which ultimately enhanced the stem length and vegetative growth. The above results are in conformity with findings of (8) in gladiolus, (9) in tuberose and (10) in China aster. The increase in flower quality characters might be due to the fact that nitrogen is a major constituent part of amino acids and carbohydrates leading to the improved flower quality and adequate quantity of nutrients for better production.

Flowering and yield parameters : The data presented in Table 2 revealed that the important attributes related to flowering and yields were significantly influenced by spacing. Minimum days required for opening of first spike emergence (62.66) and Number of spike per plant (2.00) were observed in wider spacing (S_3) 40 x 25 cm. Whereas, maximum days required for opening of first spike emergence (67.65), number of spike per plot (24.75) and number of spikes per hectare (275000) were found in close spacing (S_1) 40 x 15 cm. Maximum number of spike per plant and minimum days required for opening of first spike emergence at wider spacing was mainly due to less competition among the plants or nutrient and light. Similar results were also recorded by (14) in gladiolus. The delay in flowering with higher doses of nitrogen might be due to

continuation of vegetative growth for longer period. Minimum days required for opening of first spike emergence (61.82) were observed with 150 kg N/ha while maximum number of spike per plant (2.01), number of spike per plot (19.93) and number of spike per hectare (261113.61) were noted with 250 kg N/ha.

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EFFECT OF DIFFERENT SEED STORAGE CONTAINERS ON SEED QUALITY IN TERMS OF GERMINABILITY AND VIGOUR IN GROUNDNUT (*Arachis hypogea* L.)

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ABSTRACT

The effect seed storage containers on quality of groundnut pods were studied under laboratory condition of Seed Science and Technology, Junagadh Agricultural University, Junagadh. Fresh pods of groundnut variety; GG 20 were sun dried to bring the moisture content to around 6 to 8 per cent and after treatment stored in moisture vapour proof high density laminated polyvinyl bags, polyvinyl bags 700 gauge, aluminium foil laminated bag, polyvinyl bag packing with vaccum and cloth bag. The observations were recorded on 150 and 250 days of storage periods. Result revealed that pods stored aluminum foil laminated bag seed container was found superior than rest of other containers by recording higher germination percentage, seed vigour index (mass) and lowest test weight, while pods stored in polyvinyl bag packing with vaccum bag recorded significantly lowest seed moisture per cent, seedling length (cm), seed vigour index (length) and minimum bruchid infestation and pods stored in polyvinyl bag (700 gauge) recorded the highest seedling dry weight.

Key words : Groundnut, storage container, storage, germination and vigour.

Groundnut (*Arachis hypogea* L.) is one of the most extensively grown kharif oilseed crop in India. Groundnut also known as peanut is considered as one of the important oil seed crops and grown throughout the world. Groundnut is an annual herb belonging to family Fabaceae. It is important food legume among all food legumes for production worldwide. The extent of seed deterioration depends on species, seed containers, storage environment, duration of storage period and initial quality of stored seeds. The maintenance of seed quality during storage is most important challenging in the crop due to problem of quick loss of seed quality. Groundnut deteriorates its quality in storage, due to fungal, insect or other pest infestation. Quality of pods in storage also influenced by genotypes, age of seeds, moisture content of seeds, field damaged and extant of initial viability of the seed to be stored besides the storage containers. Being hygroscopic in nature, viability and vigour of seeds are known to be regulated by variations in seed containers, storage period, initial seed quality, packaging conditions and physiochemical factors etc. Seed containers or packaging materials are considered as one of the most important factors influencing longevity of seeds in storage in many field crops in general and groundnut in particular. The physical properties of lots are also influenced to very large extent by moisture content and the relative humidity of the atmosphere surrounding the seeds. Mandate of this experiment was to investigate the effect of seed storage containers on quality of groundnut pods.

MATERIALS AND METHODS

The pods of groundnut variety viz., GG 20 were obtained from College Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh. The

production year of GG 20 pods was kharif – 2013 and moisture content was 6 to 8 per cent. The treated pods were packed in seed container as per treatment. The seed treatment material was mixed uniformly with the seed and then packed in moisture vapour proof high density laminated polyvinyl bags (C₁), polyvinyl bags 700 gauge (C₂), aluminium foil laminated bag (C₃), polyvinyl bag packing with vaccum (C₄) and cloth bag (C₅) seed containers for the period from 15th April to 20th December, 2014. Each seed storage container was filled with 4 kg of treated seeds. The observations on seed moisture content (1), test weight (gm), germination percentage (2), seedling length (cm), seedling dry weight (gm) (3), seed vigour index (length and mass) (4), and bruchid infestation (per cent) were recorded after 150 and 250 days of storage of treated seeds. Statistical analysis of the data was worked out using factorial completely randomized block design (5) for each character and treatments were compared by critical difference at five per cent and one per cent levels of significance.

RESULTS AND DISCUSSION

Effect of seed containers : A significant effect on seed moisture per cent, test weight, germination percentage, speed of germination, seedling length and seed vigour index (length and mass) seedling dry weight and bruchid infestation was observed by using different seed containers throughout the storage periods (Table-1 and 2). The significantly lowest seed moisture (3.93% and 4.87 %) was recorded by moisture vapour proof high density laminated polyvinyl bag (C₁) and pods stored in polyvinyl bag packing with vaccum (C₄), while the highest seed moisture (5.42% and 7.31%) was recorded by pods stored in cloth bag (C₅) after 150 and 250 days storage periods, respectively. The suitability of polyvinyl bag container for

Table-1 : Effect of seed storage containers on seed moisture per cent, test weight (gm), Germination per cent and seedling length during storage periods in groundnut.

Storage Containers	Seed moisture		Test weight		Germination %		Seedling length	
	Storage Period (Days)							
	150	250	150	250	150	250	150	250
C ₁	3.93	7.27	48.78	47.74	94.76	94.80	13.25	13.17
C ₂	4.75	5.09	47.60	47.25	93.90	93.56	14.19	14.13
C ₃	4.25	4.98	45.51	45.16	96.56	96.46	14.75	14.66
C ₄	4.35	4.87	46.66	47.63	94.76	93.50	15.13	15.12
C ₅	5.42	7.31	46.75	47.33	88.76	85.46	14.05	13.71
S.Em±	0.05	0.11	0.26	0.25	0.45	0.51	0.16	0.17
C.D @ 5%	0.14	0.31	0.75	0.71	1.26	1.45	0.45	0.47

Table-2 : Effect of seed storage containers on seed vigour index length, vigour index mass, seedling dry weight (gm) and bruchid infestation during storage periods in groundnut

Storage Containers	Vigour index length		Vigour index mass		Seedling dry weight		Bruchid infestation	
	Storage Period (Days)							
	150	250	150	250	150	250	150	250
C ₁	1412.06	1204.24	139.92	111.49	1.47	1.16	6.03	11.46
C ₂	1403.30	1388.83	141.43	114.10	1.51	1.22	5.24	14.70
C ₃	1319.34	1291.30	143.77	114.90	1.46	1.16	6.90	13.93
C ₄	1446.59	1398.46	137.31	106.74	1.46	1.15	5.23	6.23
C ₅	1227.14	1206.95	120.72	102.19	1.39	1.11	13.10	17.70
S.Em±	22.34	15.03	1.41	1.35	0.013	0.01	0.14	0.17
C.D @ 5%	62.79	42.23	3.98	3.79	0.037	0.03	0.40	0.49

lowest seed moisture per cent might be due to moisture imperviousness property, while cloth bag having porous nature and reacts with change in atmospheric conditions. (6) reported that increasing rate of seed moisture was higher in seed stored in cloth bag, while polythene bag is moisture proof, so metabolic activity rate was minimized.

The pods stored in aluminum foil laminated bag (C₃) had exerted the lowest test weight (45.51 gm and 45.16 gm), while the pods stored in moisture vapour proof high density laminated polyvinyl bag (C₁) recorded significantly the highest test weight (48.78 gm and 47.74 gm) after 150 and 250 days of storage periods, respectively. The test weight greatly depended on atmosphere moisture retention in seed container. Similar result was reported by (7) and stated that the maximum 1000 seed weight of french bean was recorded in gunny bag and the lowest 1000 seed weight was recorded in tin container which was statistically at par with seed stored in polythene bag.

Pods stored in aluminum foil laminated bag (C₃) container recorded significantly the highest germination (96.56% and 96.46%) and cloth bag (C₅) recorded the lowest germination (88.76% and 85.46%) after 150 and 250 days storage periods respectively. The maximum germination percentage in aluminum foil laminated bag may be due to its moisture proof nature due to which lesser seed deterioration was observed. (8) revealed that seeds stored in polylined gunny bag recorded significantly

higher germination per cent after nine months of storage period in summer groundnut.

At 150 and 250 days storage period, the highest seedling length (15.13 cm and 15.12 cm) was recorded by pods stored in polyvinyl bag packing with vaccum (C₄), while the lowest seedling length (13.25 and 13.17 cm) was recorded by the pods stored in moisture vapour proof high density laminated polyvinyl bag (C₁) after 150 and 250 days storage periods, respectively. The maximum seedling length in polyvinyl bag packing with vaccum bag may be due to maintained seed vigour, seed health and maintained the cell wall integrity. Similar result reported by (9) that seedling length parameters i.e. root and shoot length of seedlings were highest under double polythene bag container, hence are responsible for maximum seedling length in stored wheat seeds.

After 150 and 250 days of storage period the highest vigour index length based (1446.59 and 1398.46) was recorded by pods stored in polyvinyl bag packing with vaccum (C₄), respectively, while the lowest vigour index (1227.14) was recorded by pods stored in cloth bag (C₅) after 150 days of storage period and the lowest seed vigour index (1204.24) was recorded by pods stored in moisture vapour proof high density laminated polyvinyl bag (C₁) after 250 days of storage. The maximum vigour index in polyvinyl bag packing with vaccum bag may be due to unavailability of oxygen caused poor ageing effect

of seedlings. (10) reported that rice seeds stored in 700 gauge polythene bag recorded significantly highest seedlings vigour index.

After 150 and 250 days of storage period, the highest seed vigour index mass based (143.77 and 114.90) was recorded by pods stored in aluminum foil laminated bag (C₃), while the lowest seed vigour index (120.72 and 102.90) was recorded by pods stored in cloth bag (C₅), respectively. The highest seed vigour index (mass) under pods stored in aluminum foil laminated bag might be due to highest seedlings dry weight as these are the components of seed vigour index (mass). (11) reported that seed vigour was measured as dry weight of normal seedlings and it was highest in soybean seeds stored in 700 gauge polythene bag.

Among different seed containers, polyvinyl bag (C₂) had retained top rank by recording the maximum seedlings dry weight (1.51 gm and 1.22 gm), while significantly the lowest seedlings dry weight (1.39 gm) and (1.11 gm) was recorded by pods stored in cloth bag (C₅) after 150 and 250 days of storage period, respectively. The retention of better dry weight in polyvinyl bag was probably attributed to its impervious nature of pores which has offered better protection of seeds by showing less fluctuation in seed moisture content. (12) reported that chickpea seeds stored in poly lined gunny bag recorded highest dry matter as compared to seeds stored in gunny bag and HDPE bag.

The pods stored in polyvinyl bag packing with vaccum (C₄) had exerted the lowest bruchid infestation (5.23% and 6.23%) after 150 and 250 days of storage periods, respectively, while the pods stored in cloth bag (C₅) recorded significantly the highest bruchid infestation (13.10% and 17.70%) after 150 and 250 days of storage periods, respectively. The lowest bruchid infestation in polyvinyl bag packing with vaccum may be due to unavailability of oxygen for respiration of bruchids caused inhibition of oviposition by bruchids. (13) revealed that seeds stored in polythene bags followed by galvanized iron drum found to be better to prevent bruchid infestation in cowpea seeds.

CONCLUSION

Aluminum foil laminated bag seed container was found superior than rest of other containers by recording higher germination percentage, seed vigour index (mass) and lowest test weight, while pods stored in polyvinyl bag

packing with vaccum bag recorded significantly lowest seed moisture per cent, seedling length (cm), seed vigour index (length) and minimum bruchid infestation and pods stored in polyvinyl bag (700 gauge) recorded the highest seedling dry weight.

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GRAIN YIELD STABILITY OF WHEAT GENOTYPES UNDER DIFFERENT ENVIRONMENT IN GUJARAT

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ABSTRACT

Eight genotypes of wheat including three check varieties i.e., LOK 1 (C), HI 8998 (C) and GW 1139 (C) were planted at six different agro climate in Gujarat at November, 2012-13. Stability analysis for grain yield was conducted to check the response to Genotype x Environment interactions. The combined and individual analysis of variance for locations was conducted. Pooled analysis of variance revealed highly significant ($p > 0.01$) difference for analysis for genotype, environment and genotype x environment (GxE) interaction. Genotype GW 1277 produced the highest mean yield (5279 kg/ha) in 6 location average and had regression coefficient (b) close to unity (-1.087*) and S²d close to zero (-.0858). This indicated that below average response, poor unfavorable and specific adaptability of these genotype to harsh (unfavorable) environment stability of performance of all genotype except LOK 1 (C) is suitable performance in average stable cultivar so it is suitable for general cultivar. These findings suggested all genotype could be as stress tolerant genotype under stressed environment (such as drought heat and salinity stress).

Key words : Stability, genotypes, environments, grain yield, wheat.

Wheat (*Triticum aestivum* L.) is the major cereal crop in India on which the food security rests. It covers an area around 31.18 million hectares, 3075 kg/ha with the annual production near 95.90 million tones in India (1). Environmental factors such as abiotic (soil, fertility, moisture, temperature, sowing time, day length) and biotic (diseases and pests) are not consistent across years and locations which ultimately affect the yield stability of wheat genotypes. Plant breeders engaged in crop improvement program often desire to develop genotypes, which are adapted to wide range of environments (2) suggested that the inconsistency for yield among genotypes from one environment to another may arise due to the expression of different sets of genes in different environments or difference in responses of the same set of genes to different environments. The phenotypic performance of a genotype may not be the same under diverse agro climatic conditions. This variation is due to G x E interactions, which reduces the stability of a genotype under different environments.

Many models have been developed to measure the stability of various parameters and partitioning of variation due to G x E interactions. The most widely used model. The method suggests that a genotype is regarded stable or widely adaptable over environments, if it possesses high mean yield, a unit regression coefficient (b) close to 1.0 and the lowest or close to zero S²d. Ten genotypes were studied and found that both linear and non-linear components were highly significant and only two genotypes showed the regression coefficient closer to unity along with low deviation from regression. Similarly in

a study involving twelve genotypes at 6 locations revealed that G x E interactions was significant indicating the influence of environment on grain yield. The linear component has major contribution toward difference in stability of a genotype. Highly significant differences for genotypes, environments and G x E interactions are reported earlier. Hence the present studies were undertaken to investigate the response of wheat genotypes in different environments. Stability studies (Genotype x environment interaction) are therefore of great importance to identify superior genotypes that perform well across a wide range of environments and to detect specific adaptability of genotypes over favorable or unfavorable environments.

MATERIALS AND METHODS

Five wheat advanced lines/genotypes name GW 1255, GW 1276, GW 1277, GW 1278 and GW1283 along with three check varieties namely LOK 1 (C), HI 8998 (C) and GW 1139 (C) were planted during November, 2012-13 throughout the Gujarat province at six different locations. The experiment was laid out using Randomized Complete Block Design with four replications. The experimental plot for each entry consists of six rows of five meter length and rows were 30 cm apart.

The seed rate used was 100 kg/ha and NPK fertilizers were applied @ 100-75-0 kg/ha at each location. At maturity a net plot size of 5.40 m² was harvested from each entry and the data were recorded for grain yield.

Table-1 : Yield of wheat trials at different locations.

Sr. No.	Location	Yield (kg/ha)	Mean	Total	Date of sowing
1.	VIJAPUR	4471	5.142	164.539	22-11-11
2.	JUNAGADH	5201	5.981	191.407	18-11-11
3.	SK NAGAR	4071	4.681	149.805	29-11-11
4.	ANAND	3484	4.00625	128.200	18-11-11
5.	DHARI	5391	6.200	198.390	2-12-11
6.	JAMANAGAR	5726	6.584	210.699	7-12-11

Table-2 : Pooled analysis of variance.

Source of variation	df	Sum of Squares	Mean Squares
Environment	5	39.196	0.93**
Varieties	7	6.507	7.839**
Var x Env.	35	6.937	0.198**
Error	126		0.315

Table-3 : Stability analysis of 8 wheat lines.

Source of variation	df	Ss	Mean squares
Genotypes (G)	7	1.515	0.2164
Env. + (Gen. x Env.)	40	-110.737	-2.7684
Environments (linear)	1	-59.699	-59.6989
G x Env. (linear)	7	-33.022	-4.7174
Pooled deviations	32	-18.017	-0.5630
GW 1255	4	-8.661	-2.165 ns
GW 1276	4	-6.345	-1.586 ns
GW 1277	4	-3.011	-0.753 ns
GW 1278	4	-2.824	-0.706 ns
GW1283	4	-4.884	-1.221 ns
LOK 1 (C)	4	-21.026	-5.257 ns
HI 8998 (C)	4	-8.254	-2.063 ns
GW 1139 (C)	4	-1.474	-0.369 ns
Pooled error	126		0.105

RESULTS AND DISCUSSION

The combine analysis of variance (Table-2) revealed that there were significant differences among environments and for each location and pooled genotypes for grain yield indicating the presence of variability in genotypes as well as diversity of growing conditions at different locations. (Table-II) The G x E interaction was highly significant reflecting the differential response of genotypes in various environments (3).

As regarding the locations the highest average grain yield was obtained at Jamanagar (5726 kg/ha) followed by Junagadh (5391 kg/ha) Junagadh (5201 kg/ha), Vijapur (4471 kg/ha), and S.K.nagar (4071 kg/ha) while the lowest grain yield was observed at Dhari (3484 kg/ha) with different date of sowing (Table-1). The ranking of genotypes according to yield indicated that GW 1277 was at the top followed by GW 1255, LOK 1 (C), HI 8998 (C),

GW 1276, GW 1278, GW1283 and GW 1139 (C). A significant G x E interaction may be a non-cross-over type in which case the ranking of genotypes remain constant across environments and the interaction is significant, because of change in magnitude of response of varieties. It may be a cross-over G x E interaction in which case a significant change in rank occurs from one environment to another. In the present investigations, the interaction is of cross over type as the ranking of varieties changed at every location (4).

By partitioning G x E interaction into linear and non-linear (pooled deviation) components, it is noted that differences between environments (environment linear) were non significant, which indicated the lack of genetic control of genotypic response to environments.

The G x E interactions, were however of non-linear type, because G x E (linear) was non -significant for pooled deviation, reflecting lack of genetic differences among genotypes for their response to varying environments. While pooled deviations were highly non significant against pooled error (Table-3) showing that the lack of differences in stability were due to deviation from linear regression.

(2) regarded deviation from regression (S^2_d) to be the most appropriate criteria for measuring phenotypic stability in an agronomic sense, because this parameters measure the predictability of genotypic reaction to environment with these parameters, high and desirable per se performance of a variety over environment is also a positive point to rate the variety as a better and highly stable genotype.

Eberhart and Russell suggested that a genotype may be said stable over different environments if it shows unit slope, low deviation from regression Sd_2 and high per se performance. In the present investigation the regression coefficients range from -2.359 to -1.087. The high yielding variety GW 1277 has bi value -1.087* with significant deviation from regression followed by GW 1278 which has a bi value -1.22 * and also a significant deviation from regression. Although GW 1276 has a bi value -1.689 and significant deviation is stable but its

Table-4 : Stability characterization for grain yield of 18 wheat genotypes.

Genotype	Mean	Mean Kg/ha	Regression co-efficient (bi)	Deviation from regression (s^2_{di})	bi test from 0	bi test from 1
GW 1255	5.747	4998	-1.869*++	-2.270	2.09	3.21
GW 1276	5.417	4711	-1.689*++	-1.691	2.21	3.52
GW 1277	6.071	5279	-1.087*++	-0.858	2.07	3.96
GW 1278	5.183	4507	-1.22*++	-0.811	2.39	4.35
GW1283	5.034	4377	-1.7*++	-1.326	2.54	4.03
LOK1 (C)	5.583	4855	-2.359+	-5.361	1.70	2.41
HI 8998 (C)	5.557	4832	-1.921*++	-2.168	2.20	3.35
GW 1139 (C)	4.868	4233	-1.402**++	-0.473	3.81	6.52

Table-5 : Classification of genotypes according to stability parameters for grain yield.

Name of group	Criteria	Name of Parents	Suitability for cultivation
Average stable	High mean, $b_i=1$ but non significant and S^2_{di} Non significant	LOK 1 (C)	Suitable for general cultivation
Above average response	High mean, $b_i > 1$ and significant and S^2_{di} Non significant	NIL	Suitable for favorable environment
Below average response	High mean, $b_i < 1$ and significant and S^2_{di} Non significant	GW 1277, GW 1255, GW 1276, GW 1139 (C), GW 1278, GW1283 and HI 8998 (C)	Suitable for poor/unfavorable environment
Unstable	High or Low mean, $b_i=1$, >1 or <1 and S^2_{di} significant	Nil	Unpredictable response in all environments

average yield, hence not fit. Both GW 1277 and GW 1255 these genotypes have average yield above the trial's average but only suitable for poor/unfavorable environments due to high mean $b_i < 1$ and significant and S^2_{di} non-significant. The wheat Ckeck variety LOK-1 has b_i value almost is non significant, -deviation from regression and above average grain yield, which indicates that this variety is the most suitable and stable over different environments (Table-4). The genotype may express different phenotypes in different environments, each of which being better adapted for the particular situation. This type of behavior has been regarded as adaptive plasticity (5), individual adaptability (6) and individual buffering (7).

The results are in accordance with the findings of by (8). All these scientists were found G X E interaction and both G X E linear and pooled deviation were significant, indicating that both predictable and unpredictable components shared G X E interaction; however, linear component was larger than pooled deviation suggesting that performance of the genotypes could be predicted for different environments.

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GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE FOR QUANTITATIVE CHARACTERS IN BREAD WHEAT (*Triticum aestivum* L.)

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ABSTRACT

Fifty diverse genotypes of bread wheat were evaluated during rabi 2014 for genetic parameter viz., variability, heritability and genetic advance. High phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were recorded for biological yield per plant followed by grain yield per plant, length of main spike, grain weight per main spike, number of grains per spike, number of effective tillers per plant, 1000 grain weight, peduncle length of main spike, days to 50% flowering and number of spikelet per main spike. High heritability with moderate genetic advance expressed as percentage of mean observed for grain filling period, days to maturity, plant height and harvest index may be attributed to the presence of non-additive gene action and influence of environment in the expression of these characters and thus, the selection would be less effective.

Key words : Genetic variability, heritability, genetic advance, bread wheat.

Wheat is the second most important staple food next to rice, consumed by nearly 35% of the world population and providing 20% of the total food calories. It is the most widely cultivated food crop of the world. It is known for its remarkable adoption to a wide range of environments and its role in world economy. Globally, demand for wheat by the year 2020 is forecasted around 950 million tonnes to meet future demands imposed by population growth. This target will be achieved only, if global wheat production is increased by 2.5% per annum (1). Therefore, there is need to exploit the existing genetic variability in wheat for developing high yielding varieties that can be adjusting and highly productive under changing climatic scenario. Availability of sufficient genetic variability is very important in a crop improvement programme. For successful breeding programme, amount of variability present in the experimental material is desirable characteristic. Yield and yield contributing characters are controlled by polygene and highly influenced by environment. Hence, it becomes necessary to partition the observed variability into heritable and non-heritable components. The genetic variability is determined with the help of certain genetic parameters viz., genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV). Heritability estimates and genetic advance are important genetic parameters. The knowledge of heritability coupled with expected genetic advance for a trait will help us in deciding the scope of improvement of that particular trait through selection. Expected genetic advance indicates the expected genetic progress for particular trait under selection cycles and measures the extent of its stability under selection pressure. The present study was therefore conducted to estimate variability, heritability in wheat for utilization in selection programmes aimed at productivity increase of future genotypes.

MATERIALS AND METHODS

Fifty genotypes of bread wheat were sown in a Randomized Block Design (RBD) with three replications during Rabi 2014. Each genotype was accommodated in a single row of 2.5 m length with a spacing of 22.5 cm between rows. The experiment was surrounded by two guard rows to avoid damage and border effects. Other recommended agronomical practices in vogue were followed for reaping good crop. The observations were recorded on various quantitative characters viz., days to 50% flowering, grain filling period, days to maturity, plant height, number of effective tillers per plant, length of main spike, peduncle length of main spike, number of spikelet per main spike, number of grains per main spike, grain weight per main spike, 1000 grain weight, grain yield per plant, biological yield per plant, harvest index. Five randomly selected competitive plants in each row of each replication for all the characters were recorded for all the traits under study except of days to 50 per cent flowering, grain filling period and days to maturity which were recorded on plot basis. Further, the value of harvest index was calculated as per the formula given by (2). The mean performance of individual genotypes was embayed for statistical analysis. Analysis of variance to test the significance for each character was carried out as per methodology given by (3). Genotypic and phenotypic coefficients of variation (GCV and PCV) were calculated by the formula given by (4), heritability in broad sense (h^2) by and genetic advance given by (5).

RESULTS AND DISCUSSION

The analysis of variance (Table-1) revealed that the treatments were highly significant for all the characters. This suggested that the genotypes selected were genetically variable and considerable amount of variability existed among them. Similar finding were reported by (1).

Table-1 : Analysis of variance showing mean squares for 14 characters in 50 genotypes of bread wheat.

Source of Variation	d.f.	Days to 50% flowering	Grain filling period	Days to maturity	Plant height (cm)	Number of effective tillers per plant	Length of main spike (cm)	Peduncle length of main spike (cm)
Replications	02	3.4400	4.1266	0.8866	82.9071**	0.2850	0.3625	10.7670*
Genotypes	49	117.6768**	21.9455**	90.8877**	172.2165**	1.1613**	8.7057**	50.3666**
Error	98	2.1270	2.3647	2.4853	11.2604	0.5403	0.1993	2.4150

Table-1 : Contd....

Source of Variation	d.f.	Number of spikelet per main spike	Number of grains per main spike	Grain weight per main spike (g)	1000 grain weight (g)	Grain yield per plant (g)	Biological yield per plant (g)	Harvest index (%)
Replications	02	0.8610	1.9496	0.0203	5.4996*	0.8940	6.5270	12.4929
Genotypes	49	10.5843**	213.2845**	0.5838**	134.5445**	10.0146**	46.3854**	82.9002**
Error	98	0.4803	9.3964	0.0625	1.7801	3.3176	12.0709	20.3768

*, ** Significant at 5% and 1% levels, respectively.

Table-2 : Range of variation, mean, phenotypic and genotypic coefficients of variation, heritability (Broad Sense), genetic advance and genetic advance expressed as percentage of mean for 14 characters in 50 genotypes of bread wheat

Character	Range	Mean	PCV (%)	GCV (%)	h^2 b.s	GA	GAPM
Days to 50% flowering	49.33 to 73.00	58.70	10.66	10.57	98.19	12.66	21.58
Grain filling period	31.33 to 44.66	37.46	7.21	6.81	89.22	4.97	13.26
Days to maturity	83.33 to 113.33	96.16	5.72	5.64	97.27	11.02	11.46
Plant height (cm)	56.78 to 99.34	77.50	9.77	9.45	93.46	14.58	18.82
Number of effective tillers per plant	3.00 to 5.80	4.21	14.74	10.78	53.48	0.68	16.24
Length of main spike (cm)	6.60 to 13.35	9.89	17.21	17.01	97.71	3.42	34.65
Peduncle length of main spike (cm)	24.31 to 42.36	32.41	12.64	12.33	95.21	8.03	24.79
Number of spikelet per main spike	15.33 to 24.80	18.14	10.35	10.11	95.46	3.69	20.35
Number of grains per main spike	42.26 to 70.86	55.34	15.23	14.89	95.59	16.60	30.00
Grain weight per main spike (g)	1.68 to 3.59	2.62	16.78	15.86	89.29	0.81	30.87
1000 grain weight (g)	33.51 to 62.54	48.01	13.95	13.85	98.68	13.61	28.35
Grain yield per plant (g)	5.83 to 13.98	8.87	20.59	16.83	66.87	2.51	28.36
Biological yield per plant (g)	11.53 to 29.53	18.32	21.46	18.46	73.98	5.99	32.70
Harvest index (%)	31.50 to 58.59	48.86	10.75	9.34	75.42	8.16	16.71

PCV (per cent) = Phenotypic coefficient of Variation, GCV (per cent) = Genotypic coefficient of Variation, h^2 b.s. (per cent) = Heritability in broad sense, GA = Genetic Advance and GAPM = Genetic advance in per cent of mean.

The mean, range, variance, coefficient of variability, heritability and genetic advance are presented in Table 2. The present experimental material showed a wide range of variation for biological yield per plant followed by grain yield per plant, grain weight per main spike, length of main spike, number of effective tillers per plant, 1000-grain weight and harvest index (Table-2). The genotypic (GCV) and phenotypic (PCV) coefficients of variation were observed in the experimental material for all the traits studied. Wide range of GCV was observed for biological yield per plant followed by length of main spike, grain yield per plant, grain weight per main spike, number of grains per main spike, 1000 grain weight, peduncle length of main spike, number of effective tillers per plant, days to 50% flowering and number of spikelet per main spike. High phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were recorded for biological yield per plant followed by grain yield per plant,

length of main spike, grain weight per main spike, number of grains per spike, number of effective tillers per plant, 1000 grain weight, peduncle length of main spike, days to 50% flowering and number of spikelet per main spike. Similar finding were reported by (7). The moderate value of GCV was observed for plant height, harvest index, grain filling period and days to maturity. The finding of these characters are supported by (8).

The estimates of heritability are more advantageous when expressed in terms of genetic advance. (5) suggested that without genetic advance the estimate of heritability will not be practical value and emphasized the concurrent use of genetic advance along with heritability. (9) stated that heritability and genetic advance are two complementary concepts. Based on this consideration, high heritability estimates were observed for 1000 grain weight followed by days to 50% flowering, length of main spike, days to maturity, number of grains

per main spike, number of spikelet per main spike, peduncle length of main spike, plant height, grain weight per main spike, grain filling period, harvest index and biological yield per plant. Similar findings were reported by (10). In case of grain yield per plant and number of effective tillers per plant have reported moderate heritability and similar result also reported by (11) in bread wheat. High estimates of heritability coupled with high to moderate genetic advance expressed as percentage of mean was observed for length of main spike followed by biological yield per plant, grain weight per main spike, number of grains per main spike, grain yield per plant, 1000 grain weight, peduncle length of main spike, days to 50 % flowering and number of spikelet per main spike, which indicated preponderance of additive gene action and these traits possessed high selective value. Similar results were obtained (12).

High heritability with moderate genetic advance expressed as percentage of mean observed for grain filling period, days to maturity, plant height and harvest index may be attributed to the presence of non-additive gene action and influence of environment in the expression of these characters and thus, the selection would be less effective. Low value of genetic advance have been reported in wheat for number of spikelet per main spike, length of main spike, grain yield per plant, grain weight per main spike, number of effective tillers per plant and grain filling period. Similar findings were reported by (8).

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GRASS CARP, *Ctenopharyngodonidella* (val.) REARING IN AQUATIC WEED INFESTED COMMUNITY FISH POND OF ALLAHABAD DISTRICT, U.P.

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ABSTRACT

Aquatic weeds are major problem of community fish pond in Allahabad district. Demonstration of Grass Carp rearing in aquatic weed infested village pond was conducted at Hathigan village of Chaka block of Allahabad district of Uttar Pradesh. Two treatments were assigned : Traditional practice–Rearing of Indian major carp species, Rohu (*Labeo rohita*), Catla (*Catla catla*) and Mrigal (*Cirrhinus mrigala*) and Demonstration-Grass Carp rearing along with Indian major carp species were Rohu (*Labeo rohita*), Catla (*Catla catla*) and Mrigal (*Cirrhinus mrigala*). Fish yield was in 35.26q/ha in demonstration pond and 20.26q/ha in local check. Yield percentage increase of fish 74.04% was recorded. Gross return was Rs74,046. And Rs42,546 per hectare were recorded from demonstration pond and local check pond. A net profit of Rs.53,871 and Rs.24,346 per hectare in demonstration pond and local check pond and benefit-cost ratio of 3.67 and 2.34 were observed in demonstration pond and local check pond respectively. Favorable cost benefit ratio is self-explanatory of economic viability of the trial and convinced the farmers for adoption of intervention imparted. The results showed that grass carp rearing in weed infested pond was suitable for enhancing the productivity of pond and also supplement the income of fish farmer.

Key words : Composite fish culture, aquatic weeds, grass carp, survival rates, yield, benefit-cost ratio.

Fish is an inexpensive source of protein and an important cash crop in many regions of world and water is the physical support in which they carry out their life functions such as feeding, swimming, breeding, digestion and excretion (1). The excessive growth of Aquatic weeds is undesirable in fish ponds as they reduce productivity by depletion of essential nutrients. Aquatic weeds create certain problems in the ponds such as providing breeding grounds for aquatic insects, enabling to harbor predatory insects, restricting the free movement of fry, causing obstruction during netting and resulting in depletion of plankton production. Emphasis has to be given on weeds control by biological means using herbivorous fishes like grass carp, *Puntius javanicus*, *Puntius punctellus* and Gorami (2). Grass carp (*Ctenopharyngodonidella*) feeds voraciously and can even consume feed almost equal to their body weight. They feed on aquatic weeds. Therefore it should be fed with adequate aquatic weeds, viz. Wolffia, Lemna, Azolla, Spirodella etc. (3). The specific objectives of the study were :

To study of survival percentage of fish and yield of fish in Local check pond and demo pond.

To study the economic indicators.

MATERIALS AND METHODS

Study area : During PRA survey by KVK Allahabad, while interacting with fish farmers of the village, there was general consensus amongst the fish farmers that low yield of fish needs to be increased. Problem diagnosed that low yield of fish in fish farming system due to lack of knowledge of composite fish farming. Aquatic weeds are major problem of community fish pond in Allahabad

district. Demonstration of Grass Carp rearing in aquatic weed infested village pond was conducted at Hathigan village of Chaka block of Allahabad district of Uttar Pradesh. Village pond was infested with Lemna, water hyacinth, Hydrilla.

Selection of fish farmer : Before conducting demonstration, a list of farmers was prepared from group meeting and specific skill training was imparted to the selected farmers regarding different aspects of cultivation (4). The necessary step for selection of site and farmers, layout of demonstration etc. were followed as suggested by Choudhary (5).

Thematic area : Composite fish culture (semi intensive culture).

Production technology : The ponds were prepared by repairing the dikes and liming at a rate of 200 kg/ha. Ponds were filled with canal water and then cow-dung was applied. After five days all the ponds were stocked at the rate of 6,000 fry/ha with the selected indigenous carp species Rohu (*Labeo rohita*), Catla (*Catla catla*) and Mrigal (*Cirrhinus mrigala*), and exotic carp species Grass carp (*Ctenopharyngodonidella*) (Table 1). Chemical and biological conditions of pond soil and water were regularly monitored during the study period. No feeding during study period, only cow dung manure was provided to pond. Visits of the farmers and the extension functionaries were organized at demonstration plots to disseminate the message at large. Yield data were collected from local check pond (Farmer's practice) and demonstration ponds. Cost of production, net income and benefit cost ratio were computed and analyzed also.

Table-1 : Stocking density of carp species.

Carp Species	Common name of carps	Local check pond		Demo pond	
		Stocking Ratio (%)	No. of Fish/ ha	Stocking Ratio (%)	No. of Fish/ ha
<i>Catla catla</i>	Catla	40	2,400	40	2,400
<i>Labeo rohita</i>	Rohu	30	1,800	25	1,500
<i>Cirrhinus mrigala</i>	Mrigal	30	1,800	20	1,200
<i>Ctenopharyngodonidella</i>	Grass carp	-	-	15	900
Total stocking		100	6,000	100	6,000

Table-2 : Survival rates (%), Average weight, Yield performance in composite fish culture.

Fish species	Local check pond				Demo pond			
	Survival rates (%)	Survival Number	Average weight (Kg) ± SE	Production (q/ha)	Survival rates (%)	Survival Number	Average weight (Kg) ± SE	Production (q/ha)
Catla	82	1968	0.576±0.054	11.34	84	2016	0.745±0.058	15.02
Rohu	78	1404	0.610±0.078	8.56	83	1245	0.648±0.068	8.07
Mrigal	79	1422	0.250±0.048	0.36	83	996	0.321±0.038	0.32
Grass carp	-	-	-	-	91	819	1.447±0.098	11.85
Yield (q/ha)	20.26				35.26			
% Change in yield	74.04							

Data Analysis

1. % Change in Yield

$$= \frac{\text{Yield Demo.} - \text{Yield Check}}{\text{Yield Check}} \times 100$$

2. Net Return = Gross Return - Cost of Production.

$$3. B : C \text{ Ratio} = \frac{\text{Gross Return}}{\text{Cost of Production}}$$

4. Increased Cost = Cost of Production (Demo) – Cost of Production (Check).

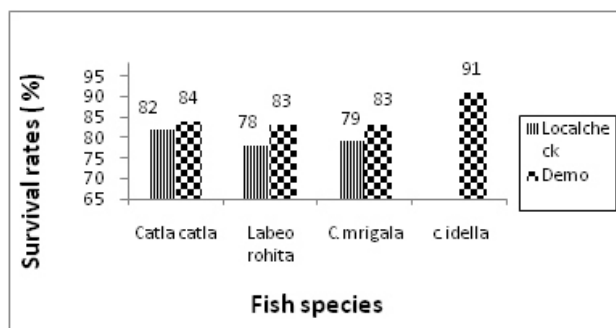
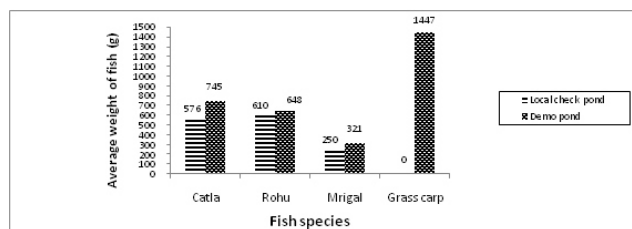
5. Increased Return = Gross Return (Demo) – Gross Return (Check).

6. Effective Gain = Net Return (Demo) – Net Return (Check).

RESULTS AND DISCUSSION

Survival rates (%) : Fig. 1. Shows survival rates (%) of fish species in different fish culture systems. The Survival rates (%) of catla, rohu, mrigal and grass carp ranged between 78 to 91 % in different fish culture systems. Demo pond (84, 83, 83, and 91 for catla, rohu, mrigal and grass carp respectively) resulted in significantly higher Survival rates (%) compared to Local check pond (82, 78 and 79 % for catla, rohu and mrigal respectively).

Average weight (Kg) of fishes : Fig. 2. Shows average weight (Kg) of fishes in different fish culture systems. Average weight of catla, rohu, mrigal and grass carp ranged between 0.250 $\pm$ 0.048 to 1.447 $\pm$ 0.098 Kg in

**Fig-1.** Survival rates (%) of fish species in different fish culture systems.**Fig-2.** Average weight (g) of fishes in different fish culture systems.

different fish culture systems. Demo pond (0.745 $\pm$ 0.058, 0.648 $\pm$ 0.068, 0.321 $\pm$ 0.038 and 1.447 $\pm$ 0.098 Kg for catla, rohu, mrigal and grass carp respectively) resulted in significantly higher average weight compared to Local check pond (0.576 $\pm$ 0.054, 0.610 $\pm$ 0.078 and 0.250 $\pm$ 0.048 Kg for catla, rohu and mrigal respectively). Grass carp (*Ctenopharyngodonidella*) feeds voraciously

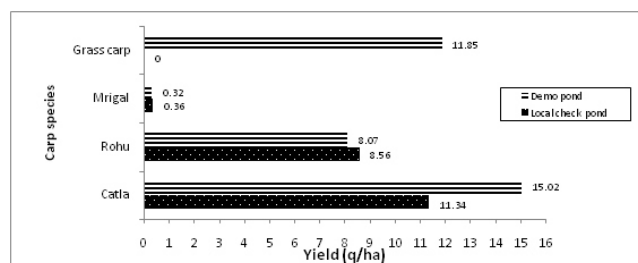


Fig. 3. Production (q/ha) of fishes in different fish culture system during the study period.

and can even consume feed almost equal to their body weight. Study revealed that weight of grass carp was highest among all species. Grass carp cleans aquatic weeds so other India major carps also grow better in demo pond than local pond.

Production (q/ha) of fishes : Fig. 3 shows production (q/ha) of fishes in different fish culture system during the study period. The production of catla, rohu, mrigal and grass carp ranged between 0.320 to 15.019 q/ha in different fish culture systems. Demo pond (15.019, 8.068, 0.320 and 11.853 q/ha for catla, rohu, mrigal and grass carp respectively) resulted in significantly higher production compared to Local check pond (11.34, 8.564 and 0.356 q/ha for catla, rohu and mrigal respectively).

Yield performance in composite fish culture : Fish yield was 35.26 q/ha in demonstration pond and 20.26 q/ha in local check. Yield percentage increase of fish 74.04 % was recorded.

Economic indicators in composite fish culture : Economic indicators i.e. cost of production, gross returns, net returns and BC ratio, in Composite fish culture system are presented in Table 3. The data clearly revealed that, Cost of production was Rs 18,200 and Rs 20,175 per hectare from Check and Demo pond. Gross return was Rs

74,046. And Rs 42,546 per hectare were recorded from demonstration pond and local check pond. A net profit of Rs. 53,871 and Rs. 24,346 per hectare in demonstration pond and local check pond and benefit-cost ratio of 3.67 and 2.34 were observed in demonstration pond and local check pond respectively. Increased Cost was Rs 1,975 /ha. Increased Return was Rs. 31,500/ha. Effective gain was Rs. 29,525 /ha. The results showed that the grass carp rearing in weed infested pond was suitable for enhancing the productivity of fish and to supplement the income of fish farmer.

CONCLUSION

Favorable benefit cost ratio is self-explanatory of economic viability of the trials and convinced the farmers for adoption of intervention imparted. The results showed that grass carp rearing in weed infested pond was suitable for enhancing the productivity of pond and also supplement the income of fish farmer.

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CONSTRAINTS FACED BY VEGETABLE GROWERS IN ADOPTION OF VEGETABLE CULTIVATION

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ABSTRACT

This study was conducted during the year 2014-15 in Saharanpur district and Hapur district of Western Uttar Pradesh. To know the constraints in adoption of vegetable cultivation faced by vegetable growers. It was observed that unavailability of quality seed at the time of sowing on top priority with mean percentage score 82.08. Application of plant protection measure is risky due to lack of knowledge with MPS 81.46. Field functionaries go through formalities to cover the targeted areas with MPS 77.08. Insufficient training programmes were organized by Government department on vegetable cultivation with MPS 81.25. Short life of harvested vegetable with MPS 78.96 and policeman created problem at barrier/police check post with MPS 81.04. These were priority basis constraints regarding input, technical, socio-psychological, general and marketing constraints as perceived by vegetable growers.

Key words : Vegetable growers, constraints, mean percentage score and ranks.

Knowledge regarding constraints in vegetable production will help policy makers and planners in making suitable, corrective and remedial measures source to make this enterprise more profitable. Hence it was felt very essential to study the constraints in adoption of vegetable production technology.

RESEARCH METHODOLOGY

The descriptive type survey based research design was used for the investigation. Western Uttar Pradesh comprises of eighteen districts. Out of which two district was selected for this study on the basis of maximum and minimum as per hectare productivity of vegetable crops. From each district two blocks was selected randomly and from each block four villages selected purposely. Thus total 16 villages were selected for the study and 10 farmers purposely selected from each village. List of farmers prepared on the basis of their land holding and then farmers were selected randomly. The total sample size was of 160 respondents for the investigation. The data were collected through personal interview with the help of interview scheduled.

The constraints were categorized into 5 categories i.e. input, technical, socio-psychological, general and marketing constraints. The identified constraints were administered through a three point continuum as most important, important and least important with a score of 3, 2 and 1 respectively on the basis of score obtained by the vegetable growers mean percent score (MPS) was calculated and ranked the constraints. Mean percent score: It was computed by multiplying total obtained score of the respondents by hundred and divided by the maximum obtainable score under each constraints the formula is as under.

RESULTS AND DISCUSSION

The data presented in Table-1, that unavailability of quality seed at the time of sowing on top priority and ranked in first

in constraints hierarchy with 82.08 mean percentage score, second importance was given to high price of hybrid seeds, fertilizers and chemicals with MPS 79.38, followed by lack of money to purchase requisites with MPS 77.92. It was ranked in third, supply of inferior quality seeds by the input dealers with MPS 75.08. It was ranked fourth, unavailability of fertilizers and micronutrients in proper time with MPS 74.58. It was ranked in fifth, Unavailability of quality plant protection chemicals with MPS 74.42. It was ranked in sixth and reduction of soil fertility with use of high dose of chemical fertilizers with MPS 73.75. It was ranked in seventh. These were input constraints as perceived by the vegetable growers. The above findings are supported by (1) who found that lack of knowledge and technical guidance, high cost of input, poor economic condition of farmers and non-availability of pure seed in time were important constraints perceived by the pulse growers of Udaipur district in Rajasthan.

It is clear from Table-2, that application of plant protection measure is risky due to lack of knowledge was perceived as top priority constraint by the vegetable growers with MPS 81.46. It was ranked in first, followed by lack of knowledge about plant growth regulators with MPS 78.33. It was ranked in second, lack of knowledge about balance fertilizers/ IPNM concept with MPS 73.33. It was ranked in third, lack of knowledge regarding recommended package of practices with MPS 77.71, It was ranked fourth. Lack of knowledge regarding plant protection measures with MPS 76.46. It was ranked in fifth, application of technology is highly technical with MPS 75.21. It was ranked in sixth. Unavailability of technology sound labour with MPS 74.79. It was ranked in seventh, poor confidence in recommended newly technically with MPS 74.38. It was ranked eighth. Lack of knowledge about planting distance with MPS 73.96. It was ranked in ninth and operational difficulty in application of technological tools due to unavailability of labour with MPS 73.33. It was ranked in tenth.

Table-1: Input constraints as perceived by vegetable growers:

Constraints	Most important	Important	Least Important	MPS	Rank
Unavailability of quality seed at the time of sowing	90	54	16	82.08	I
Supply of inferior quality seeds by the input dealers	69	63	28	75.08	IV
High price of hybrid seeds, fertilizers and chemicals	84	53	23	79.38	II
Unavailability of fertilizers and micronutrients in proper time	71	56	33	74.58	V
Reduction of soil fertility with use of higher dose of chemical fertilizers	71	52	37	73.75	VII
Unavailability of quality plant protection chemicals	75	52	33	74.42	VI
Lack of money to purchase requisites	79	56	25	77.92	III

Table-2 : Technical constraints as perceived by the vegetable growers.

Constraints	Most important	Important	Least Important	MPS	Rank
Lack of knowledge regarding recommended package of practices	79	55	26	77.71	IV
Operational difficulty in application of technological tools due to unavailability of labour	64	64	32	73.33	X
Application of technology is highly technical	68	65	27	75.21	VI
Poor confidence in recommended newly technology	67	63	30	74.38	VIII
Lack of knowledge about balance fertilizers/IPNM concept	79	57	24	78.13	III
Lack of knowledge about plant growth regulators	81	54	25	78.33	II
Lack of knowledge regarding plant protection measures	72	63	25	76.46	V
Lack of knowledge regarding planting distance	69	57	34	73.96	IX
Application of plant protection measure is risky due to lack of knowledge	89	53	18	81.46	I
Unavailability of technically sound labour	69	61	30	74.79	VII

Table-3 : Socio-psychological constraints as perceived by vegetable growers.

Constraints	Most important	Important	Least Important	MPS	Rank
Lack of motivation and education	68	68	24	75.83	III
Lack of coordination among the beneficiaries	70	55	35	74.00	IV
Field functionaries go through formalities to cover the targeted areas	76	58	26	76.04	II
Inadequate extension activities were conducted by the Govt. Department	65	59	28	71.04	VI
Local leaders are less interested in the programme	73	49	37	73.75	V
Vegetable enterprise is very risky	77	51	32	77.08	I

Table-4 : General constraints as perceived by the vegetable growers.

Constraints	Most important	Important	Least Important	MPS	Rank
Insufficient training programmes are organized by the Govt. Department on vegetable cultivation.	20	62	14	81.25	I
Insufficient demonstrations are conducted at farmers filed by the govt.	72	65	23	76.88	VIII
Credit facilities are not available on vegetable cultivation.	83	61	16	80.63	II
Timely agricultural information are not available at proper time.	69	71		76.87	IX
Poor transport facilities.	70	60	30	75.00	X
Short life of harvested vegetable.	79	61	20	78.96	IV
New and timely information are not available at proper time.	86	53	21	80.21	III
Storage facilities are not available.	79	61	20	78.95	V
Unavailability of labour at peak season and high charges of labour.	79	56	25	77.92	VI
High charges of irrigation	81	52	27	77.91	VII

The data presented in Table-3, reveals that the vegetable enterprise is very risky with MPS 77.08. It was ranked in first perceived as top priority constraint by the

vegetable growers regarding socio-psychological constraints, followed by field functionaries go through formalities to cover the targeted area with MPS 76.04. It

Table-5: Marketing constraints as perceived by the vegetable growers.

Constraints	Most important	Important	Least Important	MPS	Rank
Poor marketing channel	78	57	25	77.71	VII
Unavailability of procurement prices of the product absence of assumed marketing at remunerative price	67	67	27	76.67	VIII
There was no cooperative society to sale vegetable at Govt. rate	83	54	23	79.17	IV
Due to long distance of mother dairy the farmers were not able to sale vegetable in mother dairy	85	53	22	79.79	II
More interference of middleman in marketing system	81	53	26	78.12	VI
Unavailability of market in the vicinity	79	61	20	78.96	V
Marketing information is not available at time	82	57	21	79.37	III
Police man create problem at barrier/police check post	87	55	18	81.04	I

was ranked in second, lack of motivation and education with MPS 75.83. It was ranked in third, lack of coordination among the beneficiaries with MPS 74.00. It was ranked in fourth, the local leader were less interested in the programme with MPS 73.75. It was ranked in fifth and inadequate extension activities were conducted by the government with MPS 71.04. It was ranked in sixth. These constraints related to socio- psychological constraints as perceived by the vegetable growers. The above findings are similar to findings of (2) who reported that lack of knowledge about recommended plant to plant and row to row distance and application of technology is risky' as the least important constraints. (3) reported that lack of coordination among beneficiaries and local leader are less interested in the programme.

The data presented in Table-4, reveals that constraint of insufficient training programmes organized by Govt. department on vegetable cultivation with MPS 81.25. It was ranked in first regarding general constraints, followed by credit facilities are not available on vegetable cultivation with MPS 80.63. It was ranked in second, new and timely information are not available with MPS 80.21. It was ranked in third. Short life of harvested vegetable with MPS 78.96 and ranked in fourth. The storage facilities are not available with MPS 78.95. It was ranked in fifth. Unavailability of labour at peak season and high charges of labour with MPS 77.92. It was ranked in sixth. High charges of irrigation with MPS 77.91 and ranked in seventh. Insufficient demonstrations are conducted at farmers field by the govt. department with MPS 76.88. It was ranked in eighth. Timely agricultural information are not available at proper time with MPS 76.87. It was ranked in ninth and poor transport facilities with MPS 75.00. It was ranked tenth and last constraint regarding general constraints perceived by vegetable growers.

The data presented in Table-5, reveals that policeman created problem at barrier/police check post with MPS 81.04. It was ranked in first regarding marketing constraint perceived by vegetable grower, followed by

due to long distance of mother dairy the farmers were not able to sale vegetable in mother dairy with MPS 79.79. It was ranked in second. The marketing information's were not available at time with MPS 79.37 and ranked in third. There was no cooperative society to sale vegetables at government rate with MPS 79.17. It was ranked fourth, unavailability of market in the vicinity with MPS 78.96. It was in ranked fifth, more interference of middle man in marketing system with MPS 78.12. It was ranked in sixth. Poor marketing channel with MPS 77.71. it was ranked in seventh and unavailability of procurement prices of the produce absence of assumed marketing at remunerative price with MPS 76.67, It was ranked in eighth and last constraint regarding market as perceived by vegetable growers.

CONCLUSION

On the basis of finding it can be conduct that the major constraints faced by vegetable grower were unavailability of quality seeds at the time of showing, application of plant protection measure is risky due to lack of knowledge, field functionaries go through formalities to cover the targeted areas, insufficient training programmes are organized by government department , policeman created problems at barrier/police cheek post in adoption vegetable production and Insufficient demonstrations are conducted at farmers filed by the govt.

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THE CURRENT SCENARIO FOR REARING LIVESTOCK IN BUNDELKHAND REGION OF U.P.

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ABSTRACT

Keeping livestock is an important risk reduction strategy for vulnerable communities, and livestock are important providers of nutrients and traction for growing crops in smallholder systems. The Six villages from each village 60 households from different land holding were selected by proportionate sampling methods. The desired information was generated using a specially developed questionnaire and schedule, supplemented with visual observation and actual measurement. All the 360 selected respondents were interviewed and the relevant information regarding profile of farmers, herd size, system, typing of housing and feeding cover of related to dairy farming were recorded. The overall regression coefficient of herd size was positive and found highly significant for medium and large farmers. This indicated that most of the farmers in the study area had the herd size below the optimum size. There is a scope for increasing the milch animals to enhance their net income. The most common source of water used by the sample households was pumping set/hand pumps plus water pond/ditches plus water works depending on the season, time and availability of manpower. While a small number of farmers was dependents upon johar for drinking water in the landless and small farmer's categories of the sample households. About 75.26 per cent of the farmers were offering water in tasla/buckets to their animals followed by 19.59 per cent farmers in the old drums by the sample households.

Key word : Livestock, herd size, kharif

Livestock systems occupy about 30 per cent of the planet's ice-free terrestrial surface area (1) and are a significant global asset with a value of at least \$1.4 trillion. The livestock sector is increasingly organized in long market chains that employ at least 1.3 billion people globally and directly support the livelihoods of 600 million poor smallholder farmers in the developing world (2). Keeping livestock is an important risk reduction strategy for vulnerable communities, and livestock are important providers of nutrients and traction for growing crops in smallholder systems. Livestock products contribute 17 per cent to kilocalorie consumption and 33 per cent to protein consumption globally, but there are large differences between rich and poor countries (3). Livestock systems have both positive and negative effects on the natural resource base, public health, social equity and economic growth (4). Currently, livestock is one of the fastest growing agricultural subsectors in developing countries. Its share of agricultural GDP is already 33 per cent and is quickly increasing. This growth is driven by the rapidly increasing demand for livestock products, this demand being driven by population growth, urbanization and increasing incomes in developing countries (5). The global livestock sector is characterized by a dichotomy between developing and developed countries. Total meat production in the developing world tripled between 1980 and 2002, from 45 to 134 million tons (4). Much of this growth was concentrated in countries that experienced rapid economic growth, particularly in East Asia, and revolved around poultry and pigs. In developed countries, on the other hand, production and consumption of

livestock products are now growing only slowly or stagnating, although at high levels. Even so, livestock production and merchandizing in industrialized countries account for 53 per cent of agricultural GDP (4). Geographically, Bundelkhand lies between the Indo-Gangetic Plain to the north and the Vindhya Range to the south. This complex, diverse, and vulnerable agrarian region is socioeconomically heterogeneous and ethnically unique. Over 90% of the population is dependent on agriculture, livestock, usufructs from forest and outsourcing income by seasonal migration after *rabi* sowing. The flora of the region is rich in grasses with declared pasture lands, a reason for the dominant pastoral economy. The region can be credited with traditional agriculture, where field agriculture has an effective integration with pastoral agriculture, which plays a major role in agricultural activities, starting from the use of draft in sowing, irrigation, transport of goods and passengers and even the use of dung as fuel and manure, and for generating additional income from selling of milk, to improve the rural economy. Consequently, until recently, Bundelkhand had more livestock than humans. Recognizing that the monsoon is the only source of water [the majority of which falls in about 40 days spread over four months (June–September), with 50% in just 20 hours, limiting the time for penetration into the soil and recharging the groundwater (6).

MATERIALS AND METHODS

The sample data were collected from the Hamirpur district from Uttar Pradesh and Chhatarpur district from Madhya

Table-1 : Profile of farmers and herd size.

Particulars	Landless farmer (N=72)	Marginal farmer (N=72)	Small farmer (N=72)	Medium farmer (N=72)	Large farmer (N=72)	Total farmer (N=360)
Age						
<18 years	-	10.00	-	15.00	5.88	6.17
18-28 years	35.00	45.00	40.00	10.00	14.71	28.94
28-38 years	15.00	20.00	40.00	5.00	35.29	23.05
>38 years	50.00	25.00	20.00	75.00	44.12	41.82
Education status						
Illiterate	80.00	60.00	45.00	55.00	61.76	60.35
Primary	-	10.00	15	-	11.76	9.35
Middle	-	15.00	25	-	5.88	5.17
Matric	10.00	10.00	15	45.00	14.71	18.94
Graduate	-	5.00	-	-	5.88	2.176
PostGraduate	-	-	-	-	-	-
Main occupations						
Agriculture	-	-	-	-	-	-
Agriculture + Dairying	-	70.00	80.00	95.00	82.35	65.45
Casual labour + Dairying	80.00	-	-	-	-	16.00
Agriculture + Casual labour + Dairying	20.00	10.00	-	-	-	6.00
Agriculture + Dairying + Service	-	20.00	20.00	5.00	17.64	12.52
Percent area under fodder in Rabi and Kharif seasons						
< 5% Rabi Kharif	-	10.00	15.00	12.50	14.71	10.44
	-	-	10.00	8.50	11.76	6.05
5.1–10% Rabi Kharif	-	60.00	20.00	25.50	5.88	22.17
	-	75.00	25.00	22.50	5.88	25.67
10.1–20% Rabi Kharif	-	30.00	45.00	45.00	14.71	26.94
	-	20.00	55.00	60.00	23.52	31.70
> 20% Rabi Kharif	-	-	20.00	15.00	64.71	21.94
	-	-	10.00	10.00	58.82	15.76

Pradesh as it represented the Bundelkhalld region in true sense. Gohand (Hamirpur, Uttar Pradesh) and Naugao blocks (Chattarpur, Madhya Pradesh), falling in the milk shed areas of Hamirpur were selected. From each block, 3 villages were chosen purposively to suit the objectives of this study in consultation with the state government departments such as Animal Husbandry, Dairy Husbandry Departments and on the basis of information available from various secondary sources. Ten farmers each in the category of small, medium and large were selected randomly. Thus, 120 samples were collected from 4 villages through primary survey using specially designed and tested schedules (7). However, only valid samples were included for analysis as some farmers provided inconsistent information/data. Simple tabular approach was used for analyzing the data. All the livestock held by farmers were converted into equivalent adult cattle units for ease of computation and comparison. Weighted means for various parameters/indicators were calculated with weights being the respective proportions of small, medium and large farmers (8) in the population. Standard measures of central tendency and dispersion were used for working out mean, SE etc.

RESULTS AND DISCUSSION

The land and livestock holding patterns (Table-1) revealed that large farmers kept more livestock compared to small farmers. The same pattern was visible in respect of average family size as well. Larger families with more manpower usually kept larger livestock herds.

Profile of Farmers and Herd Size : The practices have been studied from the angle of bovine keepers as the beneficiaries of the project. To know about the socio-economic condition of the bovine keepers, their age, educational status, and main occupation were recorded.

Age : The data regarding age of the bovine keepers are presented in table-1. A majority of the farmers (41.82%) were above 38 years of age in the study area. Those who were in the age group of 18-28 and 28-38 years comprised 28.94 and 23.5 respectively. While below less than 18 years were 6.19 per cent. It was found that majority of the medium farmers (75 %) belonged to the age group of more than 38 years and there were (40 %) small farmers in both age groups of 18-28 and 28-38 years. The reports of (9) are in consonance with the

Table-2 : Herd size composition in studied households (% total with in each category).

Particulars	Landless farmer (N=72)	Marginal farmer (N=72)	Small farmer (N=72)	Medium farmer (N=72)	Large farmer (N=72)	Total farmer (N=360)
1. Milch Cattle						
1-2	75.00	60.00	25.00	5.00	5.88	34.17
3-5	25.00	20.00	45.00	35.00	11.76	27.35
5-10	-	20.00	30.00	20.00	23.52	18.70
>10	-	-	-	40.00	61.76	20.35
Cattle heifer						
1-2	65.00	75.00	85.00	10.00	-	47.00
3-5	35.00	25.00	15.00	90.00	100.00	53.00
Cattle calve						
1-2	80.00	77.00	55.00	-	-	42.4
3-5	20.00	22.50	45.00	100	100	57.5
Cattle Bullock						
1-2	-	100.00	95.00	100.00	100.00	79.00
3-5	-	-	5.00	-	-	21.00

Table 3 : System and type of housing for cattle in different categories of sample Households (% total) with in each category).

Particulars	Landless farmer (N = 72)	Marginal farmer (N = 72)	Small farmer (N = 72)	Medium farmer (N = 72)	Large farmer (N = 72)	Total farmer (N = 360)
1. System of housing						
Loose	-	-	-	-	-	-
Confined	100.00	100.00	100.00	100.00	100.00	100.00
2. Type of housing						
Pacca	15.00	10.00	2.50	-	-	5.56
Kachcha	77.50	80.00	90.00	92.50	100.00	88.00
Thwacked	7.50	10.00	7.50	7.50	8.5	6.7

present investigation. He reported that a large percentage of farmers were above 40 years of age in adopted. The variation from earlier studies was probably due to different study area.

Educational Status : The particulars of farmers engaged in bovine keeping according to their educational status are shown in table 1. The standard of education moulds the farmer's response to improve technology and market performance since enlightened farmers have higher motivation to sell milk to diversify farm business and to earn more. This is especially true of dairy farming which warrants a better quality of management input than the conventional crop farming. Majority of the farmers were illiterate (60.35%) in the study area among the remaining. The distribution of education as primary, middle, metric and graduate was 9.35, 5.17, 18.94 and 2.76 per cent, respectively. There was not a single post graduate farmer in the sample households. The highest percentage of illiterate (80%) was found in landless category. Further perusal of table indicated that 10 per cent farmers were found to be with primary and metric qualification in the landless and marginal farmer's categories. Contrary to these findings.

Main occupation : The data pertaining to main

occupation of sample households of the study area is presented in table 1. A perusal of the data revealed that on an average 65.45 per cent of households were mainly dependent on crop farming plus dairying in the study area. Among remaining farmers 16.00, 6, 12.49 per cent were engaged in the casual labour plus dairying, crop farming plus casual labour plus dairying and crop farming plus dairying plus in service, respectively. The majority of landless farmers 80 per cent were engaged in casual labour plus dairying in the study area and remaining 20 per cent in crop farming plus casual labour plus dairying. Twenty per cent of the farmers belonging to marginal and small farmer's categories were found to be dependent upon crop plus dairying plus in service.

Area under fodder crops : It was observed that less than 5, 5.1 to 10 and 10.1 to 20 per cent and more than 20 per cent land was being used for fodder production by 12.50 and 8.50 and 25.67, 26.94 and 31.70, 21.94 and 15.76 per cent farmers in the seasons of rabi and *Kharif*, respectively in the study area. Most of the farmers (26.94 and 31.70 %) were using 10.1 to 20 per cent of their land for fodder production in the *Rabi* and *Kharif* seasons, respectively. It was further observed that 5.1 to 10 per cent land was being use d of fodder production by the 60 per cent and 75 per cent marginal farmers in *Rabi* and *Kharif*

Table-4 : Mode of housing for cattle on different categories of sample households (% total with in each category).

Particulars	Landless farmer (N=72)	Marginal farmer (N=72)	Small farmer (N=72)	Medium farmer (N=72)	Large farmer (N=72)	Total farmer (N=360)
(a) Mode of housing						
In Open	-	-	-	-	-	-
Under tree	-	-	-	-	-	-
Under shelter	-	-	-	-	-	-
Close house	-	7.50	2.50	5.00	-	3.00
1+2+4	22.50	15.00	12.50	17.50	8.82	15.26
5+3	20.00	22.50	47.50	7.50	14.70	22.44
2+4	37.50	50.00	35.00	70.00	76.47	53.79
1+3+4	37.50	50.00	35.00	70.00	76.47	53.79
(b) Place of keeping animals						
Inside Dwelling	5.00	-	-	-	-	1.00
Near Dwelling	-	-	7.50	-	-	1.5
Separate Dwelling	12.50	22.50	22.50	32.50	11.76	20.35
In field	-	-	7.50	-	-	1.5
In open at public place	2.50	-	-	-	-	0.5
1+2	17.50	8.54	-	-	-	4.60
1+3	18.50	2.54	-	7.50	-	5.70
2+7	5.00	7.00	-	-	-	2.4
1+4	30.00	5.00	-	2.5	-	7.5
2+3	5.00	7.50	23.54	17.50	-	10.70
2+4	-	25.00	12.50	15.00	29.41	16.38
3+4	-	22.50	23.00	25.00	58.80	25.86
8+4	5.00	2.50	5.00	-	-	2.5

seasons, respectively. While more than 20 per cent land was being used for fodder production by 64.71 and 58.82 per cent large farmers in *Rabi* and *Kharif* seasons, respectively. There was increasing trend in placing of land under fodder production in both the seasons with the increasing holding size i.e., 5.1 to 10 per cent, 10.1 to 20 per cent and more than 20 per cent land was placed under fodder production by the majority of marginal, small, medium and large farmers, respectively. It is clear from the data that large farmers were more progressive in term of percentage of land used for fodder production for feeding of their buffaloes *vis a vis* other category of farmers presumably because of more land available at their disposal for cultivation of green fodder and thereby they were aware of the value of feeding green fodder to their cattle.

Herd strength : The profiles of buffalos kept by the various categories of farmers presented in table 2. The majority of farmers 34.17 were maintaining 1-2 milch cattle and only 20.35 per cent were having more than 10 cattle seventy five per cent landless and 60 per cent marginal farmers possessing. None out of the landless category was keeping more than 5 cattle. However, the upper limits of number were up to 10 in case of marginal and small categories of farmers. Forty per cent medium and 61.76 per cent large farmers were having more than 10 cattle in their herds. All the categories of farmers excluding landless were keeping at least one cattle bullock for the purpose of bullock cart.

Housing Management Practice : The main objective of housing is to provide protection against adverse weather conditions, *i.e.* excessive heat, cold or rains. It is necessary to provide comfortable and sanitary housing for the animals for achieving rapid growth and higher productivity. The requirement for animal housing is also important from the point of view of animal health, comfort, hygienic conditions, and minimum feed wastage, efficient and economic use of labour and hygienic milk production.

System of Housing : The data collected from the different categories of farmers regarding housing of cattle are presented in table 3. It was found that not even a single respondent kept the animals under loose house condition. They were keeping them in the confined /conventional housing. For this, the reasons could be the lack of space in the red boundary of respective village and small herd sizes with different type/category of animals. The majority of farmers (88.00%) were having *kachcha* house for their animals in the studied households. Out of the remaining 5.56 per cent were having *pacca* and 6.70 per cent households were having *thatched* type of housing. It was further observed that all the large farmers kept their animals in *kachcha* house and even 77.50 per cent landless farmers confined their animal to *kachcha* structure (table 3). The findings are in conformity with (10, 11, 12 and 9) who surveyed the animal husbandry practices prevalent in different villages of Karnal.

Mode of Housing : Almost all the farmers did not keep

Table-5 : Watering facilities available for cattle on different categories of holding (% total within each categories).

Particulars	Landless farmer (N=72)	Marginal farmer (N=72)	Small farmer (N=72)	Medium farmer (N=72)	Large farmer (N=72)	Total farmer (N=360)
(a) Mode of providing water						
Use of water through	-	2.50	-	7.50	14.71	4.94
With buckts	12.50	25.00	15.00	40.00	20.44	22.58
Taking animals to water source	77.50	52.50	60.00	32.50	50.00	54.5
2 + 3	10.00	20.00	27.50	20.00	14.71	18.44
(b) Source of water						
Canal	5.00	10.00	-	15.00	5.88	7.17
Tube Well	-	7.50	2.50	12.50	8.80	6.26
Wells	12.50	10.00	20.00	15.00	23.53	16.20
Water pond	15.00	-	10.00	-	-	5.00
Water works	12.50	5.00	-	-	-	3.5
1+2+3	-	5.00	-	17.50	17.65	8.03
3+5+6	50.00	60.00	67.50	40.00	44.00	52.58
3 + 6	5.00	2.50	-	-	-	1.55
(c) Type of water troughs/ vessels						
Constructed (Pacca)	72.50	82.50	65.00	85.00	70.59	75.11
Old drums	27.50	17.50	22.50	10.00	20.59	19.61
Tasla/bucket	-	-	12.50	5.00	8.80	5.26
(d) Frequency of drinking water per day						
1. One time						
Summer	17.50	12.50	12.50	12.50	20.59	15.11
Winter	12.50	7.50	7.50	15.00	20.59	12.61
Rainy	-	-	-	-	-	-
2. Two to three time						
Summer	87.50	92.50	92.50	85.00	79.42	87.38
Winter	82.50	77.50	82.50	82.50	73.53	79.70
Rainy	72.50	70.00	52.50	60.00	64.71	63.94
3. More than three time						
Summer	27.50	30.00	47.50	45.00	35.15	37.03
Winter	-	10.00	5.00	5.00	5.00	5.00
Rainy	-	-	-	-	-	-

their animals generally at a single place throughout the year or even for a whole day and night. The modes of houses provided by the various categories of respondents were mainly dependent on the economic status of the farmers. They kept their animals in combination at different places. it was observed that majority of the farmers (53.79%) kept their animals in open plus under shelter and closed house wherein they were let loose in a day for sometimes, depending on the prevailing climatic conditions. On an average, 22.44 per cent farmers were keeping their animals in combination of in open plus under tree plus indoor plus let loose in a day for some time plus under shelter. The number of farmers under different categories who were following other combinations as mode of housing, their animals was quit small (table 4). There is a common belief amongst the farmers that animals should be kept indoors at least during winter night. (13) reported that majority of the respondent had closed sheds, one side open and sheds in open area of the house and most of the buffaloes kept under covered shed during summer given them bath regularly. (14) reported that farmers were keeping their animals e.g. tethering under trees, tethering closed to and in the shade

of their dwelling quarters, under thatched of mud roofed shed, enclosing with in fenced or mud walled paddocks, etc. buffaloes are in invariably let out for grazing, rooming around or wellowing in ponds etc.

Place of keeping animals : The place of keeping animals by farmers is presented in table 4. Perusal of the data reveals that 20.35 per cent farmers were keeping animals at separate place from dwelling and 25.86 per cent in combination of separate from dwelling in fields/in open. The remaining farmers were keeping animals at single or in combination of place as indicated in table 4. There were only few per cent landless farmers who were keeping their animals inside the building where they were living. This may be due to the greater economic backwardness of landless farmers, 30 per cent were keeping animals in combination of inside dwelling and in field or in open. While among large farmers, 58.82 per cent were keeping animals in combination of separate from dwelling and in fields or in open. The present findings are in line with (15) who surveyed the management husbandry practices prevalent in different villages. On the other hand, (11) reported that 81.70 per cent of the respondents were

housing their animals in human dwelling and 76.40 per cent of the respondents were in favour of constructing animal's sheds outside the village in Hisar. (16) investigated the migratory dairy farming in Jammu and Kashmir and reported that the Dodi Gujjar herdsman trek with their dairy cattle to the plains around Jammu and winter and the pastures of per paschal during summer, living during temporary dwelling which accommodates both the family and animals.

Watering facilities : Facilities for clean drinking water is an important aspect of management process as feeding etc. in rural areas, most of the animals suffer from end parasitic infection, especially roundworms due to dirty and contaminated drinking water. Considering the importance of drinking water various aspects related to the watering facilities for bovine were studied in the villages of and the data pertaining to this are presented (table 5).

Mode of providing water : Provision of separate drinking water through was found to be rare (4.94%) in the study area (table 5). It was found that 54.5 per cent farmers had preferred to take their animals to the water source followed by 22.58 and 18.44 per cent with buckets /tasla, in combination of with buckets and taking animals to water source, respectively. Significantly higher percentage of landless farmers took their animals to water source than any other category of farmers.

Type of water troughs/vessels : Only 5.26 per cent of the farmers were found to be having tasla/bucket water trough for their animals in sample households, while (17) Planning and management of canal based rural drinking water supply schemes a study of Bathinda District. (Table-5)

Frequency of drinking water per day : Frequency of providing drinking water two to three times per day during summer, winter and rainy seasons were 87.38, 79.90 and 63.94 per cent, respectively. For one time offer of water, there were 12.61 and 15.11 per cent cases in winter and summer seasons, respectively. More than three times per day during summer and winter seasons was observed in 37.03 and 5.00 per cent cases, respectively (table 5). Perusal data showed that majority of the farmers were found providing drinking water 2-3 times per day.

It is concluded that with proper planning of the integrated crop livestock development programmes, the livestock production and productivity could be increased many fold in the region. This will be generated additional employment and improve the economic condition of the farmers.

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STUDIES ON AVAILABILITY OF FEED, FODDER AND GRAZING RESOURCES FOR LIVE-STOCK IN BUNDELKHAND REGION

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ABSTRACT

Livestock is an important component of agriculture in India. In Bundelkhand region of Central India, animals are reared for milk, manure, draft and as wealth. The traditional practices in animal feeding depend upon the locally available feed. Green fodder feeding is practiced by only 27.47 per cent farmers the percentage of farmers preferred straw feeding was the highest (31.62%). About one-fourth, of the farmers could not feed plenty of green fodder as they did not grow sufficient fodder due to cereal crop pressure on land and it was difficult to procure it from outside. Most of the farmers (92.50 %) did not provide concentrate to their animals. However 7.5 per cent of farmers provide concentrate, dry concentrate and green fodder plus concentrate was observed in 15.67, 4.12 and 2.50 per cent of the sample households. In case of landless and marginal farmers, dry concentrate and green fodder plus concentrate was recorded. Before feeding roughage chaffing was practiced by 85.47 per cent farmers of the sample households and as 14.4 per cent farmers were feeding roughage without chaffing. The percentage of landless and marginal farmers who were feeding roughage without chaffing was on higher side. The daily expenditure was highest for fodder followed by concentrate, labour, electricity, treatment and service/A.I. in all the categories of farmers keeping milch animals. The values of regression coefficient of fodder cost were positive and highly significant ($p>0.01$) for all the categories of farmers except medium category.

Key word : Feed, roughage chaffing, grazing, tree.

Bundelkhand region covers 7 districts of Uttar Pradesh and 6 districts of Madhya Pradesh. Livestock is an essential part of the rural economy and important source of livelihood in the region. Animals are reared as an insurance against crop failure due to low productivity of soils and unreliable rain. (1) depicted that the density of cattle (0.71 animals/ha land) was maximum followed by goats (0.30 animals/ha), buffaloes (0.2 animals/ha) and sheep (.07 animals/ha) (1). They are mainly fed on crop residues as wheat, pea and gram straw. The green fodder is only being fed to milch animals which consist of locally available annual grasses and tree leaves. Livestock are being left for grazing (commonly known as *anna pratha*) during lean season and also during rainy season (2). Fodder (browse) is an agricultural term for animal feed, and fodder trees and shrubs are those plants (shoots or sprouts, especially tender twigs and stems of woody plants with their leaves, flowers, fruits or pods) that are raised, used and managed to feed livestock. Fodder plants are plants which are grown in order to provide the nutritional needs of animals. (3) Opined that fodder and shrubs are important components of ruminant diet and they have been found to play important roles in the nutrition of grazing animals in areas where few or no alternatives are available (4). Development and growth of livestock are conditioned by the availability of fodder from forest and arable land. Traditionally, cattle grazed on the pastures and grazing lands and supported by feeding crop residues. Crop residues and by-products comprise the main feed stuff accounting for 40 per cent of the total feed

and fodder consumption (5). Green fodder contributes about 26 per cent, while concentrate feed contributes only 3 per cent of the total feed consumption. The rest comes from grazing (6). Large gap exists between requirement and the actual availability of feed and fodder at the national level. The deficiency in feed and fodder is more conspicuous in arid and semi-arid regions (7).

MATERIALS AND METHODS

Bundelkhand region is located between 23°8-26°31 latitude and 78° 11-81 ° 31 E longitudes. The region is characterized as hot semi arid eco region along with growing period of 90-150 days. The annual rainfall ranges from 838.6-1251mm over the region which is often erratic. Diurnal variation in temperature is very high. In the study two blocks were selected randomly viz., Gohand (Hamirpur, Uttar Pradesh) and Naugao (Chattarpur, Madhya Pradesh), respectively and each block three villages were selected namely; Auta, Akauna and Dhanauri villages from Gohand block and Doni, Khurda and Jhijhan villages from Naugao block and each villages 60 farmers were selected to their land holdings. Survey was mainly done on a pre-tested and modified format by open ended interviews about the livestock feeding pattern, fodder resources, major diseases of animals, prevalent traditional practices for controlling diseases by plants and other raw materials and mode of application. The documented practices were further scientifically validated by consulting experts from Indian Grassland and Fodder Research Institute, Jhansi as well as from relevant

Table-1 : Feeding practice followed by cattle owners on different categories of holdings (%total with in each category).

Particulars	Landless farmer (N=72)	Marginal farmer (N=72)	Small farmer (N=72)	Medium farmer (N=72)	Large farmer (N=72)	Total farmer (N=360)
(a) Roughages						
Straw	7.50	26.50	37.50	42.50	44.12	31.62
Green fodder	-	-	-	-	-	-
Legumes + Non legumes	7.50	30.00	30.00	37.50	32.35	27.47
Other residues	40.00	10.00	10.00	7.50	2.94	14.08
1+2	20.00	25.00	12.50	7.50	14.71	15.94
5+4	5.00	-	-	-	-	1.03
y+6+5	20.00	7.50	10.00	5.00	5.88	9.67
(b) Concentrate						
Feed	25.00	10.00	2.50	-	-	7.5
Not Feed	75.00	90.00	97.50	100.00	100.00	92.50
(c) Mode of concentrate feeding						
Dry concentrate	-	-	5.00	7.50	8.82	4.22
Water concentrate	15.00	7.50	27.50	12.50	38.24	20.14
Straw concentrate	85.00	92.50	65.50	77.50	64.71	77.04
Green fodder concentrate	-	-	-	2.50	11.77	2.85
(d) Concentrate composition followed						
Mustard cake	52.50	47.50	40.00	25.00	17.65	36.5
Cotton seed cake	-	15.00	10.00	10.00	5.88	8.17
Wheat flour	-	-	5.00	7.50	8.82	4.26
Gram husk	-	5.00	2.50	5.00	5.88	1.67
1+2	-	7.50	7.50	10.00	11.62	7.12
5+4	47.50	25.00	35.00	32.50	35.29	35.05
2+3+4	-	-	-	10.00	14.72	4.94
(e) scale used for feeding fodder and concentrate						
Age	-	-	-	-	-	-
Body weight	-	-	-	-	-	-
Milk yield	70.00	65.00	54.50	65.00	47.06	60.31
Breed	2.50	5.00	11.50	10.00	11.76	8.15
1+2+3+4	27.50	28.00	32.00	25.00	41.18	30.73
(f) Feeding frequency of fodder and concentrate per day						
One time :						
Roughage	26.50	37.50	32.50	30.50	23.53	30.10
Concentrate	10	5.00	5.00	2.50	5.88	5.67
Two time :						
Roughage	70.00	42.50	42.50	60.00	79.41	58.88
Concentrate	30.00	60.00	65.00	80.00	76.48	62.29
(g) Feeding timing of roughage :						
Early morning	5.00	-	-	2.50	5.88	2.67
Just afternoon	-	-	-	-	-	-
Late night	5.00	5.00	5.00	-	-	3.09
1+2	-	15.00	10.00	-	-	5.00
1+3	30.00	45.00	45.00	50.00	58.80	45.76
2+3	-	-	10.00	35.00	17.50	12.5
4+3	60.00	35.00	30.00	12.50	17.64	31.02

literature. The matrix ranking of local grasses and tree sp. was worked out to prioritize the utilization and knowledge of farmers regarding fodder grasses, trees and water sources (8).

RESULTS AND DISCUSSION

Good quality roughage with concentrate is essential and economical for feeding dairy animals. Regular supply of green fodder throughout the year is very important for

Table-2 : Feeding practice followed by cattle owners on different categories of holdings (%total with in each category).

Particulars	Landless farmer (N=72)	Marginal farmer (N=72)	Small farmer (N=72)	Medium farmer (N=72)	Large farmer (N=72)	Total farmer (N=360)
(h) Green fodder feeding during the day						
Throughout the year	10.00	20.00	25.00	50.00	38.20	28.64
Seasonal	90.00	80.00	75.00	50.00	61.70	71.34
(i) Animal grazing practice						
Regular	80.00	67.50	40.00	22.50	26.40	47.28
Occasionally	20.00	32.50	60.00	77.50	73.53	52.70
(j) Grazing site						
Road side	45.00	12.50	2.50	-	-	12.00
Post harvest fields	15.00	57.50	75.00	87.50	73.53	61.70
Road side + Post harvest fields	40.00	30.00	22.50	12.50	26.47	26.29
(k) Whether roughage chaffing before feeding						
Done	27.50	20.00	7.50	2.50	14.70	14.4
Not done	72.50	80.00	92.50	97.50	85.29	85.55
(l) Usual ratio of dry and green fodder						
2:1	65.00	55.00	17.50	5.00	-	28.5
vr1p11:1	30.00	37.50	67.50	45.00	38.21	43.64
1:2	5.00	2.50	7.50	15.00	20.58	10.11
1:3	-	5.00	7.50	35.00	41.17	17.73
(m) Provision of jiggery feeding						
Not feed	60.50	60.00	75.00	82.50	82.35	72.07
Feed	35.50	35.00	25.00	17.50	17.50	26.1
(n) Provision of salt feeding						
Offered	7.50	12.50	10.00	20.00	26.45	15.29
Not offered	92.50	87.50	80.00	80.00	73.53	82.70
Through feed	50.00	75.00	30.00	72.50	64.70	58.44
Through chapatti	48.00	25.00	65.00	26.50	35.29	39.95
(p) Roughage feeding ad lib						
Yes	55.00	67.50	70.00	65.50	85.50	68.7
No	45.00	32.50	30.00	32.50	14.50	30.9
(q) Fodder seeds of improved varieties used						
Yes	-	20.00	20.00	-	5.88	9.17
No	-	75.00	80.00	95.50	95.12	69.12

efficient animal production and reproduction. Question relating to each practices of feeding was posed separately to know the level of followed practices. The data showing these responses are contained in table-1.

Roughages : The green fodder feeding is practiced by only 27.47 per cent farmers (Table-1). The percentage of farmers preferred straw feeding was the highest (31.62%). Grasses plus weeds, straw plus green fodder plus legumes plus non-legumes, ad straw plus green fodder plus legumes plus grasses plus weeds was offered to their animals by 14.08, 15.94, 1.03 and 9.67 per cent sample households, respectively. About one-fourth of the farmers were being provided green fodder, possibly due to the reason that the farmers could not feed platy of green fodder as they did to grow sufficient fodder due to cereal crop pressure on land and it was difficult to procure it from outside. However, (9) observed that people preferred to provide green fodder to their animals ad preferred also to have green fodder on their lad for their buffalo first that for

cereals. (10) This conducted examined two different categories of feeding practice: (1) intensive, (2) semi-intensive, and feeding practice depend solely on commercially manufactured pelleted feeds while the semi-intensive category refers to the feeding practice of using farm-made aqua feeds.

Concentrate : Most of the farmers (92.50%) did not provide concentrate to their animals. However 7.5 per cent of farmers provide concentrate to their animals (Table 1). (11) Also reported that idea all the farmers provided concentrate to the milch cattle except a few in the rural area.

Mode of concentrate feeding : It was found that straw plus concentrate was the popular mode of concentrate feeding as followed by majority (77.04%) of the farmers. Water plus concentrate, dry concentrate and green fodder plus concentrate was observed in 20.14, 4.32 and 2.58 per cent of the sample households. In case of landless ad

marginal farmers, dry concentrate and green fodder plus concentrate plus concentrate was not recorded (Table-1). (12) Reported that majority of the farmers were giving concentrate plus roughage (green) to their pregnant and lactating buffaloes in Ludhiana district.

Concentrate composition : The concentrate prepared by mixing at least 2-3 ingredients in proper ratio not only help in balanced feeding to animals but also reduced the cost of concentrates. However, it is not commonly practiced by the farmers in rural areas. About 36.5 per cent of the farmers were providing mustard cake to their animals of the sample households followed by 35.05 per cent of the farmers who were offering concentrate in combination of mustard cake plus wheat flour to their animals. Rest of the farmers were giving binola (8.17%), wheat flour (4.26%), gram husk (3.67%) and in combination of these (Table 1). (13) Found that about 33.00 per cent respondents were given binola to their animal to increase fat content of milk.

Scale used for feeding fodder and concentrate : The scale used for feeding fodder and concentrate to the animal generally was based on milk yield. Majority (60.31%) of the farmers followed these criteria (Table 1) there were 30.73 per cent farmers who were found to consider overall performance of the animal including age, body weight, milk yield and breed for feeding fodder and concentrate. The small percentage of households (8.15%) was giving weight age to the breed of the animal.

Feeding frequency of fodder and concentrate per day: Data regarding frequency of feeding and fodder concentrate during the day are presented in table 1. The maximum number of households (62.29%) was found offering 2 times roughage feeding per day. However, there were 31.44 percentages of farmers who were following the practice of three times a day feeding and quite opposite, i.e. one time feeding was also recorded in 5.67 per cent households. Perusal of data showed that majority of the land less farmers (60.00%) were found to be giving roughage and three times during the day and in case of all other categories of farmers, the majority was feeding 2 times. It is also observed that one time feeding roughage was more prevalent in landless households (10.00%) in comparison to all other categories of farmers. In case of concentrate feeding, the frequency of 2 times per day was recorded in majority of households (58.88%). However, there were 30.10 per cent farmers who were giving concentrate to their animals only one time and 11.86 per cent were doing so three times in a day. The percent of landless farmers who were feeding concentrate one time and three times in a day was less than in case of other farmers.

Feeding timing : Proper roughage feeding and feeding timing are very important consideration in the process of

feeding practice management. The common roughage feeding routine as early morning, late night, early morning plus just after noon, early morning plus late night, just afternoon plus late night and early morning plus just after noon plus late night was adopted by 2.58, 3.09, 5.00, 45.76, 12.5 and 31.02 day per cent of sample households, respectively (Table-1). (14) reported that during all the three seasons, 65 to 67 per cent of roughage feeding occurred during the day and 33 to 35 percent during the night, and buffaloes had 3 major feeding periods during day-night hours and 2 during the night.

Green fodder feeding : Green fodder feeding was practiced by 28.64 per cent of the farmers as seasonal and 71.65 per cent throughout the year (Table 1). (15) Also reported that less than 1 /4th (23.75%) farmers fed green fodder throughout the year in Karnal. The percentage of regular green fodder feeding throughout the year was minimum (10.00%) in landless in comparison to other categories of farmers. The highest percentage feeding green fodder round the year was observed in large farmers households (50.00%).

Grazing practices : In response of grazing practices, 52.70 and 47.28 per cent farmers were found to be sending their animals out for grazing regular and occasional, respectively (Table 1). the data presented in the table revealed that regular animal grazing practice was maximum in case of landless farmers (80.00%). on the other hand, only about 1/4th of medium and large farmers were sending their animals regularly for grazing. (15) Reported that 85 per cent farmers were sending their animals out for grazing in the villages of Karnal.

Grazing sites : Majority (61.70%) of the farmers were found to be keeping grazing site for their animals in the post-harvested fields. rest of the farmers who were keeping grazing site on road sides and in post - harvested fields plus on road sides as 12.00 and 26.29 per cent, respectively (Table 1). the majority of landless farmers (45.00%) were utilizing road sides as common grazing site. On the other hand, none of the medium and large farmers have sent their animals for road side grazing. In case of marginal and small farmers also the percentages were only 12.50 and 2.50, respectively. The social status of the farmers and availability of post harvested fields might be major factor for these differences.

Roughage chaffing : Before feeding roughage chaffing was practiced by 14.4 per cent farmers of the sample households and as 85.55 per cent farmers were feeding roughage without chaffing. The percentage of landless and marginal farmers who were feeding roughage without chaffing was on higher side (Table 1). (16) Suggested that to popularize fodder production and its chaffing, a farmer providing certain acreage of fodder should be encouraged by giving him a chaff cutter free as an incentive.

Dry and green fodder ratio : The usual ratio of dry and green fodder 1:1 was followed by the majority (43.64%) of farmers of the sample households followed by ratio of 2:1, 1:3, and 1:2 by 28.5, 17.73, and 10.11 per cent of the farmers, respectively (Table I). from the data given in the table, it is quite evident the percentage of landless farmers feeding dry and green fodder in ratio of 2:1 was highest (65.00%) and none of them was feeding green in ratio of 1:3 on the other hand, the majority of large farmers (41.17%) were feeding dry and green in 1:3 ratio and they were not feeding green fodder less than of 1:1 ratio. The feeding of more green than dry fodder by farmers with higher land holding was perhaps due to use of more land of fodder production. Possibly those using high ratio of dry and green fodder were compelled to do so due to shortage of green fodder.

Provision of jaggery feeding : About 72.16 per cent of farmers were not found to fed jaggery (gur) to their animal and only 27.84 per cent families were following the practice of giving jaggery (gur) to their animals. It is also noted that the percentage of landless farmers was more (37.50%) than large farmers (17.64%) who were offering gur to their animals (Table-1).

Provision of salt feeding : There were 85.05 per cent of farmers who were found not offered salt to their animals in sample households. The large farmers offered the salt in higher percentage (26.01) in comparison to landless farmers (7.50%)

Procedure of salt feeding : By the majority of farmers (58.44), salt was offered to their animals through feed and by 39.95 per cent through chapatti etc. the half of the landless farmers fed salt either through feed or chapatti in the study area. While in case of marginal farmers salt was fed three times more through feed than through chapatti (Table-1).

Roughage feeding : The farmers were also asked to reply whether they fed roughage *ad lib* to their animal. Accordingly, 68.7 per cent of the sample households were found to give positive response and rest of the farmers 30.09 per cent had given negative response (Table 1). The percentage of farmers giving *ad lib* roughages was highest in case of large farmers (85.50%) and lowest in case of landless households (50.00%). About 69.12 per cent of the farmers agreed with the use of improved varieties of fodder seeds. Remaining farmers (12.34%) agreed with the traditional on-going varieties of fodder seeds (Table-1).

In general, it was concluded that the farmers can increase the productivity of milch animals through feeding of qualitative availability, effective and timely treatment, better housing system, use of electricity in chaffing, watering and grinding etc., more and productive milch animal and better utilization of manpower. Thus by

diverting the expenditure on above explanatory variables productivity and net income can be increased significantly.

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EFFECT OF RHIZOBIUM INOCULATION AND NITROGEN APPLICATION ON GROWTH, SEED YIELD AND QUALITY OF MUNGBEAN (*Vigna radiata* L.)

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ABSTRACT

An experiment was conducted during summer season 2011 at student instructional farm, N.D.U.A. and T Kumarganj, Faizabad (U.P.) the study was aimed to evaluate the effect of Rhizobium and nitrogen levels on yield and yield attributing characters of summer greengram (*Vigna radiata* L.). The eight treatments viz., control N0R0, N10R0, N20R0, N30R0, N0R1, N10R1, N20R1, and N30R1 were replicated thrice in Randomized Block Design. The greengram variety NDM-1 was taken a test crop. The results of field experiment revealed that plant height, number of nodule/plant, fresh and dry weight of nodule plant-1 and plant population increased significantly due to inoculation of 20 kg N/ha with Rhizobium. Maximum yield and yield attributing characters viz., no. of pods/plant, test weight, seed and stover yield found in the same treatment combination. Nitrogen and protein content of seed, showed significantly increased with application of 20 kg N/ha with Rhizobium.

Key words : Rhizobium inoculation, growth, yield and quality attributes.

In commercial agriculture, the use of chemical fertilizers cannot be ruled out completely. However, there is a need for integrated application alternate sources of nutrient for sustaining the desired crop productivity. Nitrogen fixation by grain legumes is an effective and economic way of providing nitrogen in the crop, livestock farming system. The most reliable approach is to inoculate the beneficial microorganism into soil as part of mixed culture and at a sufficiently high inoculums density to maximize the probability of its adaption to environmental and ecological conditions (1). Inoculation of mungbean with Rhizobium, which enhances the nitrogen nutrition of the crop through symbiotic fixation of atmospheric nitrogen for augmenting the efficiency of biological nitrogen fixation, the native efficient and component strains are required to be isolated from seed inoculation of legumes. Effectiveness of the symbiotic nitrogen fixation depends upon the relationship between host, efficient Rhizobium strains and ecological factors. Inoculations of mungbean with Rhizobium increased plant height, number of nodule/plant and seed yield (2). (3) obtained the seed yield of mungbean with Rhizobium inoculation similar to that of 20 kg N/ha. Nitrogen, being a major constituent of protein and chlorophyll content must be adequately and timely supplied to the crops. Although pulses are capable of extracting nutrients from soils and fixing atmospheric nitrogen, yet they need a small initial basal dose of nitrogen fertilizer for quick and better establishment of plant. At late stage when roots are well developed, they start fixing atmospheric nitrogen with the help of root nodule bacteria (*Rhizobium* Spp.), so no need of top dressing of nitrogen. Although this crop is capable of fixing atmospheric nitrogen through Rhizobium species living in root nodules however, under our agro-ecological conditions the nodulation of mungbean is poor and is a

major cause of its lower yield. The present studies were conducted to evaluate effect of soil and seed inoculation alone and in combination with different nitrogen levels on yield and yield attributing characters of mungbean plant and to compare the efficiency of seed inoculation against soil inoculation for nitrogen fixation.

MATERIALS AND METHODS

For evaluating the response of mungbean to soil and seed inoculation and use of nitrogen fertilizer, a field experiment was initiated during the summer season 2011 on a sandy loam at student instructional farm, N.D.U.A. and T. Kumarganj, Faizabad in Uttar Pradesh. The pH, EC, organic carbon and available phosphorus of the experimental soil at the initial stage (before sowing) were 8.07, 0.32 dS/m, 0.36% and 17.80 kg/ha respectively. The soil was high in available nitrogen (260.0 kg/ha) and high in potassium (272.20 kg/ha). Nitrogen was applied to soil at the rate of 0, 10, 20 and 30 kg/ha through urea in greengram (NDM-1). The crop was sown in the rows 30 × 10 cm at seed rate of 25 kg/ha in furrows on 29 march 2011. Randomized block design was followed with three replications. A basal application of nitrogen and potassium was given to greengram through urea and muriate of potash, respectively. The green gram crop was allowed to grow up to 66 days and grain yield was recorded. Nitrogen in plants was determined by kjeldahl method plant samples were digested in diacid (HNO³OHClO₄) mixture and phosphorus concentration was determined by ammonium molybdate vanadate yellow colour method (4). Potassium in acid extract determined by flame photometer, using neutral normal ammonium acetic solution (4). For seed, inoculation seeds were coated with @ Rhizobium 20 g/kg seeds. The treated seeds were kept in shade approximately for 2-3 hrs to get in dry, there after

Table-1: Effect of rhizobium and nitrogen levels on growth parameters in greengram.

Treatments	Plant height (cm)	No. of nodules/plant	Fresh weight of nodules/plant	Dry weight of nodules/plant	Plant population (m ²)
Nitrogen levels (kg/ha)					
N ₀	48.94	21.50	243.30	51.54	27.00
N ₁₀	57.13	30.52	301.57	61.20	28.25
N ₂₀	57.80	31.73	304.04	62.52	29.00
N ₃₀	55.60	27.02	291.20	55.23	28.50
SEm ±	1.29	0.61	6.65	1.32	0.65
CD at 5%	3.91	1.85	20.16	4.00	NS
Rhizobium Inoculation					
R ₀	52.28	22.60	260.19	52.92	28.13
R ₁	57.45	32.78	309.87	62.32	28.25
SEm ±	1.49	0.71	7.67	1.52	0.79
CD at 5%	4.51	2.14	23.28	4.62	NS

Table-2 : Effect of rhizobium and nitrogen levels on yield attributes, yield and quality of mungbean (*Vigna radiata* L.)

Treatments	Yield attribute		Yield (q/ha)	
Nitrogen levels (kg/ha)				
	No. of pods/plant	Test weight (g)	Seed	Straw
N ₀	29.17	31.07	7.89	17.13
N ₁₀	33.75	33.67	10.38	21.17
N ₂₀	35.76	34.05	10.52	21.49
N ₃₀	34.28	32.35	9.52	19.68
SEm ±	0.77	0.78	0.22	0.46
CD at 5%	2.33	NS	0.66	1.40
Rhizobium Inoculation				
R ₀	31.87	32.32	8.53	17.37
R ₁	34.61	33.25	10.62	22.36
SEm ±	0.89	0.90	0.25	0.53
CD at 5%	2.69	NS	0.76	1.61

the seeds were sown in the plots as per treatment. All agronomic practices were kept uniform and normal for all treatments. Data on growth parameters such as plant height, number of nodule/plant, fresh and dry weight of nodule/plant and plant population therefore yield attributing characters viz., no. of pods/plant, test weight (1000 seeds), seed, stover yield and harvest index was recorded. The plant samples were analyzed for available nitrogen (5). Available Phosphorus (6), available potash (4) and nutrient content in seed was computed. Protein content in seed was obtained by multiplying total nitrogen in seed with a factor of 6.25 (7). The data recorded during investigation were statistically analyzed by fisher's analysis of variance technique (8).

RESULTS AND DISCUSSION

Nodulation : Data (Table-1) showed that application of increasing levels of fertility upto 20 kg N/ha with Rhizobium produced significantly increased the no. of root nodules/plant, fresh and dry weight of nodules/plant at harvest stage, respectively. Better nodulation in combined inoculation might be due to increased nitrogen availability through Rhizobium and enhanced biological nitrogen fixation in mungbean (9). Since nitrogen has a specific role in nodule formation and microbial activities in the soil, the adequate supply of 20 kg N/ha with Rhizobium have

enhanced the growth attributes significantly. Similar results were also reported by ().

Yield attributes : Dual inoculation of mungbean seed with 20 kg/ha with Rhizobium recorded the maximum no. of pods/plant, test weight (1000 seeds), seed yield and straw yield over control (Table-2). Such increases in yield attributing characters might be because Rhizobium inoculation increased the root nodulation through better root development and more nutrient availability resulting in vigorous plant growth and dry matter production, which resulted in better flowering, fruiting and pod formation, and ultimately there was beneficial effect on seed yield (10).

(10) who reported that no. of pods/plant of mungbean was increased with the application of nitrogen fertilizer (11) reported that inoculation and nitrogen fertilizer rates up to 20 kg/ha increased no. pods/plant of mungbean and test weight (Table-2) was significantly affected by inoculation and fertilizer applications. (12) reported that Rhizobium inoculation significantly increased 1000 seed weight of mungbean. Enhanced vegetative growth in terms of dry matter production plant-1 provided more sites for the translocation of photosynthesis and ultimately resulted in increased no. of yield attributes. The starter dose of nitrogen play a vital

role in metabolic process of photosynthesis that results in increased flowering and fruiting thereby improving no. of pods plant⁻¹ and test weight (11).

Yield : Inoculation of seed with Rhizobium and nitrogen fertilizers brought a significant improvement in seed and straw yield of mungbean over control (Table-3). Increasing levels of nitrogen levels significantly increased the seed and straw yield of mungbean upto 20 kg N/ha over control. It is well established fact that seed yield of a crop is a function of yield attributes such as no. of pods plant⁻¹ and test weight. Significant increase in seed yield could be attributed to the increased vegetative growth possibly a result of effective utilization of nutrients absorbed through extensive root system developed under nitrate fertilization (10). The increase in seed yield under application of nitrogen might be due to the concomitant increase in yield attributing characters. This might be because excess assimilates stored in the plant leaves and later translocated into seeds at the time of senescing being the closest sink thus, ultimately increased the seed yield. The increase in straw yield might be due to the result of overall increased growth and development of plants. The increased yield attributes, seed, straw and biological yields due to nitrogen fertilization.

Nutrient Content and Quality : Seed inoculation with Rhizobium significantly enhanced nitrogen and protein content in seed over untreated control. The increase in nitrogen content, seed and protein content in seeds was registered due to application of nitrogen levels over control (Table-2). Application of 20 kg N/ha with Rhizobium significantly enhanced nitrogen content in seed and straw by mungbean crop over control. This might be due to improved nutritional environment in the rhizosphere as well as its utilization in the plant system leading to enhanced translocation to reproductive structure viz., pods, seed and other plant parts. The nitrogen fertilization to mungbean crop increase the cation exchange capacity (CEC) of roots thereby enabling them to absorb more phosphorus from the soil thus nitrogen might have been utilized in greater quantities due to their abundant availability. Another reason for higher nitrogen content might be due to increased activity of nitrate reductase in synthesis of protein in seeds that it is a primary component of amino acids, which are the building blocks of protein molecules (11). Phosphorus availability under higher nitrogen doses upto maturity of crop, which increases the synthesis of protein in different parts of plant and ultimately translocated to the developing seeds (13).

CONCLUSION

Seed inoculation with 20 kg N/ha was found to be more efficient as compared to other treatments. Therefore, from this it is convenient to say that a protein crop of mungbean cv. NDM-1 can be grown with nitrogen application @ of 20

kg N/ha and using Rhizobium inoculated seed. Significantly affected the growth, yield and quality of greengram.

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EFFECT OF NON-GENETIC FACTORS ON BODY WEIGHT AND BODY MEASUREMENTS AT BIRTH IN KONKAN KANYAL GOATS

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ABSTRACT

A present study was conducted at Dr. BSKKV, Dapoli (Maharashtra) to evaluate the birth weight and body measurements viz., height at wither, body length and heart girth of Konkan Kanyal goats were 2.093 ± 0.009 kg and 27.93 ± 0.052 , 26.65 ± 0.045 and 25.96 ± 0.045 cm, respectively. Significantly heaviest birth weight (2.24 ± 0.04 kg) and body measurements viz., height at wither (28.75 ± 0.24 cm), body length (27.45 ± 0.22 cm) and heart girth (26.66 ± 0.20 cm) were observed in the year 2005. The kids born in South west monsoon season was observed significantly higher in birth weight (2.2 ± 0.02 kg) and body measurements viz., height at wither, body length and heart girth as 28.41 ± 0.14 , 27.14 ± 0.09 and 26.30 ± 0.11 cm, respectively. The least square means of type birth weight and body measurements viz., height at wither, body length and heart girth of single born kids were 2.15 ± 0.01 kg, 28.17 ± 0.07 , 26.92 ± 0.06 and 26.17 ± 0.06 cm, respectively. The sex showed significant effect on birth weight and body measurements, the male goat was 2.15 ± 0.01 kg heavier than the female 2.03 ± 0.01 kg. The higher body measurements of 28.32 ± 0.08 cm height at wither, 27.08 ± 0.07 cm body length and 26.30 ± 0.07 cm heart girth were found in male than the body measurements of female as 27.48 ± 0.07 cm wither height, 26.31 ± 0.06 cm body length and 25.63 ± 0.05 cm heart girths, respectively. It was concluded that the significant effect of non-genetic factors on birth weight and body measurements at birth.

Key words : *Konkan kanyal goat, body weight, body measurements.*

Livestock sector is an important component of India's economy in terms of income, employment, equity and foreign exchange earnings. Amongst the domesticated animals, goat has positively established its identity, especially in rural section, as an animal, offering secured income with least risk. Goats are extremely important in providing livelihood security to a large number of small and marginal farmers and landless labourers in India and management practices are broadly based on agricultural situation of the region. Goat farming is a viable occupation and has got immense scope for growth in India.

The body weight and body measurements at birth are the first measurable economic traits in the life of the goats which can be of breeding worth for future prospective animals at an early age without waiting for expression of productive and reproductive traits. It provides the base on which the reproductive and productive aspects are mostly dependent. It also helps goat growers in computing the nutrient requirement, doses of medicine, etc. The present investigation was undertaken to study the effect of non-genetic factors viz., year of birth, season of birth, type of birth and sex on body weight and body measurements at birth was considered for growth performance of Konkan Kanyal goat.

MATERIALS AND METHODS

The data of 888 birth observations of body weight and body measurements viz., height at wither, body length and heart girth of Konkan Kanyal goats generated at Cattle

Breeding Farm, Nileli, Tal. Kudal, Dist. Sindhudurg of Konkan region in jurisdiction of the Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra State in India for the period of 2003 to 2013 were utilized for the study.

All the animals were maintained category-wise under conventional barn in semi-intensive system of management. The floor made up of bamboo raised above one meter of the ground was provided to the goats. The standard uniform feeding and management practices were provided throughout the experimental period to all the animals. The goats were sent out for grazing daily in morning and evening in fallow land, orchards and surrounding hillock of the farm. Apart from grazing the goats were fed with green tree leaves at noon and dry fodders in the evening after grazing hours. Concentrate was supplied at the rate of 200 g /adult and additional 100 g extra concentrate ration fed to the advanced pregnant and lactating stage of does. Mineral lick blocks were provided to the goats in each shed in such a manner that the individual goat can take the required quantity of the minerals as per their choice. The climate of the region is warm and humid except for a very short period of mild cold climate from December to February. The seasons observed in the region are summer (March to May), South-west monsoon (June to August), North-west monsoon (September to November) and winter (December to February). All 888 observations of birth were divided into five groups as below 1.75 kg, 1.75 - 2.00

Table-1 : Analysis of variance for various effects on body weight and body measurements at birth.

Source	df	MSS			
		Body weight	Wither height	Body length	Heart girth
Year of birth	10	0.7738*	34.8467*	19.1921*	22.5328*
Season of birth	3	0.5538*	2.4145*	3.0044*	3.5465*
Type of birth	2	2.6597*	50.1384*	43.0217*	35.4178*
Sex	1	2.2000*	156.1563*	119.1415*	88.3179*
Birth weight	4	0.0645*	245.8768*	160.8163*	125.8989*
Error	865	0.0082	0.936132	0.913676	0.946264

*P<0.05

kg, 2.01 - 2.20 kg, 2.21 - 2.40 kg and above 2.40 kg. To study the effect of various factors like year, season, type of birth, sex and birth weight groups, the data were analyzed by using least square method of fitting constants (1).

RESULTS AND DISCUSSION

The analysis of variance indicating significance of various effects on body weight and body measurements at birth and least square means for body weight and body measurements at birth are presented in Table.1 and Table 2. It was observed that the overall birth weight and body measurements viz., height at wither, body length and heart girth of Konkan Kanyal goats were 2.093±0.009 kg and 27.93±0.052, 26.65±0.045 and 25.96±0.045 cm, respectively. These results were broadly in accordance with (2) who observed 1.94±0.17 and 2.1±0.27 kg birth weights in Barbari and Marwari goats, respectively. The same animals observed slightly higher averaged for body measurements viz., 33.25±0.44 and 34.16±0.66 cm height at wither, 27.62±1.95 and 28.84±2.15 cm body length and 31.05±0.87 and 31.68±1.74 cm heart girth, respectively. The corresponding values recorded by (3) in Osmanabadi goats as 1.93±0.03 kg, 29.71±0.10, 27.65±0.12 and 28.67±0.14 cm, respectively, (4) in Osmanabadi goats as 1.846±0.011 kg, 32.182±0.242, 29.501±0.215, and 30.00±0.248 cm under field and 1.856±0.071 kg, 30.716±0.205, 27.514±0.158 and 28.828±0.137 cm, respectively under project conditions and (5) in Ganjam goats body length, height at wither and heart girth under field condition as 25.5±0.2, 27.1±0.2 and 30.1±0.2 cm, respectively.

The average birth weight and body measurements were significantly varied according to the effect of year of birth. The heaviest birth weight (2.24±0.04 kg) and body measurements viz. height at wither (28.75±0.24 cm), body length (27.45±0.22 cm) and heart girth (26.66±0.20 cm) were observed in the year 2005 and the lowest birth weight (1.87±0.01kg), wither height (26.50±0.34 cm), body length (25.50±0.22 cm) and heart girth (25.00±0.26 cm) were observed in the year 2013. The trend of birth weight and body measurements was found increased initially up to 2005 and from the year 2006 to 2008 not

found any specific trend, thereafter decreasing trend was noticed. These results were in agreement with (3) in Osmanabadi goats, (6) in Beetal, Black Bengal and their crosses, (7) in Jakharana kids and (8) in Surti kids under field condition. The variation in birth weight due to year may possibly be attributed to the availability of certain green fodder, management and suitable climate during the year.

The season of birth was observed significantly affected on body weight and body measurements at birth. The kids born in South west monsoon season was observed significantly higher in birth weight (2.2±0.02 kg) and body measurements viz. height at wither, body length and heart girth as 28.41±0.14, 27.14±0.09 and 26.30±0.11 cm, respectively. The significantly lowest birth weight was 2.02±0.02 kg and body measurements viz., height at wither, body length and heart girth were 27.67±0.09, 26.49±0.08 and 25.67±0.08 cm, respectively in the North-west monsoon season, which was in agreement with (9) in Barbari goats, (4) in Osmanabadi goat under field condition, (10) in Osmanabadi, Beetal X Osmanabadi, Saanen X Osmanabadi and Alpine X Osmanabadi kids, (11) in Alpine X Beetal, Saanen X Beetal, Alpine X Saanen-Beetal and Saanen X Alpine-Beetal crossbred dairy goats under stall-fed condition, (12) in Sirohi goats and in Marwari goats (13).

The analysis of variance indicated significant effect of type of birth on birth weight and body measurements is presented in Table-1. The single born kids weighed heavier than the twin and the triplet kids. The least square means of birth weight and body measurements (Table 2) viz. height at wither, body length and heart girth of single born kids were 2.15±0.01 kg, 28.17±0.07, 26.92±0.06 and 26.17±0.06 cm, respectively. The lower birth weight in twin (2.00±0.01 kg) and triplet (1.87±0.06 kg) born kids might be related to absence of intra-uterine space competition and nutritional status for development at foetus stage. The finding was in agreement with (9) in Barbari goats, (3) in Osmanabadi goats and (4) in Osmanabadi goats under field and project conditions. (12) noted that the single (2.28 ± 0.05 kg) born kids had

Table-2 : Least square means for body weight and body measurements at birth affected by non-genetic factors.

Variable	N	Birth weight (kg)	Wither height(cm)	Body length (cm)	Heart girth (cm)
	888	2.09 ± 0.009	27.93 ± 0.052	26.65 ± 0.045	25.96 ± 0.045
Year of birth					
2003	33	2.01 ± 0.06 ^{fed}	27.73 ± 0.31 ^{dc}	26.42 ± 0.27 ^{def}	25.79 ± 0.21 ^{dc}
2004	78	2.12 ± 0.03 ^{bde}	28.65 ± 0.21 ^a	27.05 ± 0.17 ^{bac}	26.35 ± 0.15 ^{ba}
2005	105	2.24 ± 0.04 ^a	28.75 ± 0.24 ^a	27.45 ± 0.22 ^a	26.66 ± 0.20 ^a
2006	110	2.18 ± 0.03 ^{ba}	27.66 ± 0.15 ^{dc}	26.66 ± 0.14 ^{dc}	26.23 ± 0.13 ^{bac}
2007	109	2.10 ± 0.04 ^{bde}	27.47 ± 0.16 ^{de}	26.46 ± 0.15 ^{de}	25.83 ± 0.15 ^{dc}
2008	99	2.14 ± 0.02 ^{bac}	28.33 ± 0.14 ^{ab}	26.85 ± 0.11 ^{bdc}	25.95±0.11 ^{bc}
2009	94	2.07 ± 0.01 ^{bcd}	28.62 ± 0.11 ^a	27.20 ± 0.09 ^{ab}	26.53 ± 0.09 ^a
2010	77	2.04 ± 0.01 ^{fedc}	27.99 ± 0.11 ^{bc}	26.67 ± 0.11 ^{dc}	25.79 ± 0.11 ^{dc}
2011	105	1.95 ± 0.01 ^{fg}	27.17 ± 0.10 ^{ef}	25.99 ± 0.08 ^f	25.03 ± 0.09 ^e
2012	72	1.96 ± 0.01 ^{leg}	26.92 ± 0.10 ^{fg}	26.10 ± 0.10 ^{ef}	25.40 ± 0.11 ^{de}
2013	6	1.87 ± 0.04 ^g	26.50 ± 0.34 ^g	25.50 ± 0.22 ^g	25.00 ± 0.26 ^e
Season of birth					
Summer	236	2.07 ± 0.02 ^b	27.97 ± 0.10 ^b	26.67 ± 0.09 ^b	26.00 ± 0.09 ^b
SWM	165	2.20 ± 0.02 ^a	28.41 ± 0.14 ^a	27.14 ± 0.09 ^a	26.30 ± 0.11 ^a
NWM	249	2.02 ± 0.02 ^c	27.67 ± 0.09 ^c	26.49 ± 0.08 ^b	25.67 ± 0.08 ^c
Winter	238	2.11 ± 0.02 ^b	27.84 ± 0.11 ^{cb}	26.64 ± 0.10 ^b	26.02 ± 0.09 ^b
Type of birth					
Single	540	2.15 ± 0.01 ^a	28.17 ± 0.07 ^a	26.92 ± 0.06 ^a	26.17 ± 0.06 ^a
Twin	339	2.00 ± 0.01 ^b	27.60 ± 0.08 ^b	26.37 ± 0.07 ^b	25.68 ± 0.07 ^a
Triplet	9	1.87 ± 0.06 ^b	26.56 ± 0.29 ^c	25.56 ± 0.34 ^c	24.78 ± 0.43 ^b
Sex					
Female	436	2.03 ± 0.01 ^b	27.48 ± 0.07 ^b	26.31 ± 0.06 ^b	25.63 ± 0.05 ^b
Male	452	2.15 ± 0.01 ^a	28.32 ± 0.08 ^a	27.08 ± 0.07 ^a	26.30 ± 0.07 ^a
Birth weight group (kg)					
Below 1.75	66	1.57 ± 0.02 ^e	25.88 ± 0.09 ^e	25.00 ± 0.09 ^e	24.39 ± 0.09 ^e
1.75 – 2.00	377	1.94 ± 0.01 ^d	27.14 ± 0.05 ^d	26.08 ± 0.04 ^d	25.38 ± 0.05 ^d
2.01-2.20	248	2.14 ± 0.01 ^c	28.20 ± 0.07 ^c	26.85 ± 0.06 ^c	26.20 ± 0.06 ^d
2.21-2.40	95	2.35 ± 0.01 ^b	29.13 ± 0.15 ^b	27.56 ± 0.12 ^b	26.63 ± 0.11 ^b
Above 2.40	102	2.65 ± 0.02 ^a	30.01 ± 0.16 ^a	28.91 ± 0.17 ^a	28.00 ± 0.17 ^a

(*a,b,c,d,e,f means under each class in the same column with different superscript differed significantly P < 0.05)

Note: SWM: South-west monsoon, NWM: North-west monsoon

significantly heavier birth weight than kids born as twins (1.96 ± 0.06 kg) in Sirohi goats, in Jamunapari goats under semi- intensive management system (14) and in Surti kids under field condition (8).

The sex showed significant effect on birth weight and body measurements, the male goat was 2.15±0.01 kg heavier than the female 2.03 ± 0.01 kg. The higher body measurements of 28.32 ± 0.08 cm wither height, 27.08 ± 0.07 cm body length and 26.30 ± 0.07 cm heart girth were found in male than the body measurements of 27.48 ± 0.07cm wither height, 26.31 ± 0.06 cm body length and 25.63 ± 0.05 cm heart girth in female goats, respectively. The results confirmed the finding of in Sirohi goats found that the male kids weigh heavier (2.04 ± 0.6 kg) than the female (1.86 ± 0.1 kg) kids at birth, in Ganjam goats of 2.41 ± 0.02 kg in male was significantly higher than 2.08 ± 0.02 kg in female goats (5). The average height at wither,

body length and heart girth of kids of male and female in same animals were 30.6 ± 0.2 and 29.6 ± 0.3, 28.7 ± 0.3 and 28.1 ± 0.4 and 30.1±0.4 and 28.9 ± 0.3 cm, respectively. Similar results were also reported by (16) in Pallai adu goats under field conditions, in Jamunapari goats (17) Jakharana kids (18), in Pashmina male and female goats 2.32 ± 0.25 and 2.17 ± 0.19 kg, respectively (19) and in Surti kids under field condition (8). Higher growth in prenatal stage under the influence of male sex hormones with anabolic effect may be the reason for higher birth weight of male kids.

The analysis of variance and least square means indicating significant effects of birth weight groups on body weight and body measurements are presented in Table-1 and Table-2. The least square means and their standard error for body weight and body measurements at birth were 2.65 ± 0.02 kg body weight, 30.01 ± 0.16 cm

height at wither, 28.91 ± 0.17 cm body length and 28.00 ± 0.17 cm heart girth in above 2.40 kg group, 2.35 ± 0.01 kg body weight, 29.13 ± 0.15 cm height at wither, 27.56 ± 0.12 cm body length and 26.63 ± 0.11 cm heart girth in 2.21 to 2.40 kg group, 2.14 ± 0.01 kg body weight, 28.20 ± 0.07 cm wither height, 26.85 ± 0.06 cm body length and 26.20 ± 0.06 cm heart girth in 2.01 to 2.00 kg group, 1.94 ± 0.01 kg body weight, 27.14 ± 0.05 cm wither height, 26.08 ± 0.04 cm body length and 25.38 ± 0.05 cm heart girth in 2.00 to 1.75 kg group and 1.57 ± 0.02 kg body weight, 25.88 ± 0.09 cm wither height, 25.00 ± 0.09 cm body length and 24.39 ± 0.09 cm heart girth in below 1.75 kg group.

It may be concluded from present investigation that the average body weight at birth was 2.093 ± 0.089 kg in Konkan Kanyal goats. The effect of year, season, type of birth and sex were significantly affected on body weight and body measurements at birth. The male goats were significantly heavier than females. The kids born in South-west monsoon season showed higher weight at birth.

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EFFECT OF SLAUGHTER AGE ON CHEVON QUALITY AND QUANTITY OF KONKAN KANYAL GOAT

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ABSTRACT

Fifteen Konkan Kanyal goats of 6, 9, and 12 months of age (5 goats each group) were selected randomly and slaughtered for the experiment. The pre-slaughter weight of Konkan Kanyal goats was significantly differed at the age of 6, 9 and 12 months of 11.68 ± 0.43 , 16.2 ± 0.43 and 19.3 ± 0.43 kg, respectively. The dressing per cent was 49.1 ± 0.45 , 51.11 ± 0.45 and 51.25 ± 0.45 per cent, respectively in 6, 9 and 12 months of age. The slaughter age of goats had non-significant effect on the composition of primal cuts except rack and leg. The primal cuts comprised 9.75 ± 0.23 , 10.1 ± 0.23 and 10.5 ± 0.23 per cent of loin at the slaughter age of 6, 9 and 12 months, respectively. The corresponding values of rack were 11.4 ± 0.19 , 12.8 ± 0.19 and 13.0 ± 0.1 per cent, neck and shoulder were 25.8 ± 0.58 , 26.8 ± 0.58 and 27.9 ± 0.58 per cent, breast and shank were 18.8 ± 0.55 , 20.2 ± 0.55 and 19.8 ± 0.55 per cent and leg were 32.1 ± 0.35 , 30.3 ± 0.35 and 28.7 ± 0.35 per cent, respectively. The organoleptic qualities of Konkan Kanyal goat's meat did not differ significantly at 6, 9 and 12 months of slaughter age. The overall acceptability was recorded for the slaughter age of 9 months followed by 6 and 12 months. The highest score was 7.90 ± 1.12 and 7.87 ± 1.09 points for general appearance and flavour, respectively at 9 months slaughter age and the lowest score of 7.33 ± 1.10 points was recorded for the juiciness at 12 months of slaughter age. The highest score for tenderness and juiciness 7.84 ± 1.10 point was recorded at 6 months of slaughter age. The chemical components did not vary significantly due to age at slaughter of the different primal cuts. The moisture, protein, fat and ash content in the range of 74.80 ± 0.99 to 79.15 ± 0.48 per cent, 17.24 ± 0.55 to 20.39 ± 0.36 per cent, 77 ± 0.13 to 2.58 ± 0.19 per cent and 0.85 ± 0.06 to 1.34 ± 0.08 per cent, respectively.

Key words : Konkan kanyal, carcass characteristics and organoleptic properties.

Goat is a multifunctional animal plays a significant role in the economy and nutrition of landless, small and marginal farmers in the country. As far as goats are concerned these animals are reared primary for meat purpose. It has all the characteristics required for efficient meat production viz. high prolificacy, more than one breeding season in a year, no socio religious barrier for meat consumption, higher milk production and capacity to bear twins and triplets. Being small size animal, the goats can easily be managed by women, children and old man. Feeding, watering, milking and care of goats do not require much equipment's and hard work. Investment of capital and cost of feeding are also low.

Goat is a multipurpose animal which provide meat, milk, hide, hair and manure for soil. Many people preferred to consume goat meat than cattle. Goat meat fetches higher prices in national and international markets. In spite of the prejudice against goat rearing due to environmental issues, the population of this species has grown at a faster rate than any other species of livestock.

India has the largest goat population in the world having 140.50 million goats (1). India's annual chevon production was 458 thousand MT which contributed to 12.6 per cent of total chevon produced in the world (3639 thousand MT). If we exclude buffalo meat and beef

production which were not consumed by common masses, goat meat would contribute 27.6 per cent of total meat available for mass consumption. Konkan Kanyal is recently recognized goat breed of India with accession number INDIA GOAT 1100 KONKAN KANYAL 06022 certified by Animal Breeding committee, ICAR on May, 2012. It is a meat purpose goat breed of hot and humid climate and high rainfall region of Maharashtra. The goat of this breed is more demand for meat production in Maharashtra. The quality and quantity of meat is depending upon the slaughter age of animals. The different parts of carcass of goat i.e. neck and shoulder, rack, loin, legs, breast and shank etc. has an economic importance in the market. The loin and neck are the most preferable parts of chevon as compared to others. Keeping the above facts in view, it is decided to evaluate the chevon quality and quantity at different slaughter age.

MATERIALS AND METHODS

To study the quality and quantity of carcass of Konkan Kanyal goat traits, the total male goats available on the farm of 6, 9 and 12 months age, five goats from each group were randomly selected for slaughtering. All the goats allowed pre-slaughter fasting for 18 hours with *ad libitum* supply of drinking water. The goats were slaughtered in the morning hours by cutting the throat transversely close to the head and severing carotid

Table-1 : Characteristics of carcass of Konkani Kanyal goats (kg)

Characteristics	Age in months		
	6 th	9 th	12 th
Pre-slaughter weight (kg)	11.68±0.43 ^c	16.2±0.43 ^b	19.3±0.43 ^a
carcass weight (kg)	5.74±0.24 ^c	8.22±0.24 ^b	9.89±0.24 ^a
Dressing (%)	49.10±0.45 ^b	51.11±0.45 ^a	51.25±0.45 ^a
Percentage of primal cuts			
Loin	9.75±0.23	10.1±0.23	10.5±0.23
Rack	11.4±0.19 ^b	12.8±0.19 ^a	13.0±0.19 ^a
Neck and shoulder	25.8±0.58	26.8±0.58	27.9±0.58
Breast and shank	18.8±0.55	20.2±0.55	19.8±0.55
Leg	32.1±0.35 ^a	30.3±0.35 ^b	28.7±0.35 ^c

(Significant at P < 0.05)

Table-2 : Average value of organoleptic qualities of Konkani Kanyal goat meat (chevon)

Characteristics	Age in months		
	6 th	9 th	12 th
General appearance	7.68±1.12	7.90±1.12	7.63±1.12
Tenderness	7.84±1.10	7.74±1.10	7.63±1.10
Juiciness	7.84±1.10	7.73±1.10	7.33±1.10
Flavour	7.43±1.09	7.87±1.09	7.49±1.09
Acceptability	7.58±1.11	7.97±1.11	7.53±1.11

arteries and jugular veins on both the sides. The pelt was removed properly with knife and hand pressure technique with hanging the animals on crate. The rumen and intestine were removed from the carcass. The edible offal's like liver, testicle, spleen, cauls fat and non-edible like lung were taken out separately from carcass and weighed. Only kidney and kidney fat were accounted for weight along with carcass. The weight of such carcass was recorded as hot carcass weight. Then the carcass was cut into leg, loin, rack, neck and shoulder and breast and fore shank cuts as per the specification of (2). The weights of the individual cuts were recorded and per cent of each cut to hot carcass weight was calculated.

The dressing percentage was calculated from the hot carcass weight and live weight before slaughter by using the following formula :

Dressing percentage = Hot carcass weight/Live weight×100

For analysis of meat, representative samples were collected from all the five cuts of the animals slaughtered in the experiment. Approximately 200 g samples were collected and packed in the polythene bags and kept in deep freezer with proper labeling at - 15°C temperature. The muscle samples were trimmed to exclude exterior fat and minced rapidly by food processor. The minced samples were kept in container with lids. In all the stages care was taken to prevent loss of moisture from the samples.

Proximate chemical analysis of meat samples for

moisture, protein, intramuscular fat and ash were done as per the method described by (3). Crude protein was estimated by Kjeldahl's method and the protein was reported as N×6.25. Fat was extracted with petroleum ether for 14-16 hours in Soxhlet extractor.

To evaluate the quality of collected goatmeat samples were subjected for sensory evaluation by semi-trained taste panel of 20 members. The meat cubes of 1/2 inch were prepared from the meat samples. One percent salt was added to each sample and cooked in pressure cooker for 15 minutes. After cooking, the samples were cooled to room temperature and fluid portion was discarded. A panel of 20 semi-trained judges was selected for sensory evaluation. A 9 point Hedonic scale was used to evaluate the samples for tenderness, flavor, juiciness and overall acceptability.

To test the significant difference of chevon characteristics and organoleptic qualities between various ages were analyzed statistically by Friedman's test (4).

RESULTS AND DISCUSSION

To study the quality and quantity of meat (chevon) of this breed the characters such as live weight before slaughtering, hot and carcass weight of goat, dressing per cent and primal cuts as ISI 1963 standard have been recorded and are presented in Table-1. The mean pre-slaughter weights of Konkani Kanyal goats were found to be significantly differed at the age of 6, 9 and 12 months, which were as 11.68 ± 0.43, 16.2 ± 0.43 and 19.3 ± 0.43 kg, respectively. The mean values of carcass weight of 5.74 ± 0.24, 8.22 ± 0.24 and 9.89 ± 0.24 kg, respectively were observed at the slaughter age of 6, 9 and 12 months. Comparatively lower carcass weight was reported by (5) in Gaddi goats and (6) recorded broadly higher carcass weight in Mahabubnagar goats at 12 months of slaughter age.

The dressing per cent of this breed on hot carcass weight was 49.1 ± 0.45, 51.11 ± 0.45 and 51.25 ± 0.45, respectively and based on cold carcass weight were 45.41 ± 0.35, 47.87 ± 0.35 and 50.00 ± 0.35 per cent for the slaughter age of 6, 9 and 12 months, respectively. The significantly higher dressing per cent was observed in 12 months than 6 months age of goat but it was at par with 9 months age of goat. The comparatively lower value of results were reported by (7) in Barbari goats at 9 months of slaughter age, (5) in Gaddi goats at 12 months slaughter age, (8) in Sikkim local was 48.31 per cent in yearling goats, (9) in Osmanabadi goats for the slaughtered at the age of 6, 9, and 12 months, (10) in Sirohi goats at 9 months of slaughter age and (6) in Mahabubnagar goats at 12 months of slaughter age.

Table-3 : Average chemical composition of Konkan Kanyal goat meat (chevon).

Components	Age in months		
	6 th	9 th	12 th
Moisture (%)			
Neck	76.96±0.69	77.56±0.69	75.61±0.69
Shoulder	76.95±0.75	78.46±0.75	76.48±0.75
Rack	77.44±0.83	77.41±0.83	75.46±0.83
Loin	79.15±0.48	78.07±0.48	77.44±0.48
Leg	77.46±0.39	77.69±0.39	77.14±0.39
Breast	76.93±0.99	76.83±0.99	74.80±0.99
Shank	77.41±0.83	77.36±0.83	75.56±0.83
	NS	NS	NS
Protein (%)			
Neck	17.34±0.43	17.67±0.43	17.77±0.43
Shoulder	17.60±0.45	17.59±0.45	17.84±0.45
Rack	17.74±0.64	18.90±0.64	18.57±0.64
Loin	19.34±0.36	20.04±0.36	20.39±0.36
Leg	17.24±0.55	17.27±0.55	17.55±0.55
Breast	18.02±0.45	18.09±0.45	18.22±0.45
Shank	18.72±0.34	18.82±0.34	18.99±0.34
	NS	NS	NS
Fat (%)			
Neck	2.28±0.13	2.44±0.18	2.47 ±0.19
Shoulder	2.29±0.13	2.34±0.18	2.38±0.19
Rack	2.27±0.13	2.35±0.18	2.58±0.19
Loin	2.13±0.13	2.32±0.18	2.28±0.19
Leg	2.10±0.13	2.28±0.18	2.29±0.19
Breast	2.26±0.13	2.31±0.18	2.34±0.19
riOShank	1.77±0.13	1.99±0.18	2.20±0.19
	NS	NS	NS
Ash (%)			
Neck	0.85±0.07	1.03±0.07	1.19±0.07
Shoulder	0.85±0.06	1.05±0.06	1.07±0.06
Rack	0.97±0.07	1.01±0.07	0.94±0.07
Loin	0.86±0.10	0.97±0.10	0.96±0.10
Leg	1.01±0.08	1.20±0.08	1.34±0.08
Breast	0.92±0.06	1.01±0.06	0.99±0.06
Shank	1.02±0.04	1.19±0.04	1.19±0.04
	NS	NS	NS

(NS- Non-significant)

The slaughter age of goats had non-significant effect on the composition of primal cuts except rack and leg cuts (Table 1). The leg cuts were significantly differed at the slaughter age of 6, 9 and 12 months and rack cuts affected at the slaughter age of 9 and 12 months over 6

months. The primal cuts of Konkan Kanyal goat meat comprised 9.75±0.23, 10.1±0.23 and 10.5±0.23 per cent of loin at the slaughter age of 6, 9 and 12 months, respectively. The corresponding values of rack were 11.4±0.19, 12.8±0.19 and 13.0±0.19 per cent, neck and shoulder were 25.8±0.58, 26.8±0.58 and 27.9±0.58 per cent, breast and shank were 18.8±0.55, 20.2±0.55 and 19.8±0.55 per cent and leg were 32.1±0.35, 30.3±0.35 and 28.7±0.35 per cent, respectively. The values of the results were broadly resembled with those reported by (7) in Barbari kids slaughtered at the age of 9 months, (11) in Jamunapari goats at 6 to 7 months and 9 to 10 months of slaughter age, (9) in Osmanabadi goats for the slaughtered age of 6, 9, and 12 months, (12) in Malpura lamb, (10) in Sirohi goats at 9 months of slaughter age, (6) in Mahabubnagar goats at 12 months of slaughter age and (13) in Deccani sheep at 6, 9 and 12 months of age.

Organoleptic quality of chevon : The mean score of organoleptic qualities did not differ significantly at 6, 9 and 12 months of slaughter age (Table-2). The highest score of 7.90 ± 1.12 and 7.87 ± 1.09 points was observed for general appearance and flavor, respectively for the chevon at 9 months slaughter age and tenderness and juiciness (7.84 ± 1.10 points) were recorded for 6 months of slaughter age. The lowest score of 7.63 ± 1.12, 7.63 ± 1.09, 7.33 ± 1.10 and 7.53 ± 1.11 points were recorded for the general appearance, tenderness, juiciness and acceptability at 12 months of slaughter age. The overall acceptability was recorded for the slaughter age of 9 months followed by 6 and 12 months of slaughter age. There was non-significant effect of age on all sensory quality parameters. The corresponding results were broadly resembled with (9) in Osmanabadi goats slaughtered within 6 to 12 months of age have equally good quality meat and (13) in Deccani sheep meat.

Chemical components : From Table-3, revealed that the chemical components did not vary significantly due to age at slaughter or the different primal cuts. The lowest moisture percentage was observed (76.93 ± 0.75 %) in breast and highest (79.15 ± 0.48 %) in loin at slaughter age of 6 months of Konkan Kanyal goats. The corresponding values at 9 and 12 months were 76.83 ± 0.99 per cent in breast and 78.46 ± 0.75 per cent in shoulder and 74.8 ± 0.99 per cent in breast and 77.44 ± 0.48 per cent in loin, respectively. The results agreed with the reports of (14) in Barbari goats slaughtered at the age of 496.56 and 636.56 days were 76.33 ± 0.49 and 76.56 ± 0.50 per cent moisture, respectively, (11) in Jamunapari goat primal cuts of leg, loin, rack, neck and shoulder and breast and shank were 77.8, 76.3, 76.0, 76.4 and 74.9 per cent, respectively, (9) in Osmanabadi goats moisture content in the range of 76.93 to 78.22 per cent and (13) in Deccani sheep at 6, 9 and 12 months age of primal cuts. The comparatively lower moisture per cent than the

present result was reported by (15) in carcass of Beetal x Assam local goats in between 62.15 to 67.15 per cent.

Protein content in Konkani Kanyal goat chevon was observed in the range of 17.34 ± 0.43 per cent in neck to 19.34 ± 0.36 per cent in loin at slaughter age of 6 months, 17.27 ± 0.55 per cent in leg to 20.04 ± 0.36 per cent in loin at slaughter age of 9 months and 17.55 ± 0.55 per cent in leg to 20.39 ± 0.36 per cent in loin at slaughter age of 12 months. The corresponding values were agreed with the results reported by (9) in Osmanabadi goats in the range of 18.29 to 20.07 per cent. The lower percentage of protein reported by (11) in Jamunapari primal cuts of leg, loin, rack, neck and shoulder and breast and shank were 15.8, 16.9, 16.0, 16.1 and 16.4 per cent, respectively and (13) in Deccani sheep at 6, 9 and 12 months age of primal cuts.

The intramuscular fat content in chevon of Konkani Kanyal goat was in the range of 1.77 ± 0.13 (shank) to 2.29 ± 0.13 (shoulder) at the slaughter age of 6 months. The corresponding values at 9 and 12 months were 1.99 ± 0.18 (shank) to 2.44 ± 0.18 (neck) and 2.20 ± 0.19 (shank) to 2.58 ± 0.19 (rack) per cent, respectively. These values of fat percentage were agreed with the results reported by (14) in Barberi goat, (9) in Osmanabadi goat and (13) in Deccani sheep at 6, 9 and 12 months age of primal cuts.

The highest ash content was in shank as 1.02 ± 0.04 , 1.19 ± 0.04 and 1.19 ± 0.04 per cent at slaughter age of 6, 9 and 12 months, respectively. However, the lowest ash content was 0.85 ± 0.06 (shoulder) and 0.97 ± 0.1 (loin) and 0.96 ± 0.1 (rack) per cent at slaughter age of 6, 9 and 12 months, respectively. The results were agreed with (11) in Jamunapari primal cuts and (9) in Osmanabadi goats.

CONCLUSION

It was concluded that pre-slaughter weight of Konkani Kanyal goats was significantly differed at the age of 6, 9 and 12 months. The significantly higher dressing per cent was observed in 12 months than 6 months, but it was at par with 9 months age of goat. The slaughter age of goats had non-significant effect on the composition of primal cuts except leg and rack cuts. The leg cuts were significantly differed at the slaughter age of 6, 9 and 12 months and rack cuts affected at the slaughter age of 9 and 12 months over 6 months. The chemical components did not vary significantly due to age at slaughter or the different primal cuts. The organoleptic qualities did not differ significantly at 6, 9 and 12 months of slaughter age. The acceptability of meat quality was recorded higher for 9 months of slaughter age, followed by 6 and 12 months age

of goat. Hence, it is concluded to slaughter the Konkani Kanyal goat before 12 months of age.

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EFFECT OF WEATHER PARAMETERS ON THE ACTIVITY OF VARIOUS INSECT POLLINATORS/VISITORS VISITING ON NIGER FLOWERS, *Guizotia Abyssinica* CASS

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ABSTRACT

Studies on the effect of weather parameters on different insect pollinators/visitors on niger flower during two consecutive year 2011-12 and 2012-13. Among the weather factors the morning relative humidity had negative relationship with pollinators/visitors Indian honey bee, rock bee, syrphid fly and tiger moth indicating that with every unit increase in the morning relative humidity there would be decrease in the population of pollinators/visitors. Similarly the maximum temperature had also negative effect on wasp population whereas the rainfall had positive effect on the population of tiger moth as well as on rice skipper.

Key words : Insect pollinators/visitors, niger crop, correlation, weather parameters.

Niger (*Guizotia abyssinica* Cass., Compositae) is an important oilseed crop cultivated in Ethiopia and India. It is a branched annual herbaceous plant, grows upto a height of 1.8 meter. The niger plant complete its life cycle in 3-4 months. This crop is widely adopted to all types of soil in Chhattisgarh and also in India, it is commonly grown on poor and acidic soils or on hilly slopes that are very low in fertility. The major niger growing states are Madhya Pradesh, Orissa, Maharashtra, Bihar, Karnataka and Andhra Pradesh. The area of this oilseed crop in Chhattisgarh is 1.08 lakh hectare with the production of 0.27 lakh tones and productivity is 260 kg/ha (1).

The niger seed contains about 40 per cent oil which is pale yellow with nutty taste and a pleasant odour. The oil and seeds are free from any toxin and oil taste is similar to desi ghee. The oil is used for culinary purpose, anointing the body, manufacturing paints and soft soaps and for lighting and lubricants. The crop is totally dependent on external agents for its reproductive development by way of pollination through external agencies particularly taking the help of insects that the honey bees, which frequently visit flowers gathering pollens as well as nectar for sustaining their life, which in turns results into florets get cross pollinated (2).

MATERIALS AND METHODS

The present investigation was carried out at Raj Mohini Devi Collge of agriculture and Research Station, Ambikapur, Distt. Surguja (C.G.) of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The crop was sown on single plot during two consecutive year dated 01/09/011 and 12/10/012 the plot size was 10 x 10 m² and observations were worked out when the crop was started flowering, starting from 700 to 1700 hrs at two hour intervals once every week, on randomly selected places

from one square meter area within five minutes during early as well as peak flowering period. The population of pollinators/ visitors were worked out and the weather parameters were recorded during the blooming period of the crop and the correlation coefficient and regression equation studies were also made for the relationship between dependent variables (pollinators/visitors) and independent factors (weather parameters).

RESULTS AND DISCUSSION

The different weather parameters had some positive as well as negative impact on the activity of different honey bee population and on pollinators. The correlation coefficient and regression were worked out to study the relationship between the weather parameters and the pollinators/visitors during two consecutive year (2011-12 and 2012-13). The details of the effect of weather factors on different dependent variables on niger flowers are as follows-

Indian honey bee : The pooled data (Table-1) indicated that there was negatively relationship between morning relative humidity and Indian honey bee population but the relationship was found to be significant. The "r" value being – 0.726 and the regression equation (Fig-1) being $Y_1 = 398.7 - 4.239 X_1$, whereas, X_1 is the morning relative humidity and Y_1 is the average Indian honey bee population. This indicates that every unit increase in morning relative humidity there will be decrease in Indian honey bee population by 4.239.

On the basis of two year data indicated that there was negative relationship between the morning relative humidity and Indian honey bee population but the relationship was found to be significant ($r = -0.726$). The present findings are in more or less conformity with that of earlier workers (4) who recorded the foraging behavior of bees on cashew and reported that the temperature and

Table-1 : Overall correlation coefficient of various insect pollinators/visitors on niger flowers with corresponding weather parameters during the year 2011-12& 2012-13 (Value of correlation coefficient)

Pollinators/ visitors	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	Wind speed (km/h)
	Maximum	Minimum	Morning	Evening		
Indian honey bee	0.4698	0.2798	-0.8633 **	-0.1402	0.3996	0.0866
Rock bee	0.2935	0.1101	-0.8950 **	-0.4876	0.3459	0.0619
Little bee	0.1014	0.1509	-0.1788	0.2068	0.5280	0.5275
Italian bee	0.000	0.000	0.000	0.000	0.000	0.000
Syrphid fly	0.4384	0.5309	-0.8099 *	-0.0048	0.6887	-0.1200
Rice skipper	-0.1496	0.3850	-0.0984	0.3757	0.7680 *	0.2258
Monarch butterfly	0.1793	-0.1194	-0.5069	-0.4244	-0.4026	-0.3974
Blow fly	0.0547	0.1260	-0.6433	-0.1095	0.2981	0.2595
Tiger moth	0.1901	0.4296	-0.7149 *	0.0149	0.7209 *	0.1237
Rice bug	0.1726	0.0076	-0.5382	-0.2061	0.1043	0.1941
Red cotton bug	0.1197	-0.3613	-0.3036	-0.3854	-0.3790	0.2533
Green sting bug	0.0456	-0.1979	-0.5589	-0.4398	0.3417	-0.0602
Wasp	-0.814 *	-0.5691	0.0562	-0.5980	0.0933	0.5688
Lady bird beetle	-0.5914	-0.0420	-0.2574	-0.1816	0.0131	-0.0254
Tachinid fly	-0.0613	-0.5352	0.1385	-0.2703	-0.3335	0.5501
House fly	-0.2738	-0.1298	-0.6972	-0.6096	0.2340	0.1982

*, **, Significant at 5% and 1% levels respectively.

relative humidity had a definite effect on the foraging behavior of bees. (4) who recorded the foraging activity of *Apis cerana indica*, *A. mellifera*, *A. dorsata* and *A. florea* on Indian mustard and reported that the *A. indica* was the dominant pollinators followed by *A. dorsata*, *A. mellifera* and *A. florea*, further they recorded that the *A. indica* was the positively influenced with temperature, while humidity had no significant effect.

Rock bee : The pooled data indicated (Table-1) that the correlation between the morning relative humidity and rock bee population was found significant but negative. A linear relationship with the population of rock bee, the “r” value being – 0.801 and the regression equation (Fig-2) being $Y_2 = 153.7 - 1.678 X_1$, where X_1 is the morning relative humidity and Y_2 is the mean population of rock bee. This indicates that every unit increase in morning relative humidity there will be decrease in rock bee population by 1.678.

The correlation between the morning relative humidity and rock bee population was significantly negative correlated ($r = -0.801$). The present findings are close agreements with the earlier worker (5) who recorded the flight activity of bees (*Apis cerana* and *Apis dorsata*) on peach flowers in relation to some weather factors. The foraging populations correlated significantly and positively with temperature, light, solar energy, nectar sugar concentration and negatively with relative humidity. (6)

who recorded the relative abundance of *Apis* spp. on *Helianthus annuus* and reported that *A. mellifera* was dominant visitor and also reported that the standard regression coefficient indicated the temperature played main role in fluctuating the population of *Apis* species.

Syrphid fly : The pooled data (2011 and 2012) indicated that the correlation between morning relative humidity and syrphid fly population was negatively correlated but was found significant. The “r” value being –0.656 and the regression equation (Fig-3) being $Y_3 = 37.50 - 0.408 X_1$, where, X_1 is the morning relative humidity, Y_3 is the mean population of syrphid fly. This indicates that with every unit increase in morning relative humidity there will be decrease in syrphid fly population by 0.408 (Table-1).

The two year data indicated that the morning relative humidity was correlated with syrphid fly population significantly negative correlated ($r = -0.656$). The present findings are conformity with earlier workers, (4) who recorded the foraging activity of honeybees and syrphids during the blooming period of different apple cultivars in relation to prevailing weather conditions and reported that the synchronization of blooming period among different apple cultivars and their suitable pollinizers which ranged from 25 March to 17 April. *Apis cerana indica* had better foraging frequency during morning 0600-0800hrs and evening 1400-1700 hrs at very low temperature than *A. mellifera*.

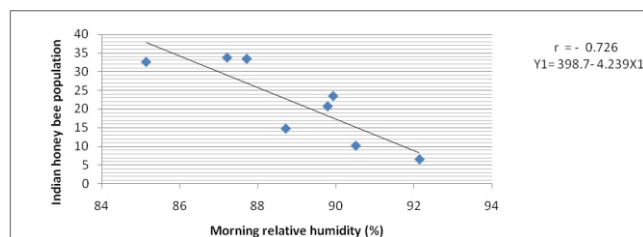


Fig-1. Regression of Indian honey bee population on morning relative humidity (%) during 2011 and 2012.

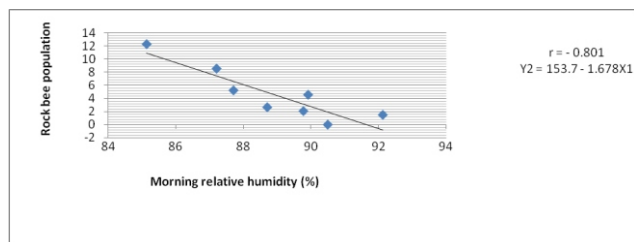


Fig-2. Regression of Rock bee population on morning relative humidity (%) during 2011 and 2012.

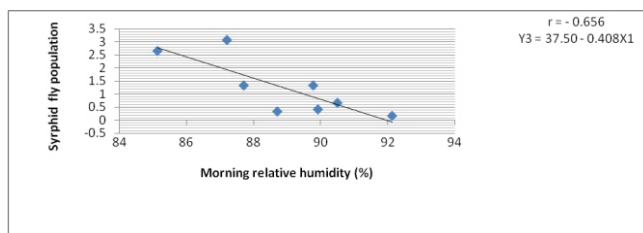


Fig-3. Regression of syrphid fly population on morning relative humidity (%) during 2011 and 2012.

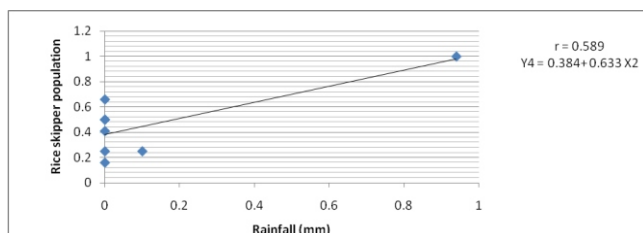


Fig-4. Regression of rice skipper population on rainfall (mm) during 2011 and 2012

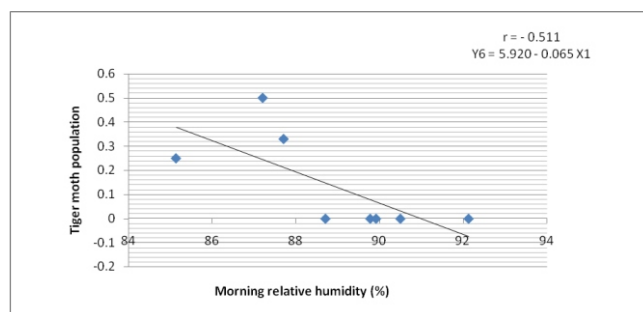


Fig-5. Regression of tiger moth population on morning relative humidity (%) during 2011 and 2012.

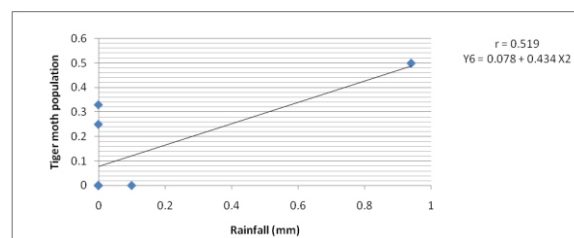


Fig-6. Regression of tiger moth population on rainfall (mm) during 2011 and 2012.

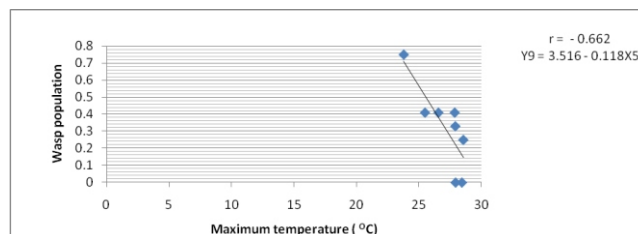


Fig-7. Regression of wasp population on maximum temperature (°C) during 2011 and 2012

Rice skipper : On the basis of pooled data (Table-1) a positive with significant correlation was found between rainfall and rice skipper population. The “r” value being 0.589 and the regression equation (Fig-4) being $Y_4 = 0.384 + 0.633 X_2$, where, X_2 is the rainfall and the Y_4 is the mean population of rice skipper. This indicates that with every unit decrease in rainfall there will be increase of rice skipper population by 0.633. On the basis of pooled data a linear and significantly positive correlation was found between rainfall and rice skipper population ($r = 0.589$). There was no report on this line.

Tiger moth : The pooled data indicated that a negative relationship was found between the morning relative humidity and tiger moth population but it was significant. The “r” value being -0.511 and regression equation (Fig-5) being $Y_6 = 5.920 - 0.065 X_1$, where, X_1 is the morning relative humidity and the Y_6 is the mean tiger moth population. This indicates that the every unit increase in morning relative humidity there will be decrease in tiger moth population by 0.065 (Table-1).

Similarly during pooled data a linear relationship was found between the rainfall and tiger moth population. The “r” value being 0.519 and regression equation (Fig-6) $Y_6 = 0.078 + 0.434 X_2$ where, X_2 is the rainfall and Y_6 is the tiger moth population. This indicates that the every unit increase in rainfall there will be increase in tiger moth population by 0.434 (Table-1).

A negative relationship was found between the morning relative humidity and tiger moth population but it was significant ($r = -0.511$). Similarly during pooled data a linear relationship was found between the rainfall and tiger moth population ($r = 0.519$). There were no report of these lines.

Wasp : The pooled data (Table-1) indicated that a significantly negative correlation was found between the maximum temperature and wasp population. The “r” value being -0.662 and the regression equation (Fig-7) being $Y_9 = 3.516 - 0.118 X_5$ where the X_5 is the maximum temperature and Y_9 is the average wasp population. This indicates that the every unit increase in maximum temperature there will be decrease in wasp population by 0.118.

The pooled data indicated that a significantly negative correlation was found between the maximum temperature and wasp population ($r = -0.662$). There was no earlier report on this line.

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GENETIC VARIABILITY FOR YIELD CONTRIBUTING TRAITS IN MUNG BEAN DURING SUMMER SEASON (*Vigna radiata* (L.) R. Wilczek)

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ABSTRACT

In the present investigation, the genotypic and phenotypic variation, heritability and genetic advance expressed as percentage of mean for yield and yield contributing traits were studied in 50 genotypes of mung bean (*Vigna radiata* (L.) R. Wilczek) during summer season. The analysis of variance revealed highly significant difference for all characters, under studied among the genotypes, indicating the presence of sufficient amount of variability in the varieties. Thus there is ample scope for selection of different quantitative characters for crop improvement. The highest GCV and PCV were observed for number of pods per plant. The moderate GCV and PCV were observed for length of pod, number of clusters per plant, biological yield per plant, number of seeds per pod, plant height, number of primary branches per plant, harvest index and 100-seed weight. High heritability (broad) along with high genetic advance as per cent of mean was observed for the traits viz., plant height, number of primary branches per plant, number of clusters per plant, number of pods per plant, length of pod, number of seeds per pod, 100-seed weight and biological yield per plant indicating that these characters would be amenable for phenotypic selection in mung bean.

Key words : Mung bean, GCV, PCV, heritability, genetic advance, genetic advance as per cent of mean.

Mung bean (*Vigna radiata* (L.) R. Wilczek) known as green-gram is one of the most important pulse crops of India. Mung bean is considered as hardiest of all pulse crops. It is a self-pollinated crop. India produces 1.19 million tons of mung bean from an area of 2.75 million hectare (1). In Gujarat, mung bean production is 1.25 million tons from an area of 0.57 million hectare. (2). However, the productivity of mung bean is only around 350 kg per hectare (3). The low productivity of this crop can be attributed to narrow genetic base resulting in low yield potential and susceptibility to biotic and abiotic stresses as well as lack of suitable plant types for different cropping situations. It is a photo and thermo insensitive crop and is grown in *kharif* and summer seasons in northern India. Mung bean provides about 25 % protein, restores and maintains the soil fertility by fixing atmospheric nitrogen, and also fits well in different cropping systems. High protein, easy digestibility and low flatulence production made the crop acceptable to the people world over (4). Keeping in mind the dietary importance of this crop and its low productivity, there is ample scope of genetic improvement in this crop. Cultivation of summer mung bean is now becoming more and more popular with farmers in northern India as their practices enable them to use the land and the water resources which otherwise would have remained unutilized during summer season. Moreover, summer mung can be fitted very well in different cropping systems. Genetic improvement of crop is largely depending on the magnitude of genetic variability and the extent to which desirable traits are heritable. Genetic variability studies about the presence of difference in their genetic constitution. It is of outmost important as it provide the

basis for effective selection. Therefore an attempt was made in the present studies to estimate the extent of variability, heritability, genetic advance, and genetic advance as percent of mean by utilizing 50 genotypes. Studies on above aspects on available germplasm under the summer season where it is to be explained are essential for successful utilization of germplasm resources for the development of superior mung bean varieties.

MATERIALS AND METHODS

The experimental material for the present study consisted of 50 mung bean genotypes received from Central Arid Zone Research Institute (CAZRI)- Jodhpur listed in Table No.1. The experiment was carried out at Instructional Farm, College of Agriculture, J.A.U., Junagadh (Gujarat) during summer 2014. The genotypes were evaluated in randomized block design (RBD) with three replications. Each entry was planted as a single row of 3m. length, keeping plant to plant distance of 10 cm and row to row spacing of 30 cm. The recommended cultural practices were adopted for the proper growth and stand of the crop. The data were recorded five randomly selected plants from each replication for plant height, number of primary branches per plant, number of cluster per plant, number of pods per plant, , length of pod, number of seeds per pod, 100-seed weight (g), biological yield per plant (g), harvest index (%) and seed yield per plant (g). Data for days to 50% flowering and days to maturity were recorded on plot basis. The mean value were used to obtained analysis of variance was carried out as per methodology advocated by (5). PCV, GCV and heritability in broad sense (h^2) were calculated by the formula given by (6), and genetic

Table-2 : Range, Mean, Phenotypic and Genotypic coefficient of variation, Heritability and Genetic advance for twelve characters in mung bean during summer season.

Characters	Range of variation	Mean	Phenotypic coefficient of variation (%)	Genotypic coefficient of variation (%)	Heritability in broad sense (%)	Genetic advance	Genetic advance expressed as percent of mean
Days to 50% flowering	35.67 - 39.00	37.47	2.62	2.37	81.99	1.66	4.43
Plant height (cm)	14.24 - 25.08	19.62	13.56	12.61	86.47	4.74	24.15
No. of primary branches per plant	2.43 - 4.17	3.19	13.51	12.58	86.73	0.77	24.13
Number of clusters per plant	2.27 - 5.93	3.37	17.28	16.41	90.07	1.08	32.07
Number of pods per plant	22.30 - 60.42	36.83	24.03	23.57	96.25	17.55	47.64
Length of pod (cm)	6.40 - 12.26	9.13	18.31	18.24	97.78	3.42	37.43
Number of seeds per pod	6.95 - 12.60	9.51	13.69	13.05	90.89	2.44	25.64
100- seed weight (g)	4.66 - 7.44	5.91	12.34	12.17	97.29	1.46	24.73
Days to Maturity	72.00 - 81.33	76.59	3.17	2.84	80.50	4.02	5.25
Biological yield per plant (g)	25.95 - 41.25	33.88	15.16	14.17	87.45	9.25	27.30
Harvest Index (%)	18.66 - 29.12	23.77	12.46	10.73	74.10	4.52	19.03
Seed yield per plant (g)	6.29 - 9.78	7.99	10.00	8.74	77.28	1.26	15.72

advance *i.e.* the expected genetic gain were calculated by using the procedure given by (7). Correlation coefficient and path coefficient was worked out as method suggested by (8).

RESULTS AND DISCUSSION

The analysis of variance revealed highly significant difference for all characters, under study among the genotypes, indicating the presence of sufficient variability in the varieties. Development of high yielding varieties requires a deep knowledge of the existing genetic variation for yield and its component characters. The mean, range, PCV, GCV, heritability, genetic advance and genetic advance as percent of mean are given in Table-2. The highest phenotypic and genotypic coefficient of variation was observed for number of pods per plant (24.03%, 23.57%).. Higher genotypic coefficient of variation in certain cases indicated that these characters were less influenced by the environment. The traits which exhibited moderate values for phenotypic and genotypic coefficient of variation *viz.*, length of pod (18.31%, 18.24%), number of clusters per plant (17.28%, 16.41%), biological yield per plant (15.15%, 14.17%), number of seeds per pod (13.69 %, 13.05%), plant height (13.56%, 12.61%), number of primary branches per plant (13.51%, 12.58%), harvest index (12.46%, 10.73%), 100-seed weight (12.34%, 12.17 %) and seed yield per plant (10.00 %, 8.73%). The days to maturity (3.16 %, 2.84%) and days to 50% flowering (2.62 %, 2.37%) had low phenotypic and genotypic coefficient of variation. This means these characters were influenced by environment and do not represent the true genotypic variability for the trait of the genotypes and indicating the role of non-fixable genetic variance. Similar result was observed by (9, 10). The estimates of phenotypic and genotypic coefficient of variability showed that the values

of phenotypic coefficient of variation were higher than genotypic coefficient of variation thus, indicating the influence of environmental factors. High heritability plays a major role in selecting suitable types based on their phenotypic performance. Genetic advance is indicative of the expected genetic progress for a particular trait under suitable selection procedure (11). Heritability and genetic advance when considered together would be more useful in predicting the resultant effects of selection (5). High value of heritability accompanied by high estimate of genetic advance as percent of mean were expressed by plant height (86.47; 24.15), number of primary branches per plant (86.73; 24.13), number of clusters per plant (90.07; 32.07), number of pods per plant (96.25; 47.64), length of pod (97.78; 37.43), number of seeds per pod (90.89; 25.64), 100-seed weight (97.29; 24.73) and biological yield per plant (87.45; 27.30) under both the seasons which suggested preponderance of additive and fixable genetic variance, therefore any selection scheme may be applied for developing stable genotypes for these traits. It is noted that these characters also exhibited high genetic coefficient of variation. Thus, it may be said that better genetic gain is obtained when the phenotypic expression is not greatly altered by the influence of environment. Similar results was observed by (12, 13). Very high heritability with low genetic advance as percent of mean was showed by days to 50% flowering (81.99; 4.43) and days to maturity (80.50; 5.25). This means that the traits may be regulated by both additive and non-additive gene action or there is presence of high genotype and environment interaction. Very high heritability for days to 50% flowering and days to maturity may due to favourable influence of environment rather than the genotype and simple selection will not be rewarding. Thus, these traits can be improved by few cycles of

recurrent selection followed by pedigree or other methods of breeding. Similar findings were reported by.

CONCLUSION

In the conclusion, based on the variability parameters high heritability coupled with high genetic advance was governed by additive genetic effects to a great extent and improvement of it would be effective through selection. The traits namely days to 50 % flowering, days to maturity and seed yield per plant expressed non-additive gene interaction, hence it needs to be complex selection process and heterosis breeding would be recommended. Similar study on existing germplasm can be rewarding for the selection of more promising genotypes.

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STUDIES ON PHYSICO CHEMICAL QUALITY OF HERBAL SHRIKHAND PREPARED WITH BASIL (*Ocimum basilicum*) Extract

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ABSTRACT

Shrikhand is a popular Indian dessert prepared by fermentation of milk. It has a semi-soft consistency and is sweetish sour in taste. Preparation of herbal shrikhand was carried out by incorporating aqueous basil extract @ 1%, 2%, 3% and 4%, indicated as T₁, T₂, T₃ and T₄ respectively, where T₀ being the control sample with no basil extract and was evaluated on various physico-chemical, organoleptic and microbiological parameters. Five treatments combination were replicated five times and used in the study. The physico- chemical analysis results shows that treatment 4 (T₄) possess maximum moisture, protein, ash content, antioxidant activity, acidity while the control sample (T₀) has maximum total solids, fat content and pH.

Key Words : Herb, shrikhand, basil extract.

Fermented milk and milk products occupy a place in satisfying nutritional requirements of human being since the time antiquity. Fermented milk products have been well recognized to have therapeutic, anticholesterolemic, anticarcinogenic properties (1). Fermented milk products not only are consumed directly but often form starting materials from which other dairy products are also manufactured (2). Shrikhand is a semi-soft, sweetish-sour, whole milk product prepared from lactic fermented curd (3). The curd (dahi) is partially strained through a muslin cloth to remove the whey and thus produce a solid mass called chakka, the basic ingredient for shrikhand (4). Shrikhand is one of the important fermented milk products which derive its name from the Sanskrit word “Shikharani” meaning a curd prepared with added sugar, flavouring agents (Saffron), fruits and nuts. It is popular in western part, especially in Maharashtra, Gujarat and Karnataka. Shrikhand is known for its high nutritive, characteristic flavour, taste, palatable nature and possible therapeutic value. It is very refreshing particularly during summer months. It can be recommended as health food for specific patients suffering from obesity and cardiovascular disease due to its low fat and sugar contents (5).

Ocimum basilicum L. (Lamiaceae), respectively, named basil, is an aromatic herb that has been used traditionally as a medicinal herb in the treatment of headaches, coughs, diarrhea, constipation, warts, worms and kidney malfunctions (6). It has a long history as culinary herb, thanks to its foliage adding a distinctive flavor to many foods. It is also a source of aroma compounds and essential oils containing biologically active constituents that possess insecticidal, nematocidal, fungistatic and antimicrobial properties (7).

The extracts obtained from the plant are extensively brought to use for curing various diseases such as the common cold, inflammation, malaria, heart disease, headaches, stomach disorders, kidney stones, heart disorders, and many more. The Indian basil Tulsi also aids in the purification of atmosphere. Tulsi plant serves as a fabulous repellent for fighting against flies, mosquitoes and insects. It is especially valuable in combating malarial fever (8).

MATERIALS AND METHODS

Manufacturing Control and Experimental Shrikhand

Preparation of curd : Standardized whole milk (6% fat and 9% SNF) is heated to 90°C and then cooled to 30-32°C. It is then inoculated @ 1% with the Shrikhand culture, which is mixed well, and incubated at 30°C till the curd sets firmly (acidity 0.7-0.8% lactic acid).

Preparation of Chakka : The curd so formed is broken and placed in a muslin cloth bag and hang on a peg for the removal of whey for 8-10 hours, during this period, the whey from the curd will drain off and the solid mass thus obtained is called Chakka, which is the shrikhand base.

Preparation of Control Shrikhand : The chakka is then admixed with sugar (crystal or ground) and kneaded for uniform mixing. The product so obtained is the Control Shrikhand sample which has got no basil extract.

Preparation of Experimental Shrikhand : For the Experimental shrikhand, the chakka is mixed with the sugar and aqueous basil extract in different percentages i.e., 1% basil extract for T₁, 2% for treatment T₂, 3% for T₃ and 4% for treatment T₄. The product is then filled in cups followed by its cooling at 10-12°C. The samples were analyzed for Physicochemical, microbial and organoleptic qualities as per the procedure laid down by (9).

Details of different treatments

Materials	Different treatments (herbalkalakand)				
	T ₀	T ₁	T ₂	T ₃	T ₄
Basil extract	-	1%	2%	3%	4%

Statistical analysis : The data obtained on different aspects as per plan were tabulated and statistically analyzed as per.

RESULT AND DISCUSSION

Average of different physiochemical parameters of Control andherbal shrikhanda : Table-1 shows average of different physiochemical parameters of Control and herbal shrikhanda.

Moisture percentage : The highest mean value for moisture percentage the herbal shrikhanda (41.94) was obtained for the treatment T₄ followed by T₃ (41.46), T₂ (41.4) and T₁ (40.1). The minimum score (39.88) was obtained by T₀ (control). There were significant differences found among the treatments. F Value was 130.871, indicating significant effect of treatment onmoisture percentage (Fig. 1).

Total Solids percentage : The highest mean value for total solids percentage the herbal shrikhanda (60.12) was obtained for the treatment T₀ (control) followed by T₁ (59.54), T₂ (58.96) and T₃ (58.54). The minimum score (58.06) was obtained by T₄. There were significant differences found among the treatments. F Value was 129.741, indicating significant effect of treatment on total solids percentage (Fig.-1).

Protein percentage : The highest mean value for proteinpercentage the herbal shrikhanda (8.61) was obtained for the treatment T₄ followed by T₃ (8.36), T₂ (8.07) and T₁ (7.77). The minimum score (7.47) was obtained by T₀ (control). There were significant differences found among the treatments. F Value was 55.662, indicating significant effect of treatment on protein percentage (Fig.-1).

Fat percentage : The highest mean value for fat percentage the herbal shrikhanda (13.50) was obtained for the treatment T₀ followed by T₁ (12.75), T₂ (12.00) and T₃ (11.18). The minimum score (10.58) was obtained by T₄. There were significant differences found among the treatments. F Value was 122.478, indicating significant effect of treatment on fat percentage (Fig.-1).

Carbohydrates : The highest mean valuefor carbohydrates percentage the herbal shrikhanda (39.10) was obtained for the treatment T₁ followed by T₀ (38.42), T₃ (38.18) and T₂ (38.10). The minimum score (38.04) was obtained by T₄. There were significant differences found among the treatments. F value was 112.321, indicating significant effect of treatment on Carbohydrates (Fig.-1).

Ash percentage : The highest mean value for ash percentage the herbal shrikhanda (0.84) was obtained for the treatment T₄ followed by T₃ (0.82), T₂ (0.78) and T₁ (0.74). The minimum score (0.72) was obtained by T₀ (control). There were significant differences found among the treatments. F Value was 62.693, indicating significant effect of treatment on ash percentage (Fig. 2).

Antioxidant activity : The highest mean value for antioxidant activity of the herbal shrikhanda (71.75) was obtained for the treatment T₄ followed by T₃ (55.00), T₂ (22.92) and T₁ (11.50). No antioxidant activity was observed for T₀ (control) sample. There were significant differences found among the treatments. F Value was 356.810, indicating significant effect of treatment on antioxidant activity.

Titration acidity percentage : The highest mean value for titration acidity percentage of the Herbal Shrikhanda (0.95) was obtained for the treatment T₄ followed by T₃ (0.91), T₂ (0.89) and T₁ (0.83). The minimum score (0.76) was obtained by T₀ (control). There were significant differences found among the treatments. F Value was 119.755, indicating significant effect of treatment on titration acidity percentage (Fig. 2).

pH value : The highest mean value for pH value the Herbal Shrikhanda (4.84) was obtained for the treatment T₄ followed by T₃ (4.70), T₂ (4.58) and T₁ (4.46). The minimum score (4.36) was obtained by T₀ (control). There were significant differences found among the treatments. F Value was 51.648, indicating significant effect of treatment on pH value (Fig. 2).

Average of microbial parametersof control and herbal shrikhanda : Table-2 shows Average of microbial parameters of control and herbal shrikhanda. The highest mean score for yeast and moulds of the herbal shrikhanda (6.80) was obtained for the treatment T₀ followed by T₄ (6.20), T₁ and T₃ (5.60). The minimum score (4.80) was obtained by T₂.

None of the samples of herbal shrikhanda i.e., control and experimental samples showed the presence of the coliforms at 0 day. The entire sample, at all the stages, were found gram-negative, which indicates proper hygienic conditions were maintained during the preparation and storage of the product.

CONCLUSION

Taking the experimental results of the present investigation into considerations, it can be concluded thatthe physico-chemical analysis results shows that treatment 4 (T₄) with 4% basil extract possess maximum moisture, protein, ash content, Antioxidant Activity, Acidity and pH while the control sample (T₀) has maximum Total Solids and Fat content. The microbial

Table-1: Average of different physiochemical parameters of Control and herbal shrikhand.

Parameters (%)	Control and herbal shrikhand					F Value	CD
	T ₀	T ₁	T ₂	T ₃	T ₄		
Moisture	39.88	40.46	41.04	41.46	41.94	130.871*	0.213
Total Solids	60.12	59.54	58.96	58.54	58.06	129.741*	0.269
Protein	7.47	7.77	8.07	8.36	8.61	55.662*	0.182
Fat	13.50	12.75	12.00	11.18	10.58	122.478*	0.318
Carbohydrates	38.42	39.10	38.10	38.18	38.04	112.321*	0.660
Ash	0.72	0.74	0.78	0.82	0.84	62.693*	0.018
Titration Acidity #	0.76	0.83	0.89	0.91	0.95	119.755*	0.020
pH	4.36	4.46	4.58	4.70	4.84	51.648*	0.079
Antioxidant Activity	0	11.50	22.92	55.00	71.75	356.810*	4.785

* Significant at 5% level, **Non-significant at 5% level, # As per Lactic Acid.

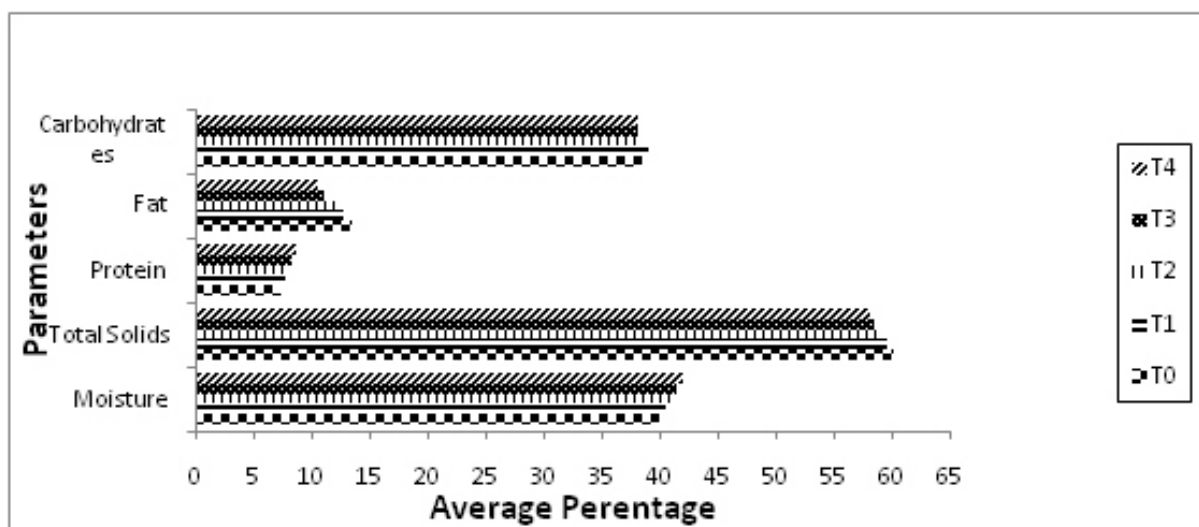
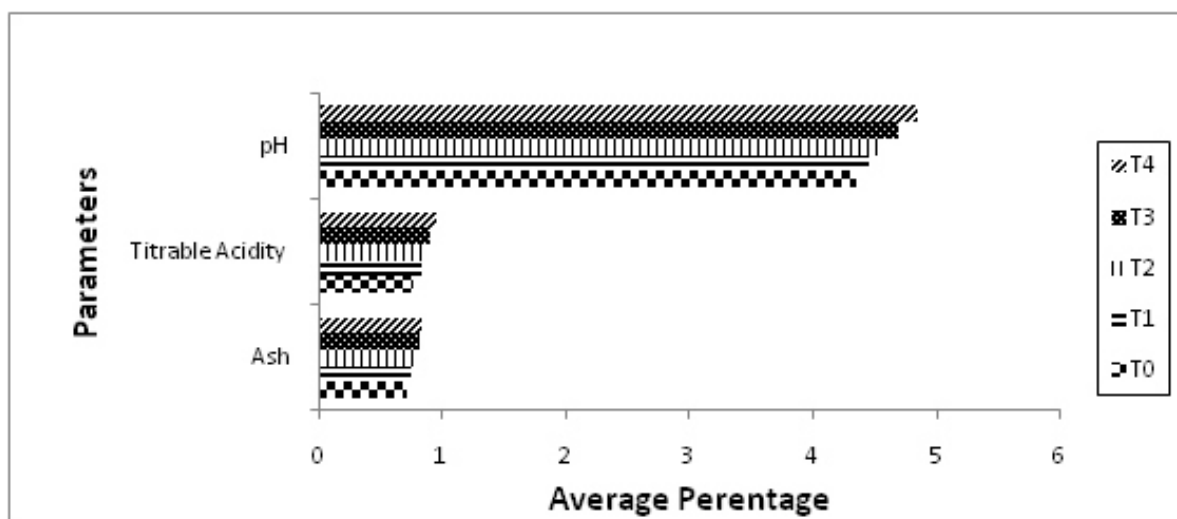
**Figure-1 :** Average of different physiochemical parameters of Control and herbal shrikhand.**Fig.-2 :** Average of different physiochemical parameters of Control and herbal shrikhand

Table-2: Average of microbial parameters of control and herbal shrikhand

Parameters	Control and herbal shrikhand					F Value	CD
	T ₀	T ₁	T ₂	T ₃	T ₄		
Yeast and Moulds(cfu/g)	2.60	2.60	3.60	3.60	2.40	7.467*	0.821
Coliform count (101/ml)	N	N	N	N	N	-	-

* Significant at 5 % level

** Non-significant at 5 % level

count was found to be within the limit. There was significant difference between and within the treatments.

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COMPARATIVE STUDY OF THREE SYMMETRIC ALGORITHM DES, BLOWFISH AND AES

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ABSTRACT

Now a days world, security is required to transmit confidential information over the network. Security is also demanding in wide range of applications. Cryptographic algorithms play a vital role in providing the data security against malicious attacks. But on the other hand, they consume significant amount of computing resources like CPU time, memory, encryption time etc. This paper implements some of the widely used symmetric encryption techniques i.e. Data Encryption Standard (DES), Advanced Encryption Standard (AES) and BLOWFISH. After the implementation, these techniques are compared on some points. These points are block size, key length, round, power consumption, speed, security, throughput.

Key words : Encryption, memory, data encryption standard (DES), advanced encryption standard (AES).

With the introduction of the computer, the need for automated tools for protecting files and other information stored on the computer became evident. This is especially the case for a shared system such as a time sharing system. The need is even more acute for systems that can be accessed over a public telephone network, data network or the Internet. Implementation of digital security techniques becomes vital requirement especially for the transaction of secret information such as in military, forensic reports, for authentication of the firm. Nowadays these techniques are also used by the antisocial elements, terrorist to cause nuisances. Sometimes these nuisances take the form of unavoidable disaster, which echoes at international level. Symmetric key cryptography is a form of encryption that uses the same key to both encrypt and decrypt data. The encryption algorithms are based on substitution and transposition techniques. There are different methods to encrypt data: DES, AES and BLOWFISH. Some algorithms are more secure than others, while some have already been proved weak. AES is one of the most popular algorithms used in symmetric key cryptography. It is available in many different encryption packages. Blowfish, a new secret-key block cipher. Here also discussed the requirements for a standard encryption algorithm, while it may not be possible to satisfy all requirements with a single algorithm, it may be possible to satisfy them with a family of algorithms based on the same cryptographic principles.

RESEARCH METHODOLOGY

DES : DES stands for Data Encryption Standard. It was previously named "Lucifer" first, and was developed by IBM in 1974. The data encryption algorithm and was adopted by the US government as standard encryption method for commercial and unclassified communications in 1977. DES begins the encryption process by using a 64-bit key. Out of 64 bits, 56 bits used as independent key, which determine the exact cryptography transformation and 8 bits are used for error detection. The U.S.

government judged it to be difficult to break and the government adopted it as a standard (US patent 3,962,539) that everyone could use it for secure communication. The US National Security Agency (NSA) made several modifications, after which it was adopted as Federal Information Processing Standard (FIPS) standard 46-3 and ANSI standard X3.92. There are 72 quadrillion or more possible encryption keys to be used in DES. It operates on blocks of 64 bits using a secret key that is 56-bit long. A key is usually chosen randomly within the available possible keys. DES is symmetric, which means that the same key used to encrypt the message must be used to decrypt it. DES uses 8 predefined S-boxes which have been determined by the U.S. National Security Agency (NSA). Using the S-boxes, groups of 6 bits are mapped to groups of 4 bits. These S-boxes are resistant against an attack called differential cryptanalysis, which was first known in the 1990s. Generally, the encryption process of DES is done in 16 rounds. The following steps explain the brief process of DES encryption a message :

The input key is used to derive sixteen 48-bit keys (known as subkeys). Each of these keys is then used in each round.

The right half is expanded from 32 bits to 48 bits using another fixed table.

The result is combined with the subkey for that round using the XOR operation.

Using the S-boxes the 48 resulting bits are then transformed again to 32 bits, which are subsequently permuted again using yet another fixed table. In the next round, this combination is used as the new left half.

The number of possible keys that could be used to encrypt DES was very huge for the computers of that time and it was believed that computers could not possibly ever become fast enough to try all of the possible keys. But eventually, in 1998 the Electronic Frontier Foundation

(EFF) created a special-purpose machine, costing less than \$250,000 which could decrypt a DES encrypted message by trying all of the possible keys in less than three days. This machine could search over 88 billion keys per second.

Decryption is done in a reverse way as that of encryption by using the same key used at the sender's end, since it is symmetric algorithm. Very high throughput rates can be achieved i.e. up to 100 Mbits/sec can be implemented on economical hardware. DES is said to be had known key problems. In DES, the key consist of 56 bits which gives space of $2^{56} = 7.2058 \times 10^{16}$ elements. In an exhaustive search known plain-text attack, the attacker will obtain the solution after 255 trials on an average. Key used in DES itself can sometimes make work easy for attacker. In situation like when all sub-keys are same then at the end of 16-rounds we will get plain text only instead of cipher text. There are many attacks which can exploit the weaknesses of DES, which makes this algorithm insecure. The number of rounds is exponentially proportional to the amount of time and fined a key using a brute-force attack. Therefore the number of rounds increases then the security of the algorithm increases exponentially. DES was clearly no longer invulnerable to the attacks. Decryption process of DES algorithm is similar to encryption, only the round keys are applied in reverse order. The drawback of this algorithm is, it can be easily prone to Brute force Attack. It is easy for the hacker to break the key by applying all possible combinations. In DES, there are only 2^{256} possible combinations which are easy to crack. So DES is not secure.

In 1998 the supercomputer DES cracker, assisted by 100,000 distributed PCs on the Internet, cracked DES in 22 h. The US government has not used DES since 1998

AES : Advanced Encryption Standard is the new encryption standard recommended by NIST to replace DES. Rijndael (pronounced Rain Doll) algorithm was selected in 1997 after a competition to select the best encryption standard. Rijndael developed by Joan Daemen and Vincent Rijmen in Belgium, becomes U.S.'s new Advanced Encryption Standard in October 2000 declared by the National Institute of Standards and Technology. Rijndael using variable key size is extremely fast and compact cipher. Its symmetric and parallel structure provides great flexibility for implementers, with effective resistance against cryptanalytic attacks. AES and DES are block ciphers. AES can be well adapted to a wide range of modern processors such as Pentium, RISC and parallel processors. In general, AES is the name of the standard, and Rijndael is the algorithm described however, in practice the algorithm is also referred to as "AES". AES is based on a design principle known as a Substitution

permutation network. It can be implemented on various platforms especially in small devices. It is fast in both software and hardware. AES encryption is fast and flexible. AES does not use a Feistel network. The AES cipher is specified as a number of repetitions of transformation rounds that converts the input plaintext into the final output of cipher text. Brute force attack is the only effective attack known against it, in which the attacker tries to test all the characters combinations to unlock the encryption. It is a symmetric key block cipher established by the U.S. NIST in 2001. AES is based on substitution and permutation network, it is fast in both hardware and software. It has a fixed block size of 128 bits and key size of 128, 192 and 256 bits. If the key size is 128 bits AES perform 10 rounds, if the key size is 192 bits it performs 12 rounds and if the key size is 256 rounds it performs 14 rounds. Each processing round performs some certain steps :

Sub Bytes : Each byte of the state is replaced with its coordination to the S-Box.

Shift Rows : Row 1 of the state is unchanged. Row 2 is shifted to the left by 1 byte.

Mix Columns : At this step each column of the state is multiplied with a fixed matrix.

Add RoundKey : Each column of the current state is then XORed by the same column from the subkey.

Each round consists of several processing steps, including one that depends on the encryption key. To transform cipher text back into the original plaintext using the same encryption key, a set of reverse rounds are applied.

BLOWFISH : Blowfish was designed in 1994 by Bruce Schneier, author of Applied Cryptography, is considered as a highly rated encryption algorithm in terms of security, with different structure and Functionality than the other mentioned encryption algorithms. Blowfish is a symmetric block cipher algorithm for encryption/decryption. Blowfish is a fast, compact, and simple block encryption algorithm with variable length key allowing a tradeoff between speed and security.

It works on 64-bit units with key lengths from 32-bits up to 448- bits. Each 64-bit block is divided into two 32-bit words, and it encrypts every block by performing 16 rounds of encryption. Blowfish is a public domain algorithm (unpatented) and is used in the SSL and other program It has a key length that can vary from 32 bits to a maximum of 448 bits (1 to 14, 32-bit words). That key is used to generate 18; 32 bit sub keys and 48×32 S-boxes containing a total of 1024 32-bit entries. The total is 4168 bytes. Blowfish is very fast since it encrypts data on 32-bit microprocessors at a rate of 18 clock cycles per byte, and can run in less than 5K of memory. The variable length

Table-1: Comparison of DES, and AES, Blowfish Factors.

	DES	AES	Blowfish
Created By	IBM in 1975	Vincent Rijmen, Joan Daemen in 2001	Bruce Schneier in 1994
Block Size	64 bits	128 bits	64 bits
Key Length	56 bits	128, 192, or 256 bits	32 bits to 448 bits
Round(s)	16	10-128 bit key, 12 - 192 bit key, 14 - 256 bit key	48
Power Consumption	Higher than AES	Higher Than Blowfish	Very Low
Speed	Slow	Fast	Fast
Security	Not Secure Enough	Excellent Security	Strong Security
Security Against Attacks	Brute force attack	Chosen plain, known plain text	Dictionary attacks
Throughput	Lower than AES	Lower than Blowfish	Very high
Tunability	No	No	Yes

key allows a tradeoff between speed and security. Blowfish is one of the most formidable conventional encryption algorithms. So far, the security of Blowfish is unchallenged. Blowfish is accepted as a fast and strong encryption algorithm because it has not been cracked. Basically the algorithm consists of two parts

(i) A key-expansion part, (ii) A data-encryption part.

Key expansion converts a key of at most 56 bytes (448 bits) into several subkey arrays totaling 4168 bytes. The data encryption occurs via a 16-round Feistel network. It is only suitable for application where the key does not change often, like communications link or an automatic file encryption.

It is significantly faster than most encryption algorithms when implemented on 32-bit microprocessors with large data caches. The nature of encryption algorithms is that, once any significant amount of security analysis is done, it is very undesirable to change the algorithm for performance reasons, thereby invalidating the results of the analysis. Thus, it is imperative to consider both security and performance together during the design phase. While it is impossible to take all future computer architectures into consideration, an understanding of general optimization guidelines, combined with exploratory software implementation on existing architectures to calibrate performance, should help achieve higher speed in future encryption algorithms.

The time-consuming sub key generation process adds considerable complexity for a brute-force attack. The advantages of blowfish algorithm are that it is secure and easy to implement and best for hardware implementation but the disadvantage is it require more space for the cipher text because of difference between

key size and block size. The subkeys are too long to be stored on a massive tape, so they would have to be generated by a brute-force cracking machine as required. Exhaustive search of the key space could be the effective way of breaking it, because designer himself admits the existence of weak keys. But so far no one has succeeded in breaking full strength Blowfish encryption. It is unpatented and license free, means Blowfish is a fast, secure and free alternative encryption method.

CONCLUSION

This paper presents a performance evaluation of selected encryption algorithms such as DES, AES, and Blowfish. Symmetric key encryption blowfish has strong security as compare with DES and AES. Tunability is available in Blowfish. Throughput is increased so power consumption is decreased. Throughput is high in blowfish and blowfish is less power consumption algorithm hence speed is fast in the Symmetric key encryption is viewed as good. Finally, in the symmetric key encryption techniques the blowfish algorithm is specified as the better solution.

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CHARACTERIZATION OF WHEAT VARIETIES (*Triticum* spp.) THROUGH PLANT MORPHOLOGY

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ABSTRACT

An experiment was carried out at the Instructional Farm, Department of Agronomy, Junagadh Agricultural University, Junagadh, to characterize 28 wheat varieties of different species (17 of *Triticum aestivum*, 9 of *Triticum durum* and 2 of *Triticum dicoccum*) released for general cultivation in Gujarat at state level as well as at the National level in Central India based on the seed morphological characters. The varieties were grouped based on the plant growth habit into four groups viz., erect (8), semi-erect (17), intermediate (2) and semi-spreading (1) types. Based on the variation in the plant height excluding awns, 7 varieties were grouped as very short, 19 as short and 2 as medium. All the varieties studied were having plant waxiness except DDK 1025 and DDK 1029. Plant flag leaf attitude was erect, semi erect, semi curved and recurved in 8, 13, 2 and 5 varieties, respectively. Based on the flag leaf length, the varieties were grouped into three groups as short (1), medium (15) and long (12). Based on the flag leaf width, the varieties were grouped as narrow (16) and medium (12). Based on the ear colour, varieties were grouped as dull white (26) and light brown (2) types. Based on the ear shape in profile, the varieties were grouped into tapering (13) parallel sided (13) and club shaped (2). The varieties were categorized based on the ear density into lax (2), medium (10), dense (10) and very dense (6) types. All the varieties were having awns. The varieties were grouped based on the awn colour into three group namely dull white (24), light brown (2) and black (2) colour types. Based on awn length, varieties were grouped into short (5), medium (7), long (6) and very long (10). Based on variation in the peduncle length, varieties were grouped into two categories as short (19) and medium (9) varieties.

Key words : Characterization, morphology, *T. aestivum*, *T. dicoccum*, *T. durum*, wheat

Wheat (*Triticum* spp. L.) is an annual plant that belongs to the grass family Poaceae, tribe Triticeae and subtribe Triticineae. It is thought to have originated on the Eurasian continent and the center of its domestication is widely accepted to be somewhere in the Middle East (1).

Three species of wheat viz., *Triticum aestivum* L. (bread wheat), *Triticum durum* Desf. (macaroni wheat) and *Triticum dicoccum* Schulb. (emmer wheat) are presently grown as commercial crop in India, covering 86, 12 and 2 per cent of the total area, respectively. The bread wheat (Hexaploid, $2n=42$) is cultivated in all the wheat growing areas of the country, the macaroni or durum wheat (tetraploid, $2n=28$) is mostly grown in the Northern (Punjab) and Southern states, while the emmer wheat (tetraploid, $2n=28$) is confined to the Southern states (mainly Karnataka) and some parts of Gujarat (2). In India, wheat is mainly grown in the states of Uttar Pradesh, Madhya Pradesh, Punjab, Rajasthan, Haryana, Bihar, Maharashtra, Karnataka and Gujarat. During 2013-14, India accounts an area, production and productivity of 31.34 million ha, 95.91 million metric tones and 3061 kg/ha, respectively (3). In Gujarat, wheat is grown during 2013-14 in about 13.51 lac ha with total production of 36.50 lac metric tones and productivity of 2074 kg/ha (3).

Maintenance of genetic purity of varieties is of primary importance for preventing varietal deterioration during successive regeneration cycles and for ensuring varietal performance at an expected level. The aspects of Distinctness, Uniformity and Stability (DUS) are fundamental for characterization of varieties. In countries having Plant Breeder's Right (PBR) in operation, a new variety is registered only, if it is distinct from other varieties, uniform in its characteristics and genetically stable. The morphological study includes the study of seed to the whole plant characterization. Seed, seedlings and full grown plant could be taken into account for morphological characterization. Grow Out-Test is conducted by growing the plants under field condition and growth features are observed in fixing genuineness. According to International Union for Protection of New Plant Varieties (UPOV), any new characteristics used in varietal characterization should be clearly defined, accepted and should have standard method of observation, least or not affected by environment, accessible to breeders, associated with reasonable costs and efforts. To identify wheat genotypes/varieties, International bodies like UPOV and IPGRI have published relevant descriptors. Such types of classical taxonomic approach is still being employed by certification agencies for the purpose of grow out test to determine the genetic

Table-1 : Identification and grouping of wheat varieties based on plant growth characters.

Varieties	Plant Growth Habit	Plant Foliage Colour	Plant Waxiness	Plant Height Excluding Awns/ Scurs (cm)	Groups
<i>Triticum aestivum</i> L.					
MP 4010	Erect	Green	Presence	54.04	Very short
HI 1500	Semi erect	Green	Presence	57.79	Very short
HI 1531	Semi erect	Light green	Presence	66.26	Short
HI 1544	Semi erect	Light green	Presence	58.40	Very short
GW 1	Semi erect	Light green	Presence	61.52	Short
GW 503	Erect	Dark green	Presence	62.08	Short
DL 788-2	Erect	Green	Presence	64.47	Short
HD 2932	Semi erect	Green	Presence	71.04	Short
GW 11	Semi spreading	Dark green	Presence	66.19	Short
GW 173	Erect	Green	Presence	60.18	Short
GW 190	Semi erect	Green	Presence	65.39	Short
GW 273	Semi erect	Green	Presence	69.44	Short
LOK 1	Semi erect	Green	Presence	58.15	Very short
GW 322	Semi erect	Green	Presence	60.99	Short
MP 3288	Semi erect	Green	Presence	67.68	Short
GW 366	Erect	Light green	Presence	67.24	Short
GW 496	Semi erect	Dark green	Presence	59.26	Very short
<i>Triticum durum</i> Desf					
HI 8381	Intermediate	Dark green	Presence	59.85	Very short
HI 8498	Semi erect	Green	Presence	70.43	Short
HI 8627	Semi erect	Green	Presence	79.95	Medium
HI 8713	Erect	Green	Presence	61.77	Short
A 28	Semi erect	Green	Presence	69.20	Short
A 206	Semi erect	Green	Presence	75.62	Medium
GDW 1255	Semi erect	Dark green	Presence	67.85	Short
GW 1139	Intermediate	Green	Presence	61.05	Short
RAJ 1555	Erect	Green	Presence	63.18	Short
<i>Triticum dicoccum</i> Schrank					
DDK 1025	Erect	Light green	Absence	63.58	Short
DDK 1029	Semi erect	Green	Absence	58.78	Very short
Mean				64.33	
S.Em ±				2.33	
C.D. at 5%				6.62	
CV %				6.46	

Plant height excluding awns or scurs (cm)

Very short : < 60 cm, Short : 60.1 to 75 cm, Medium : 75.1 to 90 cm, Long : 90.1 to 115 cm, Very long : > 115 cm

purity of seed lots. These morphological descriptors have a traditional significance and are immediately accessible on the spot without need of equipment. Thus, a clear basis for distinctness testing procedure prior to varietal registration can draw out of this. However, the approach demands a field assessment, which depends on the degree of experience of the operator.

In the light of the above facts, the present study on

documentation of characters for wheat varieties was planned with the objective to identify stable diagnostic characteristics of plant morphology of wheat varieties.

MATERIALS AND METHODS

The experiment was conducted at the Infrastructural Farm, Department of Agronomy, Junagadh Agricultural University, Junagadh, during rabi 2014 to study the varietal characterization in 28 wheat varieties viz., MP

Table-2 : Identification and grouping of wheat varieties based on flag leaf morphological characters.

Varieties	Plant Flag Leaf Attitude	Flag Leaf Anthocyanin Colouration of Auricle	Flag Leaf Hair on Auricle	Flag Leaf Length (cm)	Groups	Flag Leaf Width (cm)	Groups	Flag Leaf Waxiness of Sheath	Flag Leaf Waxiness of Blade
<i>Triticum aestivum</i> L.									
MP 4010	Semi-erect	Absence	Presence	17.73	Medium	1.41	Narrow	Medium	Very weak
HI 1500	Semi-erect	Absence	Presence	18.34	Medium	1.34	Narrow	Weak	Very weak
HI 1531	Erect	Absence	Presence	18.47	Medium	1.39	Narrow	Medium	Very weak
HI 1544	Recurved	Absence	Presence	18.00	Medium	1.45	Narrow	Medium	Very weak
GW 1	Semi-erect	Presence	Presence	24.80	Long	1.52	Medium	Medium	Very weak
GW 503	Recurved	Absence	Absence	17.83	Medium	1.28	Narrow	Medium	Medium
DL 788-2	Semi-curved	Absence	Presence	18.87	Medium	1.39	Narrow	Medium	Weak
HD 2932	Semi-erect	Absence	Absence	15.97	Medium	1.55	Medium	Strong	Medium
GW 11	Semi-erect	Absence	Presence	18.29	Medium	1.51	Medium	Medium	Weak
GW 173	Recurved	Absence	Absence	23.20	Long	1.47	Narrow	Strong	Medium
GW 190	Semi-erect	Absence	Absence	14.57	Short	1.25	Narrow	Strong	Medium
GW 273	Semi-erect	Absence	Absence	21.78	Long	1.45	Narrow	Medium	Medium
LOK 1	Semi-curved	Absence	Absence	18.31	Medium	1.45	Narrow	Medium	Weak
GW 322	Recurved	Absence	Absence	19.13	Medium	1.50	Narrow	Strong	Strong
MP 3288	Erect	Absence	Absence	24.03	Long	1.63	Medium	Strong	Very weak
GW 366	Semi-erect	Presence	Presence	19.64	Medium	1.39	Narrow	Medium	Weak
GW 496	Recurved	Absence	Presence	20.41	Long	1.36	Narrow	Weak	Very weak
<i>Triticum durum</i> Desf									
HI 8381	Erect	Presence	Absence	19.87	Medium	1.57	Medium	Medium	Weak
HI 8498	Erect	Presence	Absence	19.67	Medium	1.70	Medium	Strong	Medium
HI 8627	Erect	Presence	Absence	25.18	Long	1.59	Medium	Medium	Medium
HI 8713	Semi-erect	Absence	Absence	18.83	Medium	1.42	Narrow	Strong	Medium
A 28	Semi-erect	Absence	Absence	18.49	Medium	1.34	Narrow	Weak	Very weak
A 206	Semi-erect	Absence	Presence	21.01	Long	1.64	Medium	Weak	Very weak
GDW 1255	Erect	Absence	Presence	20.00	Long	1.73	Medium	Strong	Weak
GW 1139	Semi-erect	Absence	Absence	21.18	Long	1.72	Medium	Medium	Medium
RAJ 1555	Semi-erect	Presence	Presence	20.86	Long	1.37	Narrow	Strong	Strong
<i>Triticum dicoccum</i> Schrank									
DDK 1025	Erect	Absence	Absence	20.71	Long	1.75	Medium	Very weak	Very weak
DDK 1029	Erect	Absence	Absence	21.65	Long	1.61	Medium	Very weak	Very weak
Mean				19.89		1.50			
S.Em ±				1.47		0.09			

Flag leaf length (cm), Short : < 15 cm
Medium: 15.1 to 20 cm, Long : > 20 cm

Flag leaf width (cm), Narrow : < 1.5 cm
Medium : 1.51 to 2.0 cm, Broad : > 2.0 cm

Table-3 : Identification and grouping of wheat varieties based on ear morphological characters.

Varieties	Day to Ear Emergence (days)	Groups	Ear Waxiness	Ear Colour	Ear Length (Excluding Awn / Scurs) (cm)	Groups	Ear Shape in Profile	Ear Density
<i>Triticum aestivum</i> L.								
MP 4010	48.00	Very early	Very weak	Dull white	7.87	Short	Tapering	Medium
HI 1500	63.00	Medium	Very weak	Dull white	8.24	Medium	Parallel sided	Medium
HI 1531	65.00	Medium	Very weak	Dull white	8.73	Medium	Parallel sided	Medium
HI 1544	53.00	Early	Weak	Dull white	7.95	Short	Club shaped	Medium
GW 1	55.00	Early	Strong	Dull white	9.04	Medium	Tapering	Dense
GW 503	46.00	Very early	Medium	Dull white	7.97	Short	Tapering	Lax
DL 788-2	52.00	Early	Very weak	Dull white	9.22	Medium	Parallel sided	Medium
HD 2932	51.00	Early	Weak	Light brown	9.09	Medium	Parallel sided	Medium
GW 11	47.00	Very early	Strong	Dull white	9.19	Medium	Tapering	Dense
GW 173	55.00	Early	Weak	Dull white	8.65	Medium	Tapering	Lax
GW 190	65.00	Medium	Strong	Dull white	9.46	Medium	Tapering	Dense
GW 273	62.00	Medium	Medium	Dull white	9.21	Medium	Tapering	Medium
LOK 1	61.00	Medium	Weak	Dull white	8.36	Medium	Tapering	Medium
GW 322	66.00	Medium	Strong	Dull white	9.19	Medium	Tapering	Medium
MP 3288	57.00	Early	Medium	Dull white	9.73	Medium	Parallel sided	Dense
GW 366	49.00	Very early	Very weak	Dull white	7.97	Short	Club shaped	Dense
GW 496	61.00	Medium	Weak	Dull white	8.02	Medium	Tapering	Medium
<i>Triticum durum</i> Desf								
HI 8381	63.00	Medium	Medium	Dull white	8.13	Medium	Parallel sided	Very dense
HI 8498	64.00	Medium	Strong	Dull white	7.78	Short	Parallel sided	Very dense
HI 8627	72.00	Late	Medium	Dull white	8.59	Medium	Parallel sided	Very dense
HI 8713	69.00	Medium	Weak	Dull white	8.43	Medium	Tapering	Dense
A 28	56.00	Early	Very weak	Dull white	6.81	Short	Parallel sided	Dense
A 206	56.00	Early	Very weak	Light brown	8.08	Medium	Parallel sided	Dense
GDW 1255	60.33	Early	Strong	Dull white	7.77	Short	Parallel sided	Very dense
GW 1139	58.67	Early	Medium	Dull white	8.69	Medium	Parallel sided	Very dense
RAJ 1555	51.67	Early	Medium	Dull white	7.26	Short	Parallel sided	Very dense
<i>Triticum dicoccum</i> Schrank								
DDK 1025	73.33	Late	Weak	Dull white	8.13	Medium	Tapering	Dense
DDK 1029	72.00	Late	Very weak	Dull white	7.95	Short	Tapering	Dense
Mean	59.00				8.41			
S.Em ±	0.51				0.47			
C.D. at 5 %	1.46				1.34			
CV %	5.51				9.71			

Ear length (cm) Very short : < 6 cm

Short : 6.1 to 8 cm Medium : 8.1 to 10 cm

Long : 10.1 to 12 cm Very long : > 12 cm

4010, HI 1500, HI 1531, HI 1544, GW 1, GW 503, DL 788-2, HD 2932, GW 11, GW 173, GW 190, GW 273, LOK 1, GW 322, MP 3288, GW 366, GW 496, HI 8381, HI 8498, HI 8627, HI 8713, A 28, A 206, GDW 1255, GW 1139, RAJ 1555, DDK 1025 and DDK 1029 of different species (17 of *Triticum aestivum*, 9 of *Triticum durum* and 2 of *Triticum dicoccum*) released for general cultivation in Gujarat at state level as well as at the National level in Central India based on the plant morphological characters. Plant morphological characters viz., plant

growth habit, plant foliage colour, plant waxiness, plant height excluding awns, flag leaf attitude, flag leaf anthocyanin colouration of auricle, flag leaf hairs on auricle, flag leaf length (cm), flag leaf width (cm), flag leaf waxiness of sheath, flag leaf waxiness of blade, days to ear emergence days, ear waxiness, ear colour, ear length excluding awns/scurs (cm), ear shape in profile, ear density, awns presence, awns length (cm), awns colour, awns attitude, peduncle waxiness, peduncle length (cm) and peduncle attitude were studied as per the guidelines

Table-4 : Identification and grouping of wheat varieties based on awns morphology.

Varieties	Awns Presence	Awns Length (cm)	Groups	Awns Colour	Awns Attitude
<i>Triticum aestivum</i> L.					
MP 4010	Presence	9.16	Long	Dull white	Spreading
HI 1500	Presence	8.79	Medium	Dull white	Oppressed
HI 1531	Presence	9.24	Long	Dull white	Medium
HI 1544	Presence	8.41	Medium	Dull white	Oppressed
GW 1	Presence	9.17	Long	Dull white	Spreading
GW 503	Presence	6.99	Short	Dull white	Medium
DL 788-2	Presence	7.85	Medium	Dull white	Spreading
HD 2932	Presence	6.41	Short	Light brown	Spreading
76GW 11	Presence	6.77	Short	Dull white	Spreading
GW 173	Presence	6.91	Short	Dull white	Medium
GW 190	Presence	7.83	Medium	Dull white	Medium
GW 273	Presence	7.84	Medium	Dull white	Spreading
LOK 1	Presence	6.17	Short	Dull white	Spreading
GW 322	Presence	7.78	Medium	Dull white	Spreading
MP 3288	Presence	9.47	Long	Dull white	Spreading
GW 366	Presence	10.25	Long	Dull white	Medium
GW 496	Presence	10.81	Very long	Dull white	Spreading
<i>Triticum durum</i> Desf					
HI 8381	Presence	10.52	Very long	Black	Medium
HI 8498	Presence	15.04	Very long	Dull white	Medium
HI 8627	Presence	15.74	Very long	Dull white	Oppressed
HI 8713	Presence	11.93	Very long	Dull white	Oppressed
A 28	Presence	8.64	Medium	Dull white	Spreading
A 206	Presence	15.70	Very long	Light brown	Spreading
GDW 1255	Presence	15.21	Very long	Dull white	Oppressed
GW 1139	Presence	9.21	Long	Dull white	Spreading
RAJ 1555	Presence	10.92	Very long	Black	Medium
<i>Triticum dicoccum</i> Schrank					
DDK 1025	Presence	11.51	Very long	Dull white	Oppressed
DDK 1029	Presence	11.57	Very long	Dull white	Oppressed
Mean		9.85			
S.Em ±		0.59			
C.D. at 5 %		1.67			
CV %		10.34			

Awns length (cm), Very short : < 6 cm, Short : 6.1 to 7.5 cm
 Medium : 7.51 to 9 cm, Long : 9.1 to 10.5 cm, Very long : > 10.5 cm

of DUS testing. All the characters were analyzed following Randomized Block Design as per the method suggested by (4).

RESULTS AND DISCUSSION

Plant growth characters : Use of plant growth characteristics to identify a variety has been classical approach for varietal purity testing. The varieties were grouped based on the plant growth habit into four groups viz., erect (8 varieties), semi-erect (17 varieties), intermediate (2 varieties) and semi-spreading (1 variety) types. While, based on the plant foliage colour, the varieties were grouped into light green (5 varieties), green (18 varieties) and dark green (5 varieties) coloured. Based on the variation in the plant height excluding awns, seven varieties were grouped as very short (< 60 cm), nineteen

varieties as short (60.1-75 cm) and two varieties as medium (75.1-90 cm) type plant height. The plant height excluding awns ranged from 54.04 cm (MP 4010) to 79.95 cm (HI 8627) with a mean of 64.33 cm. Plant waxiness was present in twenty six varieties All the varieties were having waxiness except DDK 1025 and DDK 1029 (Table-1).

The varieties viz., HI 1531 and GW 1 were having semi erect plant growth habit, light green foliage colour, short plant height excluding awns/scurs and presence of plant waxiness; DL 788-2, GW 173, HI 8713 and RAJ 1555 were having erect plant growth habit, green foliage colour, short plant height excluding awns/scurs and presence of plant waxiness; HD 2932, GW 190, GW 273, GW 322, MP 3288, HI 8498 and A 28 were having semi

Table-5 : Identification and grouping of wheat varieties based on peduncle morphological characters.

Varieties	Peduncle Waxiness	Peduncle Length (cm)	Groups	Peduncle Attitude (at the time of maturity)
<i>Triticum aestivum</i> L.				
MP 4010	Medium	26.87	Short	Straight
HI 1500	Medium	25.93	Short	Straight
HI 1531	Very weak	31.84	Medium	Straight
HI 1544	Medium	24.93	Short	Bent
GW 1	Medium	27.49	Short	Crooked
GW 503	Medium	31.55	Medium	Straight
DL 788-2	Weak	27.37	Short	Bent
HD 2932	Strong	30.67	Medium	Bent
GW 11	Strong	31.41	Medium	Straight
GW 173	Strong	25.50	Short	Straight
GW 190	Strong	24.31	Short	Bent
GW 273	Strong	31.81	Medium	Straight
LOK 1	Medium	29.35	Short	Straight
GW 322	Strong	26.74	Short	Straight
MP 3288	Strong	27.03	Short	Bent
GW 366	Very weak	26.91	Short	Crooked
GW 496	Medium	26.24	Short	Straight
<i>Triticum durum</i> Desf				
HI 8381	Weak	26.26	Short	Straight
HI 8498	Strong	32.75	Medium	Bent
HI 8627	Medium	34.30	Medium	Straight
HI 8713	Weak	20.83	Short	Straight
A 28	Very weak	29.82	Short	Straight
A 206	Very weak	33.47	Medium	Straight
GDW 1255	Strong	31.53	Medium	Crooked
GW 1139	Strong	27.05	Short	Straight
RAJ 1555	Strong	30.05	Short	Bent
<i>Triticum dicoccum</i> Schrank				
DDK 1025	Very weak	25.26	Short	Bent
DDK 1029	Medium	25.26	Short	Bent
Mean		28.30		
S.Em ±		1.79		
C.D. at 5 %		5.09		
CV %		10.98		

Note : Peduncle length (cm), Short : < 30 cm, Medium : 31 to 50 cm, Long : > 50 cm

erect plant growth habit, green foliage colour, short plant height excluding awns/scurs and presence of plant waxiness; HI 8627 and A 206 were having semi erect plant growth habit, green foliage colour, medium plant height excluding awns/scurs and presence of plant waxiness; and HI 1500 and LOK 1 were having semi erect plant growth habit, green foliage colour, very short plant height excluding awns/scurs and presence of plant waxiness forming the different group and cannot be differentiated from each other in the respective group on the basis of plant morphological characters. However, the

remaining varieties were different with respect to plant growth characters for at least one character and they can be easily identified in the seed production plot on the basis of plant growth characters. Similar observations were also made by (5, 6).

Flag leaf morphological characters : On the basis of flag leaf morphological characteristics, the varieties were categorized into different groups (Table 2). Plant flag leaf attitude was erect in eight varieties, semi erect in thirteen varieties, semi-curved in two varieties and recurved in five varieties. Flag leaf anthocyanin colouration of auricles was present in six varieties and absent in twenty two varieties. Based on flag leaf hairs on auricle, the varieties were grouped as presence (12 varieties) and absence (16 varieties) types. Based on the flag leaf length, the varieties were grouped into three groups as short (<15 cm) with one variety, medium (15.1-20 cm) with fifteen varieties and long types (> 20 cm) with twelve varieties. The flag leaf length ranged from 14.57 cm (GW 190) to 25.18 cm (HI 8627) with a mean of 19.89 cm. Based on the flag leaf width, the varieties were grouped as narrow (<1.5 cm) with sixteen varieties and medium (1.51-2.0 cm) with twelve varieties. The flag leaf width ranged from 1.25 cm (GW 190) to 1.75 cm (DDK 1025) with a mean of 1.50 cm. The wheat varieties under study were grouped based on flag leaf waxiness of sheath into four categories namely very weak (2 varieties), weak (4 varieties), medium (13 varieties) and strong (9 varieties) types. Based on the flag leaf waxiness of blade, varieties were grouped into very weak (11 varieties), weak (6 varieties), medium (9 varieties) and strong (2 varieties) types.

Two red seed varieties, DDK 1025 and DDK 1029 cannot be differentiated on the basis of flag leaf characteristics were having erect type plant flag leaf attitude, absence of flag leaf anthocyanin colouration of auricle, absence of flag leaf hair on auricle, long flag leaf length, medium flag leaf width, very weak flag leaf waxiness of sheath and very weak flag leaf waxiness of blade. The varieties MP 4010 and HI 1500 were having semi erect type plant flag leaf attitude, absence of flag leaf anthocyanin colouration of auricle, presence of flag leaf hair on auricle, medium flag leaf length and narrow flag leaf width, but differing in flag leaf waxiness of sheath and blade. GW 1 was having semi erect plant flag leaf attitude, presence of flag leaf anthocyanin colouration of auricle, presence of flag leaf hair on auricle, long flag leaf length, medium flag leaf width, medium flag leaf waxiness of sheath and very weak flag leaf waxiness of blade, whereas A 206 was having semi erect plant flag leaf attitude, absence of flag leaf anthocyanin colouration of auricle, presence of flag leaf hair on auricle, long flag leaf length, medium flag leaf width, weak flag leaf waxiness of sheath and very weak flag leaf waxiness of blade.

GW 1 and GW 366 were semi erect plant flag leaf attitude, presence of flag leaf anthocyanin colouration of auricle, presence of flag leaf hair on auricle and medium flag leaf waxiness of sheath, but differing in flag leaf length, flag leaf width, and flag leaf waxiness of blade. HD 2932, GW 1139, GW 190, GW 273, HI 8713 and A 28 were having semi erect type plant flag leaf attitude, absence of flag leaf anthocyanin colouration of auricle and absence of flag leaf hair on auricle, but were distinct with respect to all the remaining flag leaf characteristics. RAJ 1555 were having semi erect type plant flag leaf attitude, presence of flag leaf anthocyanin colouration of auricle, presence of flag leaf hair on auricle, long flag leaf length, narrow flag leaf width, strong flag leaf waxiness of sheath and strong flag leaf waxiness of blade.

GW 503, GW 173 and GW 322 were having recurved type plant flag leaf attitude, absence of flag leaf anthocyanin colouration of auricle and absence of flag leaf hair on auricle, but was distinct with respect to flag leaf length, flag leaf width and flag leaf waxiness of sheath and blade. HI 1544 and GW 496 were having recurved type plant flag leaf attitude, absence of flag leaf anthocyanin colouration of auricle and presence of flag leaf hair on auricle, but was differing in flag leaf length, flag leaf width and flag leaf waxiness of sheath and blade.

LOK 1 was having semi curved type plant flag leaf attitude, absence of flag leaf anthocyanin colouration of auricle, absence of flag leaf hair on auricle, medium flag leaf length, narrow flag leaf width, medium flag leaf waxiness of sheath and weak flag leaf waxiness of blade, while DL 788-2 was having semi curved type plant flag leaf attitude, absence of flag leaf anthocyanin colouration of auricle, presence of flag leaf hair on auricle, medium flag leaf length, narrow flag leaf width, medium flag leaf waxiness of sheath and weak flag leaf waxiness of blade.

MP 3288 was having erect type plant flag leaf attitude, absence of flag leaf anthocyanin colouration of auricle, absence of flag leaf hair on auricle, long flag leaf length, medium flag leaf width, strong flag leaf waxiness of sheath and very weak flag leaf waxiness of blade. HI 1531 and GDW 1255 were having erect type plant flag leaf attitude, absence of flag leaf anthocyanin colouration of auricle and presence of flag leaf hair on auricle, but was distinct in flag leaf length, flag leaf width, flag leaf waxiness of sheath and blade. Similarly, HI 8391, HI 8498 and HI 8627 were having erect type plant flag leaf attitude, presence of flag leaf anthocyanin colouration of auricle and absence of flag leaf hair on auricle, but was differing in flag leaf length, flag leaf width, flag leaf waxiness of sheath and blade. Several workers characterized wheat genotypes on the basis of flag leaf morphological

characters such as (5, 6). The genetic constituent of the genotypes coupled with environmental and agronomic factors might be responsible to the variation in flag leaf morphometric characters.

Ear morphological characters : The genotypic variation was observed in case of ear morphological characteristics which are helped to classify the genotypes into different groups (Table-3). Days to ear emergence and ear length were most discriminating factors among the cultivars. Based on the days to ear emergence, the varieties were grouped into very early (< 50 days) with four varieties, early (51-60 days) with eleven varieties, medium (61-70 days) with ten varieties and late (71-80 days) with three varieties. The days required for emergence of ear ranged from 46.00 days (GW 503) to 73.33 days (DDK 1025) with a mean of 59.00 days. Ear length varied among the varieties and was grouped into short (6.1-8.0 cm) with nine varieties and medium (8.1-10 cm) with nineteen varieties. The ear length ranged from 6.81 cm (A 28) to 9.73 cm (MP 3288) with a mean ear length of 8.41 cm. Based on ear waxiness, varieties were grouped as very weak (8 varieties), weak (7 varieties), medium (7 varieties) and strong (6 varieties) types. Based on the ear colour, varieties were grouped as dull white (26 varieties) and light brown (2 varieties) types. Based on the ear shape in profile, the varieties were grouped into tapering with thirteen varieties, parallel sided with thirteen varieties and club shaped with two varieties. The varieties were categorized based on the ear density into lax (2 varieties), medium (10 varieties), dense (10 varieties) and very dense (6 varieties) types.

The varieties, MP 4010, GW 366, GW 503 and GW 11 were very early in ear emergence and dull white ear colour, but they were distinct with respect to ear waxiness, ear length, ear shape in profile and ear density. MP 4010 was having very weak ear waxiness, short ear length, tapering ear shape and medium ear density; GW 503 was having very weak ear waxiness, short ear length, club shaped ear shape and dense ear density; GW 503 was having medium ear waxiness, short ear length tapering ear shape and lax ear density; and GW 11 was having strong ear waxiness, medium ear length, tapering ear shape and, lax ear density.

The varieties, HI 1544, GW 173, GW 1, DL 788-2, A 28, MP 3288, GW 1139, RAJ 1555 and GDW 1255 were having early ear emergence and dull white ear colour, but they were distinct with respect to ear waxiness, ear length, ear shape in profile and ear density. HI 1544 was having weak ear waxiness, short ear length, club shaped ear shape and medium ear density; GW 173 was having weak ear waxiness, medium ear length, tapering ear shape and lax ear density; GW 1 was having strong ear waxiness, medium ear length, tapering ear shape and

dense ear density; DL 788-2 was having very weak ear waxiness, medium ear length, parallel sided ear shape and medium ear density; A 28 was having very weak ear waxiness, short ear length, parallel sided ear shape and dense ear density; MP 3288 was having medium ear waxiness, medium ear length, parallel sided ear shape and dense ear density; GW 1139 was having medium ear waxiness, medium ear length, parallel sided ear shape and very dense ear density; RAJ 1555 was having medium ear waxiness, short ear length, parallel sided ear shape and very dense ear density; and GDW 1255 was having strong ear waxiness, short ear length, parallel sided ear shape and dense ear density. A 206 and HD 2932 were having early ear emergence, light brown ear colour, medium ear length, parallel sided ear shape in profile, but were distinct with respect to very weak ear waxiness and dense ear density (A 206) and weak ear waxiness and medium ear density (HD 2932).

The varieties, GW 190, GW 273, HI 8381, GW 322, HI 8498, LOK 1, GW 496, HI 8713, HI 1500 and HI 1531 were having medium ear emergence and dull white ear colour, but they were distinct with respect to ear waxiness, ear length, ear shape in profile and ear density. GW 190 was having strong ear waxiness, medium ear length, tapering ear shape and dense ear density; GW 273 was having medium ear waxiness, medium ear length, tapering ear shape and medium ear density; HI 8381 was having medium ear waxiness, medium ear length, parallel sided ear shape and very dense ear density; GW 322 was having strong ear waxiness, medium ear length, tapering ear shape and medium ear density; HI 8498 was having strong ear waxiness, short ear length, parallel sided ear shape and very dense ear density; LOK 1 and GW 496 were having weak ear waxiness, medium ear length, tapering ear shape and medium ear density; HI 8713 was having weak ear waxiness, medium ear length, tapering ear shape and dense ear density; and HI 1500 and HI 1531 were having very weak ear waxiness, medium ear length, parallel sided ear shape and medium ear density.

The varieties, HI 8627, DDK 1025 and DDK 1029 were having late ear emergence and dull white ear colour, but they were distinct with respect to ear waxiness, ear length, ear shape in profile and ear density. HI 8627 was having medium ear waxiness, medium ear length, parallel sided ear shape and very dense ear density; DDK 1025 was having weak ear waxiness, medium ear length, tapering ear shape and dense ear density; and DDK 1029 was having very weak ear waxiness, short ear length, tapering ear shape and dense ear density.

Similar observations and grouping of genotypes based on ear morphological characteristics in wheat were

made by (5, 7). Reason attributed for differentiation in ear morphological characters among the genotypes is that the character is dependent on major gene complex and the genetic and environmental interaction and also has selective influence.

Awns morphological characters : Based on awns morphological characteristics, the genotypes were categorized into different groups (Table-4). All the varieties were having awns. The varieties were grouped based on the awn colour into three group namely dull white (24 varieties), light brown (2 varieties) and black (2 varieties) colour types. Based on the awns attitude, varieties were grouped into spreading (13 varieties), medium (8 varieties) and oppressed (7 varieties) types. Awn length varied significantly among the twenty eight varieties and categorized into short (6.1 to 7.5 cm) with five varieties, medium (7.51 to 9.0 cm) with seven varieties, long (9.1 to 10.5 cm) with six varieties and very long (> 10.5 cm) with ten varieties. The awn length ranged from 6.17 cm (LOK 1) to 15.74 cm (HI 8627) with a mean of 9.85 cm.

The results revealed that all the varieties evaluated possessed awns. Out of 26 varieties, awns colour was dull white in twenty four varieties (MP 4010, HI 1500, HI 1531, HI 1544, GW 1, GW 503, DL 788-2, GW 11, GW 173, GW 190, GW 273, LOK 1, GW 322, MP 3288, GW 366, GW 496, HI 8498, HI 8627, HI 8713, A 28, GDW 1255, GW 1139, DDK 1025 and DDK 1029), light brown in two varieties (HD 2932 and A 206) and black in two varieties (HI 8381, RAJ 1555). As far as awns length and attitude, the varieties HI 8627, HI 8713, GDW 1255, DDK 1025, DDK 1029, A 206, GW 496, HI 8381, RAJ 1555 and HI 8498 were having very long awns, but differing in awn attitude with oppressed type (HI 8627, HI 8713, GDW 1255, DDK 1025 and DDK 1029), spreading type (A 206 and GW 496) and medium type (HI 8381, RAJ 1555 and HI 8498) attitude. The varieties, MP 4010, GW 1, MP 3288, GW 1139, HI 1531 and GW 366 were having long awns, but differing in awn attitude with spreading type (MP 4010, GW 1, MP 3288 and GW 1139) and medium type (HI 1531 and GW 366) attitude. The varieties, HI 1500, HI 1544, DL 788-2, GW 273, GW 322, A 28 and GW 190 were having medium length awns, but differing in awn attitude with oppressed type (HI 1500 and HI 1544), spreading type (DL 788-2, GW 273, GW 322 and A 28) and medium type (GW 190) attitude. The varieties, GW 503, GW 173, HD 2932, GW 11 and LOK 1 were having short awns, but differing in awn attitude with spreading type (HD 2932, GW 11 and LOK 1) and medium type (GW 503 and GW 173) attitude. Similar observations were made by (6, 7) in wheat. The genetic constituent of the genotype coupled with environmental and agronomic

factors might be responsible to the variation in awn morphological characters.

Peduncle morphological characters : The varieties were classified on the basis of peduncle waxiness into four groups viz., very weak (5 varieties), weak (3 varieties), medium (9 varieties) and strong (11 varieties) waxiness types (Table 5). Based on the peduncle attitude, all twenty eight varieties were grouped into straight (16 varieties), bent (9 varieties) and crooked (3 varieties) attitude types. Peduncle length varied significantly among wheat varieties studied. Based on variation in the peduncle length, varieties were grouped into two categories as short (< 30 cm) with nineteen varieties and medium (31-50 cm) with nine varieties. The peduncle length ranged from 20.83 cm (HI 8713) to 34.30 cm (HI 8627) with a mean of 28.30 cm.

The varieties, HI 1531 and A 206 were having very weak peduncle waxiness, medium peduncle length and straight peduncle attitude, while GW 366, A 28 and DDK 1025 were having very weak peduncle waxiness and short peduncle length, but were distinct with crooked, straight and bent peduncle attitude, respectively (Table 5). The varieties, HI 8381 and HI 8713 were having weak peduncle waxiness, short peduncle length and straight peduncle attitude, while DL 788-2 was having weak peduncle waxiness, short peduncle length and bent peduncle attitude. Varieties, MP 4010, HI 1500, LOK 1 and GW 496 were having medium peduncle waxiness, short peduncle length and straight type peduncle attitude, while HI 1544, DDK 1029 and GW 1 were having medium peduncle waxiness, short peduncle length and bent type peduncle attitude and GW 503 and HI 8627 having medium peduncle waxiness, medium peduncle length and straight type peduncle attitude. The varieties, GW 173, GW 322, GW 1139, GW 190, MP 3288 and RAJ 1555 were having strong peduncle waxiness and short peduncle length, but were differing in peduncle attitude,

where GW 173, GW 322 and GW 1139 having straight type attitude and remaining having bent type attitude. The varieties, HD 2932, HI 8498, GW 11, GW 273 and GDW 1255 were having strong peduncle waxiness and medium peduncle length, but were differing in peduncle attitude with bent type (HD 2932, HI 8498), straight type (GW 11, GW 273) and crooked type (GDW 1255) attitude. Similar observations and grouping were made based on the peduncle morphological characteristics in wheat by (5, 8).

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STUDY OF VARIABILITY AND ASSOCIATION ANALYSIS IN FENUGREEK (*Trigonella foenum-Graecum* L.) UNDER TIMELY AND LATE SOWN CONDITIONS

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ABSTRACT

The experiment consisting of forty advanced breeding lines of fenugreek (*Trigonella foenum-gracum* L.) with three replication each in timely and late sown condition, during the Rabi season of the year 2013-14. The characters studied were days to 50% flowering, plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, pod length, number of seeds per pod, seed yield per plant, biological yield per plant, 1000-seed weight, days to maturity and harvest index. The analysis of variance revealed the presence of sufficient variability for different characters. Biological yield per plant had maximum range of variation followed by number of pods per plant, seed yield per plant, harvest index and plant height in both the condition (timely and late Sown condition) indicating the presence of wide variation for the characters. Genotypic correlation studies revealed that the plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, pod length, biological yield per plant, 1000-seed weight and harvest index under both the situations. Considering the relationship of seed yield with its components, an ideal plant type in fenugreek will be the one with more number of primary and secondary branches per plant, number of pods per plant, pod length, 1000-seed weight, biological yield per plant and harvest index accompanied with early flowering and maturity. Hence, these characters were considering as the great yield contributors. Therefore, due emphasis should be given to these characters while attempting yield improvement in fenugreek.

Key words : Fenugreek, variability, heritability, correlation and path analysis

Spices and condiments are defined as “natural plants or vegetable product or mixture of thereof, used in whole or ground form, mainly for imparting flavor, aroma and pungency to food” (1). Seed spices are primarily used for flavoring, seasoning and imparting aroma in variety of food items and beverages. Besides importance in food industry, the seed spices have medicinal properties and thus are used in various pharmaceutical preparations and also in cosmetic industry. Seed spices are important export oriented commodities and about ten per cent as value added products realizing foreign exchange worth of rupees 275 crores (2). The genus *Trigonella* is one of the largest genera of the tribe *Trifoliata* in the family *Fabaceae* and sub-family *Papilionaceae* (3). Among *Trigonella* species, *Trigonella foenum-graecum* L. (commonly known as fenugreek) is an annual species, with highly self-pollinated flowers (autogamous).

Improvement in seed yield could be achieved through selection of component characters influencing yield. An understanding of the character association of component traits with yield and their direct effects in path analysis is important for effective selection of traits for high yield, but the estimates of correlation coefficients and path coefficients are subjected to change by the environments in which the crop is grown. Therefore, this present investigation was undertaken to study the genotypic and phenotypic correlation coefficient of component characters with seed yield and their direct effects in path analysis in a population of different genotypes of fenugreek. The existence of sufficient level of genetic variability is a pre-requisite for variety development, hence, detailed appraisal of the accessions for different morphological, agronomic and quality traits is necessary in order to identify useful traits either for direct

use or pave a way for other improvement programmes. This study was designed to access the extent of variation that exists in fenugreek accessions for different traits.

In order to make this crop more productive and resistant to diseases and insect pests, an intensive breeding programme is required for incorporating an array of variability. Hence, an attempt was made to study the genetic variability, by determining the magnitude of genetic coefficient of variation, heritability estimates and expected genetic advance of different biometric traits, their correlation and effects in 40 genotypes of fenugreek. In order to accumulate optimum combination of seed yield contributing characters in a single genotype, it is essential to know the relationships among themselves. Further, the seed yield is influenced by its various components directly and/or indirectly via other traits that create a complex situation before a breeder for making selection. Therefore, path coefficient analysis could provide a more realistic picture of the inter relationship, as it partitions the correlation in direct and indirect effect of the variables.

MATERIALS AND METHODS

The field experiment was conducted at instructional farm, College of Agriculture, Junagadh Agriculture University, Junagadh during Rabi season 2013-14. Two situations were created by applying timely and late sown condition to obtain information on variability parameters and association analysis of yield and its component traits in forty genotypes of fenugreek. Forty genotypes of fenugreek were evaluated in Randomized Block Design (RBD) with three replications in two situations by timely and late sown condition to the crop. Each entry was planted as a single row of 4.0 m length, keeping plant to plant distance of 10 cm and row to row spacing of 45 cm.

Table-1 : Genotypic coefficient of variation, heritability and genetic advance as per cent of mean for twelve characters in fenugreek under timely and late sown condition.

Characters	Genotypic coefficient of variation (%)		Phenotypic coefficient of variation (%)		Heritability in percentage (broad sense)		Genetic advance		Genetic advance as per cent of mean	
	Timely	Late	Timely	Late	Timely	Late	Timely	Late	Timely	Late
Days to 50% flowering	2.80	2.19	4.85	4.08	33.52	28.80	1.48	0.98	3.35	2.42
Plant height (cm)	9.09	14.09	10.38	14.78	76.70	90.92	5.02	7.90	16.40	27.68
Number of primary branches per plant	29.42	18.22	32.93	19.27	79.84	89.56	3.28	1.95	54.16	35.53
Number of Secondary branches per plant	18.42	37.40	25.87	41.44	50.65	81.44	1.34	2.50	27.00	69.53
Number of pods per plant	27.40	13.87	28.31	16.02	93.65	74.94	20.36	6.50	54.63	24.74
Pod length (cm)	4.40	7.93	8.15	9.78	29.11	65.74	0.56	1.33	4.89	13.25
Number of seeds per pod	5.73	9.42	9.11	11.28	39.63	69.85	1.35	2.22	7.43	16.22
Seed yield per plant (g)	33.86	31.05	34.67	31.55	95.38	96.90	4.51	0.96	68.13	63.97
Biological yield per plant (g)	31.38	11.97	32.75	13.91	91.82	74.01	12.33	2.63	61.95	21.21
1000-seed weight (g)	10.27	11.42	12.15	12.47	71.40	83.87	2.42	2.16	17.88	21.54
Days to maturity	2.34	3.47	2.79	3.77	70.45	84.74	3.88	5.70	4.05	6.58
Harvest index (%)	21.71	20.89	26.39	22.70	73.15	84.76	13.11	4.80	38.26	39.62

Table-2 : Genotypic (rg) and phenotypic (rp) correlation coefficient for twelve characters in fenugreek under timely sown condition.

Character		Days to 50% flowering	Plant height (cm)	Number of primary branches per plant	Number of secondary branches per plant	Number of pods per plant	Pod length (cm)	Number of seeds per pod	Biological yield per plant (g)	1000-seed weight (g)	Days to maturity	Harvest index (%)
Seed yield per plant (g)	rg	-0.120	0.517**	0.380**	0.304**	0.344**	0.055	0.049	0.767**	0.087	-0.195*	0.341**
	rp	-0.032	0.493**	0.358**	0.254**	0.337**	0.046	0.043	0.757**	0.082	-0.183*	0.331**
Days to 50% Flowering	rg		0.063	-0.071	0.357**	0.157	0.810**	0.693**	-0.142	-0.162	-0.833**	-0.333**
	rp		0.046	-0.004	0.131	0.056	0.334**	0.152	-0.032	-0.067	-0.138	-0.094
Plant height (cm)	rg			0.336**	0.071	0.257**	0.318**	0.163	0.344**	-0.233*	-0.245**	0.227*
	rp			0.300**	0.059	0.243**	0.223*	0.140	0.317**	-0.197*	-0.217*	0.221*
Number of primary branches per plant	rg				0.470**	0.651**	-0.172	0.109	0.065	-0.148	0.089	0.417**
	rp				0.422**	0.624**	-0.123	0.104	0.068	-0.152	0.082	0.361**
Number of secondary branches per plant	rg					0.381**	0.052	-0.218*	0.084	-0.072	-0.047	0.237**
	rp					0.312**	0.023	-0.161	0.064	-0.055	-0.030	0.196*
Number of pods per plant	rg						-0.369**	-0.071	0.008	-0.249**	0.143	0.497**
	rp						-0.249**	-0.058	0.010	-0.238**	0.139	0.461**
Pod length (cm)	rg							-0.030	0.216*	0.336**	-0.531**	-0.348**
	rp							0.051	0.162	0.253**	-0.347**	-0.248**
Number of seeds per pod	rg								0.185*	0.035	-0.008	-0.173
	rp								0.164	0.040	-0.042	-0.149
Biological yield per plant (g)	rg									0.245**	-0.299**	-0.319**
	rp									0.221*	-0.274**	-0.334**
1000-seed weight (g)	rg										-0.420**	-0.191*
	rp										-0.394**	-0.158
Days to maturity	rg											0.178
	rp											0.154

*, ** Significant at 5 and 1 per cent, respectively.

One row was sown around each replication to remove the border effect. The experiment consisting of forty advanced breeding lines of fenugreek (*Trigonella foenum-gracum* L.) with three replication each in timely and late sown condition, during the Rabi season of the year 2013-14. The characters studied were days to 50% flowering, plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, pod length, number of seeds per pod, seed yield per plant, biological yield per plant, 1000-seed weight, days to maturity and harvest index.

RESULTS AND DISCUSSION

The analysis of variance revealed the presence of sufficient variability for different characters. Biological yield per plant had maximum range of variation followed by number of pods per plant, seed yield per plant, harvest index and plant height in both the condition (timely and late

Sown condition) indicating the presence of wide variation for the characters. Results of Mean and range, PCV, GCV, heritability and genetic advance as per cent of mean for all the twelve characters are presented in table 1 and genotypic and phenotypic correlation coefficient and direct effect of component characters with seed yield are presented in table 2 and 3.

The better index for measuring the genetic variation is genotypic coefficient of variation (GCV) as described by (4) for comparing the genetic variability present in different traits. High genotypic and phenotypic coefficients of variation were observed for seed yield per plant, number of primary branches per plant, biological yield per plant, number of pods per plant and number of secondary branches per plant under timely sown condition while number of secondary branches per plant, seed yield per plant, harvest index, number of primary branches per plant and number of pods per plant under

Table-3 : Genotypic (rg) and phenotypic (rp) correlation coefficient for twelve characters in fenugreek under late sown condition.

Character		Days to 50 % flowering	Plant height (cm)	No. of primary branches per plant	No. of secondary branches per plant	No. of pods per plant	Pod length (cm)	No. of seeds per pod	Biological yield per plant (g)	1000-seed weight (g)	Days to maturity	Harvest index (%)
Seed yield per plant (g)	r_g	-0.137	0.484**	0.447**	0.223*	0.595**	0.248**	0.059	0.877**	0.347**	-0.060	0.952**
	r_p	-0.113	0.473**	0.438**	0.214*	0.559**	0.221*	0.049	0.829**	0.338**	-0.057	0.933**
Days to 50% flowering	r_g		-0.030	-0.013	-0.063	0.232*	0.065	-0.097	0.144	0.227*	0.213*	-0.320**
	r_p		-0.008	-0.027	-0.038	0.150	0.123	0.002	0.064	0.164	0.167	-0.226*
Plant height (cm)	r_g			0.182*	0.103	0.502**	0.192*	0.135	0.409**	0.276**	-0.286**	0.521**
	r_p			0.176	0.100	0.462**	0.182*	0.125	0.389**	0.264**	-0.266**	0.493**
Number of primary branches per plant	r_g				0.568**	0.351**	0.020	-0.001	0.374**	0.020	-0.024	0.460**
	r_p				0.538**	0.328**	0.016	-0.004	0.344**	0.012	-0.027	0.442**
Number of secondary branches per plant	r_g					0.479**	-0.141	0.041	0.290**	-0.267**	-0.022	0.207*
	r_p					0.446**	-0.127	0.030	0.259**	-0.257**	-0.016	0.196*
Number of pods per plant	r_g						0.265**	0.083	0.675**	0.175	-0.160	0.497**
	r_p						0.224*	0.057	0.596**	0.143	-0.146	0.461**
Pod length (cm)	r_g							0.371**	0.406**	0.113	-0.028	0.127
	r_p							0.315**	0.370**	0.099	-0.015	0.095
Number of seeds per pod	r_g								0.055	0.017	0.055	0.047
	r_p								0.039	0.013	0.041	0.040
Biological yield per plant (g)	r_g									0.289**	0.025	0.703**
	r_p									0.267**	0.025	0.589**
1000-seed weight (g)	r_g										-0.444**	0.340**
	r_p										-0.415**	0.324**
Days to maturity	r_g											-0.115
	r_p											-0.107

*, ** Significant at 5 and 1 per cent, respectively.

late sown condition indicating broad genetic variability for these characters. High GCV and PCV for most of these traits were also reported by (5). The high genotypic coefficient of variation indicated the presence of wide genotypic variation for the character under study to allow selection for individual traits.

High heritability coupled with high genetic advance was observed for seed yield per plant, biological yield per plant, number of pods per plant and number of primary branches per plant in timely sown condition, while seed yield per plant, number of secondary branches per plant and under late sown condition, suggesting the existence of sufficient heritable variation and wider scope for effective selection of better types. High estimates of heritability with high genetic advance for these characters also reported by (5). The magnitudes of genotypic correlation were higher as compared to their corresponding phenotypic correlation which could be due to modifying effects of environments.

Genotypic correlation studies revealed that the plant height, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, pod length, biological yield per plant, 1000-seed weight and harvest index under both the situations. Considering the relationship of seed yield with its components, an ideal plant type in fenugreek will be the one with more number of primary and secondary branches per plant, number of pods per plant, pod length, 1000-seed weight, biological yield per plant and harvest index accompanied with early flowering and maturity. This result is in agreement with results obtained by (6).

Biological yield per plant and harvest index under both timely and late sown condition while number of

primary and secondary branches per plant, number of pods per plant, under timely sown condition; harvest index and biological yield per plant under late sown condition had high direct effects through some most important characters towards seed yield per plant. Hence, these characters were considering as the great yield contributors. Therefore, due emphasis should be given to these characters while attempting yield improvement in fenugreek. Seed yield was relatively higher under timely sown condition might be due to more number of seeds per pod, number of pods per plant, number of primary branches per plant and secondary branches per plant than under late sown condition.

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EMERGING PERSPECTIVES AND ISSUES ON GENDER VIOLENCE IN DEVELOPING INDIA

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ABSTRACT

In the 21st century India is fast emerging as a global power but for half of its population, the women across the country, struggle to live life with dignity continues. Women are facing problems in every sphere of life whether employment, access to health care or property rights. The attention required is still not being paid to the issues that concern this section of population. Women empowerment in India is still a distant dream. There still exists a wide gap between the goals enunciated in the constitution, legislation, policies, plans, programs and related mechanisms on the one hand and the situational reality of the status of women in India, on the other hand. India is fast developing but women's in India continue to be discriminated. If the world does not address the issue, it stands to suppress the enormous potential of women and girls. When they feel safe, when they are empowered, women and girls can be game-changers. The catalyst for the next great innovation. The leaders of a more just world. The driving force behind stronger economies.

Key words : *Gender violence, emerging perspectives, education, honour killings.*

Women's are the wealth of India and they have contributed in almost every field and made country feel proud at every occasion. They are in front, leading the country, making mile stones and source of inspiration for many. However, another reality of Indian society is that there is systematic discrimination and neglect of women's in India, which could be in terms of inadequate nutrition, denial or limited access to education, health and property rights, child labour and domestic violence etc. The fear of sexual violence has been a powerful factor in restricting women's behavior and sense of freedom. The struggle against violence is actually the struggle against the unequal distribution of power both physical and economic between the sexes. Media is the mirror of society and media reports are reflection of happenings in the society. Media has immense power to influence the masses and communication and IT revolution has further increased its importance. Unfortunately, nowadays media is wavering from its actual role and giving biased information which makes development of the society more difficult. Portraying women as equals in the society is a subject that has been given low priority by the Indian media. The Indian media needs to be sensitized to gender issues and now must focus on women issues in a decisive way as their role is detrimental for the women empowerment in India. In the light of these facts, the present paper focuses on women's issues in contemporary Indian society and role of media in addressing the issues.

The declining sex ratio in India amply portrays the discrimination shown towards women at the stage of birth. Women may be have stardom in any stream but are getting harassment every day by their surroundings. They are victims of crime directed specifically at them, rape, kidnapping and abduction, dowry-related crimes, molestation, sexual harassment, eve-teasing, etc. Around

40 per cent of married women in India are victims of domestic violence. The increasing violence against women shown in television and films and their vulgar portrayal as objects of sex is also an important contributing factor in the escalating violence against women in India. The lack of any serious effort to rectify the weaknesses in dealing with the crimes against women further compound the situation and result is that the conviction rate remains abysmally low.

Women Issues in India : Current Perspective

Women's are the wealth of India and they have contributed in almost every field and made country feel proud at every occasion. They are in front, leading the country, making mile stones and source of inspiration for many. in socio-cultural field, Medha Patekar, Arundhati Roy, Shobna Narayanan, Lata Mangeskar, Anjolie Ela Menon, Rekha, Meera Nayar and many others, in sports, Sania Mirza, Saina Nehwal are some of the names at the top. Women's are also playing important role in national growth and economic development through corporate houses. They are not only working at grass root level but participating in decision making. Jyoti Naik, President of Lijjat Papad, Kiran Mazumdar, Chairman and Managing Director of Biocon, Naina Lal Kidwai, Deputy CEO of HSBC, Ranjana Kumar, Chairman of NABARD, Ritu Kumar, CEO of Escolife, Priya Paul, Chairman of Apeejay Park Hotels, Indira Nooyi, Chairperson & CEO of Pepsico, Roshani Nadar, CEO of HCL are some of the pioneers in their respective field. At present women's are contributing and participating in every sphere, politics, business, education, science and technology, media, sports, art and culture etc.

However this is the one face of coin and on the other side of coin is the hard truth of the Indian society. There is

systematic discrimination and neglect from early childhood of women's in India, which could be in terms of inadequate nutrition, denial or limited access to education, health and property rights, child labour and domestic violence. The fear of sexual violence has been a powerful factor in restricting women's behavior and sense of freedom. The struggle against violence is actually the struggle against the unequal distribution of power both physical and economic between the sexes. It is important to address the root cause for the subordinate status of women in the Indian society.

Political Issues : Women's equality in power sharing and active participation in decision making, including decision making in political process at all levels will ensure the achievement of the goal of women empowerment. Government of India through 73 rd and 74 th Constitutional Amendment Acts reserved the one-third of seats in all local elected bodies for women as a sign of political empowerment. however women are still under-represented in governance and decision-making process. Their power is restricted, as it the men who wield all the authority. Their decisions are often over-ruled by the government machinery. All this shows that the process of gender equality and women's empowerment still has a long way to go.

Economic Issues : Women are engaged in economically productive work and earn incomes though their earnings are generally low. Most of the women work in agricultural sector either as workers, in household farms or as wagedworkers. It is precisely livelihood in agriculture that has tended to become more volatile and insecure in recent years and women cultivators have therefore been negatively affected. They should be provided with proper wages and work at par with men so that their status can be elevated in society. There is urgent need to improve women's economic status because they are fundamental to the process of economic development of the country.

Social and Cultural Issues : Women's in India need and expect equal access to education, health, nutrition, employment and productive resources. In fact they are fighting for their rights to decide their own path for development.

Education : The female literacy rate in India is though gradually rising, it's lower than the male. Although in states where enrollment rates for girls are higher, many girls drop out of school after a few years of education. Factors such as inhibition on education being imparted by male teachers to girls once they reach puberty, is responsible for drop out. Consequences are that early marriage and child birth pronounced in families of lower socio-economic status.

Health and Nutrition : A women health and nutrition status influence her newborn's birth weight and chance of

survival. Post neo-natal death is generally caused by infectious diseases. The incidence and severity of most of this disease are affected by controllable factors such as immunization, health care and nutrition. Due to gender biased, these factors are not controlled equally for male and female children.

Violence Against Women : According to the National Crime Records Bureau of India, reported incidents of crime against women increased 6.4% during 2012, and a crime against a woman is committed every three minutes. (1) In 2012, there were a total of 244,270 reported incidents of crime against women, while in 2011, there were 228,650 reported incidents. (1) Of the women living in India, 7.5% live in West Bengal where 12.7% of the total reported crime against women occurs. (1) Andhra Pradesh is home to 7.3% of India's female population and accounts for 11.5% of the total reported crimes against women. (1) 65% of Indian men believe women should tolerate violence in order to keep the family together, and women sometimes deserve to be beaten. (2) In January 2011, the International Men and Gender Equality Survey (IMAGES) Questionnaire reported that 24% of Indian men had committed sexual violence at some point during their lives. (2)

Dowry deaths : A dowry deaths is a murder or suicide of a married women caused by a dispute over her dowry (3). In some cases, husbands and in-laws will attempt to extort a greater dowry through continuous harassment and torture which sometimes results in the wife committing suicide. The majority of these suicides are done through hanging poisoning or self-immolation.

Honour killings : The most prominent areas where honour killings occur in India are northern regions. Honor killings are especially seen in Punjab, Haryana, Bihar, Uttar Pradesh, Rajasthan, Jharkhand, Himachal Pradesh and Madhya Pradesh (4). Honour killings have notably increased in some Indian states which has led to the Supreme Court of India. An honour killing is a murder of a family member who has been considered to have brought dishonor and shame upon the family. (5) Examples of reasons for honor killings include the refusal to enter an arranged marriage, committing adultery, choosing a partner that the family disapproves of, and becoming a victim of rape (6).

Female foeticide : Female foeticide is the elected abortion of a fetus, because it is female. Female foeticide occurs when a family has a strong preference for sons over daughters, which is a common cultural theme in India. Modern medical technology has allowed for the gender of a child to be determined while the child is still a fetus (7).

Rape : Rape is one of the most common crimes against women in India Criminal Law (Amendment) Act, 2013 defines rape as penile and non-penile penetration in bodily orifices of a woman by a man, without the consent of the woman. (8) Although rapes are becoming more frequently reported, many go unreported or have the complaint files withdrawn due to the perception of family honour being compromised. Women frequently do not receive justice for their rapes, because police often do not give a fair hearing, and/or medical evidence is often unrecorded which makes it easy for offenders to get away with their crimes under the current laws (9).

Marital rape : In India, marital rape is not a criminal offense. (14) 20% of Indian men admit to forcing their wives or partners to have sex (2). Marital rape can be classified into one of three types (10).

Battering rape: This includes both physical and sexual violence. The majority of marital rape victims experience battering rape.

Force-only rape: Husbands use the minimum amount of force necessary to coerce his wife.

Compulsive/Obsessive rape: Torture and/or "perverse" sexual acts occur and are often physically violent.

Gang rape : Gang rape is defined as the rape of an individual by two or more perpetrators (16). The 2012 Delhi gang rape brought a lot of international attention to the issue of gang rape in India. On 16 December 2012, in Munirka, New Delhi, a 23-year-old was beaten and gang raped on a private bus. She died 13 days later. (12) Following the rape, there was widespread national and international coverage of the incident as well as public protests against the Government of India and the Government of Delhi.

Insult to modesty : Human trafficking and forced prostitution from 2011 to 2012, there was a 26.3% decrease in girls imported to India from another country. (1) Karnataka had 32 cases, and West Bengal had 12 cases, together accounting for 93.2% of the total cases nationwide (1). From 2011 to 2012, there was a 5.3% increase in violations of the Immoral Traffic (Prevention) Act of 1956. (1) Tamil Nadu had 500 incidents, accounting for 19.5% of the total nationwide, and Andhra Pradesh had 472 incidents, accounting for 18.4% of the total nationwide. (1)

Domestic violence : Domestic violence is also known as domestic abuse, spousal abuse, battering, family violence, dating abuse and intimate partner violence (IPV). Domestic violence can be physical, emotional, verbal, economic and sexual abuse. Domestic violence

can be subtle, coercive or violent. In India, 70% of women are victims of domestic violence.

38% of Indian men admit they have physically abused their partners (2). The Indian government has taken measures to try to reduce domestic violence through legislation such as the Protection of Women from Domestic Violence Act 2005 (12).

Forced and child marriage : Girls are vulnerable to being forced into marriage at young ages, suffering from a double vulnerability: both for being a child and for being female. Child brides often do not understand the meaning and responsibilities of marriage. Causes of such marriages include the view that girls are a burden for their parents, and the fear of girls losing their chastity before marriage. (12)

Acid throwing : Acid attacks are usually directed at a victim's face which burns the skin causing damage and often exposing or dissolving bone. (13) Sulfuric acid and nitric acid are most commonly used for acid attacks. Hydrochloric acid is also used, but is less damaging. (14). Acid attacks can lead to permanent scarring, (15) blindness, as well as social, psychological and economic difficulties. (16)

Abduction : Incidents of reported kidnappings and abductions of women increased 7.6% from 2011 to 2012.[1] Uttar Pradesh had 7,910 cases, accounting for 22.2% of the total of cases nationwide.

CONCLUSION

Though the status of women in India, both historically and socially, has been one of the respect and reverence, but the hard truth is that even today, they are struggling for their own identity, shouting for diffusion of their voices and fighting for their own esteem. Every day, they cross among the fears and fraught for individuality. Despite the constitutional guarantee of equality of sexes, rampant discrimination and exploitation of women in India continues. The incidence of bride-burning, woman battering, molestation and ill-treatment of women are on increase. It is high time now that women should get a respectable and dignified position in the Indian society. Awareness in the women as well as society should be created and their equal rights should be effectively implemented. Crimes against women should be made punishable and a research should be done on every crime which comes to the light.

In the era of globalization and with revolution in means of communication and information technology, the media role has become more crucial for women empowerment in India. The Indian media now must focus on women issues in a decisive way as their role is detrimental for the women empowerment in India. It is

essential that media should devote a good percentage of their programmes to create awareness among women and the society at large, give information about women's rights and machineries to approach for their all round development. Programmes to strengthen women development should be enforced and news adversely affecting their development should be censored or banned. Thus, the distant dream of women empowerment in India can be realized with the support of media, government and NGOs. As Swami Vivekananda rightly said that "The nation which doesn't respect women will never become great". Therefore, in pursuit of making India a great nation, media should work towards giving women their much deserved status.

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EFFECT OF NON MONETARY INPUTS ON PRODUCTION POTENTIAL OF SPRING SWEET CORN UNDER SHIWALIK FOOTHILLS OF JAMMU REGION

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ABSTRACT

A field experiment was conducted from kharif season of 2013 to identify the suitable planting time and cultivar of the sweet corn. Three sweet corn cultivars "Misthi, Sugar-75 and Gold star" and six planting times "29th March 15th April, 30th April, 15th May, 30th May and 19th June" forming eighteen treatment combinations were taken as main and sub-plot treatments, respectively and tested in a split-plot design with three replications. Cultivar Misthi not only registered its numerical superiority in plants/m², yield and yield attributes, protein and starch contents, but also in net returns and benefit: cost ratio. Among the planting times, the crop sown on April 15th, March 29th and April 30th recorded statistically similar but significantly fresh cob weight and fresh cob and stover yields at harvest maturity, than the crop sown on 15th of May and onwards. The similar trends with respect to quality parameters like per cent protein and starch contents and higher net returns and benefit cost ratio were recorded at harvest maturity.

Key words : Sweet corn, planting time, yield, quality, profitability.

Planting time being a key component of cropping system which determines the duration of growth and productivity. During late sowing sweet corn crop is exposed to water stagnation condition due to rains in the monsoon period in J&K. In such situation late sown crop is exposed to variable climatic conditions during early vegetative phase and reproductive phase. A change in optimal temperature during its vegetative or reproductive growth adversely affects the rate, duration of growth and yield of sweet corn cultivars. Although sweet corn must be harvested during optimal maturity to obtain best eating quality, a finite capacity of vegetable processing facilities and steady demand for fresh produce necessitate an elongated harvest period. Producers extend harvest by staggering planting dates and planting hybrids with different maturity dates. In the context of suitable cultivar under proper planting time can help to realize maximum production potential of the crop. Hence, an experiment was conducted to study productivity, quality and profitability of sweet corn cultivars under different planting times.

MATERIALS AND METHODS

Field experiment was conducted from March – June 2013 at Research Farm of Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, in split plot design and replicated three times on sandy clay loam soil (62.52% sand, 11.73% silt and 25.75 % clay), slightly alkaline in reaction (pH 7.31), low in organic carbon (0.37%) and available nitrogen (245.78 kg/ha) but medium in available phosphorus (13.26 kg/ha) and potassium (144.26 kg/ha). Treatment consisted of three sweet corn cultivars viz. 'Misthi', 'Sugar-75' and 'Gold star' in main plots and six planting times 29th March, 15th April, 30th April, 15th May, 30th May and 19th June in sub-plot spaced at 60 cm apart

using seed rate of 12 kg/ ha, each for Misthi and Sugar-75 cultivars whereas 16 kg/ha was used for cultivar Gold star and fertilized with 120 kg N, 60 kg P and 40 kg K/ha during each planting date. Sweet corn cultivars planted on 29th of March experienced total rainfall of 268 mm in 17 rainy days up to maturity while 15th April, 30th April, 15th May, 30th May and 19th June planted crop received total rainfall of 450.3 mm, 794 mm, 874.5 mm, 967.4 mm, 894.5 mm in 26, 34, 38, 42 and 38 rainy days during their respective crop periods. The mean weekly maximum and minimum temperatures ranged from 28.4 to 42.5 °C and 12.6 to 26.10 °C, respectively during the crop growing periods. Yield attributes were recorded; quality parameters and profitability were also studied at harvest.

RESULTS AND DISCUSSION

Significant difference was recorded with the cultivars for number of plant/m² and cobs per plant. Cultivar 'Misthi' being statistically at par with 'Gold star' recorded not only maximum but also significantly higher number of plants per m² from cultivar 'Sugar-75' whereas 'Misthi' was found to be statistically at par with 'Sugar-75' and significantly superior than 'Gold star', which produced statistically equal cobs per plant with 'Sugar-75'. This difference in yield attributes among cultivars might be attributed to their genetic diversity. This results were in conformity with those of Pradakar and sharma (6). All yield attributes viz. plant/m², cobs/plant and fresh cob weight was significantly affected by planting times. May 15th planting recorded significantly higher number of plants per meter² but was found to be statistically at par with May 30th, April 15th, April 30th and May 30th plantings. All these planting dates recorded their significant superiority over March 29th and June 19th planting dates which in turn also differed significantly from one another in this parameter. Whereas

Table-1 : Effect of cultivars and sowing dates on yield attributes and yield of sweet corn.

Treatment	Plant/m ²	Cobs /plant	Fresh cob weight (g)	Fresh cob yield (t/ha)	Fresh stover yield (t/ha)
Cultivars					
Misthi	6.67	1.14	117.91	9.16	11.13
Sugar-75	5.57	1.13	110.95	7.07	11.08
Gold star	6.11	1.05	108.63	6.89	8.59
S.Em. (±)	0.17	0.02	4.52	0.28	0.16
CD(p=0.05)	0.68	0.08	-	1.10	0.64
Planting times					
March 29 th	5.78	1.22	131.38	9.17	11.65
April 15 th	6.78	1.22	133.86	10.89	11.84
April 30 th	6.57	1.20	123.99	9.55	11.44
May 15 th	6.89	1.00	103.98	7.01	9.65
May 30 th	6.57	1.00	101.43	6.50	9.54
June 19 th	4.11	1.00	80.33	3.12	7.50
S.Em. (±)	0.19	0.04	6.69	0.65	0.35
C.D. (p=0.05)	0.56	0.12	19.33	1.87	1.01

March 29th and April 15th produced maximum number of cobs per plant (1.22) and these were found statistically at par with April 30th planting. Earlier sowings produced significantly higher number of cobs per plant as compared to later sowings of May 15th, May 30th and June 19th which remained statistically alike with each other bearing 1.0 cob per plant. April 15th sowing produced cobs with significantly maximum fresh weight (g) followed by statistically similar fresh cob weight realized under March 29th and April 30th planting dates and all these dates recorded their significant superiority in this parameter over all the other sowing dates. Highest yield attributes in April 15th was probably due to vigorous plant growth owing to favourable weather conditions prevailing during this planting date. Thus resulting in adequate supply of photosynthates for the formation of cobs, number of grains per cob and increased fresh cob weight. Late sowing of June 19th planting recorded significantly poor yield attributes due to poor pollination, resulting from unfavourable weather conditions and encountering of grain filling period with excessive rains might be responsible for reducing fresh cob weight in June 19th planting date. These results were in line with the findings of (1).

Significant difference in fresh cob and fresh stover yield was recorded with the cultivars and date of sowing. Cultivar 'Misthi' recorded not only maximum but statistically higher fresh cob and stover yield as compared to 'Sugar -75' and 'Gold star' cultivars which in turn though recorded statistically comparable yields. These yield differences were attributed to differences in the growth cycles of the sweet corn cultivars. Highest fresh cob yield and fresh stover yield of cultivar 'Misthi' was probably due to cumulative effect of superior attributing characters

along with more number of plants per meter², cobs per plant and fresh cob weight in cultivar Misthi. Genetically different varieties significantly differed in their yield performance in corn was also reported by (2).

Among the planting dates, the maximum fresh cob and stover yield was obtained with April 15th planting which was statistically at par with March 29th and April 30th planting dates. All these three planting dates produced significantly higher fresh cob and stover yield over all the other planting dates of May 15th, May 30th and June 19th plantings, wherein May 15th and May 30th plantings produced not only statistically similar yields but significantly higher than June 19th planting which recorded significantly lower yields. The highest fresh cob yield and stover yield in the early sowings times was explained because of the fact that the 15th April sown crop got sufficient time for proper plant growth under suitable climatic conditions in comparison to late sowings and also early planting in spring causes encountering of grain formation and filling stages with long days and maximum energy needed to photosynthesis results in higher yields in comparison to late sowing i.e. June 19th. This reduction in yield with June 19th planting time might be due to reduction of yield attributing parameters viz., plant per meter², no. of cobs per plant, fresh cob weight, pollination and fertilization disturbance. Similarly, reproductive phase also shorten for June 19th sown crop. Similar findings were also reported by (3).

Significant difference was recorded with cultivars and planting times for per cent starch content in grains. Cultivar 'Misthi' recorded significantly highest per cent starch content which in turn was found statistically at par

Table-2 : Effect of cultivars and sowing dates on quality and economics of sweet corn.

Treatment	Protein content (%)	Starch content (%)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Cultivars						
Misthi	9.92	63.68	35299.33	192367.73	157068.4	4.45
Sugar -75	10.41	63.61	39079.33	165648.99	126569.66	3.24
Gold star	10.57	57.69	44119.33	157648.07	113528.74	2.57
S.Em. (+)	0.18	0.19	-	-	-	-
C.D. (p = 0.05)	-	0.76	-	-	-	-
Planting times						
March 29th	10.22	63.43	40496.83	181248.80	140751.97	3.48
April 15th	9.87	63.36	40181.83	206785.00	166603.17	4.15
April 30th	10.31	63.35	39866.83	198720.08	158853.25	3.98
May 15th	10.36	61.30	39236.83	171582.14	132345.31	3.37
May 30th	10.39	61.28	38921.83	164513.17	125591.34	3.23
June 19th	10.63	57.22	38291.83	108480.39	70188.56	1.83
S.Em. (+)	0.23	0.21	-	-	-	-
C D(p=0.05)	-	0.61	-	-	-	-

with 'Sugar-75' whereas 'Gold star' was found significantly inferior in this quality parameter at harvest maturity. The higher starch content in 'Misthi' and 'Sugar-75' might be ascribed due to the higher starch content present in their grains which is exclusively dependent and correlated with the genetic constitution of the cultivars. Similar findings in respect of higher starch content in different sweet corn cultivar were also reported by (4). Significantly highest starch per cent content was noticed in March 29th being statistically comparable with April 15th and April 30th plantings at harvest maturity, whereas significantly lowest starch content was recorded in the grains at harvest maturity in June 19th planting. The highest starch content with March 29th was probably due to fact that March 29th acquired longer vegetation period and resulted in more intense carbohydrate accumulation. These results are in accordance with the findings (5).

The practicability and usefulness of treatment is judged ultimately in terms of net returns. Cultivar 'Misthi' fetched maximum net returns (Rs157068.40 /ha) followed by 'Sugar-75' and Gold star with benefit cost ratio of 4.45, 3.24 and 2.75 rupee per rupee invested cultivars. This was due to significant difference in number of cobs and fresh stover yields and cost of seed of the sweet corn. Thus among the different hybrids undertaken for investigation Misthi proved more remunerative followed by Sugar-75 which is followed by Gold star. Among the different planting dates, 15th April sown crop fetched highest, net returns and benefit cost ratio of Rs.166603.17, 4.15. April 30th, March 29th, May 15th, May 30th and June 19th are the planting dates which followed

April 15th planting in the descending order of net returns and benefit cost ratio of Rs. 158853.25/ha, Rs.140751.97/ha, Rs.132345.31/ha, Rs.125591.34/ha, Rs. 70188.56/ha, 3.98, 3.48, 3.37, 3.23 and 1.83, respectively. This variation was might be due to higher yields resulting higher net returns achieved from these treatments due to the variation in fresh cob and stover yield besides cost of irrigation incurred at different planting dates. Thus, among the six planting dates April 15th planting date is the optimum date of sowing for sweet corn cultivation.

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DOES URBANIZATION INFLUENCE AGRICULTURAL ACTIVITIES? A CASE STUDY OF UTTAR PRADESH

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ABSTRACT

The present study seeks to address the influence of urbanization on agricultural activities in Uttar Pradesh and compares the differences in agricultural activities between urban and hinterland districts and identifies key factors in addition to urbanization, responsible for the spatial differences in agricultural activities. Urbanization brings major changes in demand for agricultural products both from increases in urban populations and from changes in their diets and demands. This has brought and continues to bring major changes in how demands are met and in the farmers, companies, corporations, and local and national economies who benefit. It can also bring major challenges for urban and rural food security. To test this hypothesis we use district level data on key agricultural activities and socio-economic and demographic parameter for Uttar Pradesh. This study uses the district level database for Uttar Pradesh from 1980 to 2003. The database includes all relevant and key variables related to crops, livestock, fisheries, land use, input use, infra-structure, agro-climate, socio-economy and demography. For this analysis the districts were divided into two groups urban and urban surrounded districts and hinterland districts. A district with more than one million urban population was classified as urban-surrounded districts. Rest of the districts was classified as hinterland districts. During the last four decades, food basket of urban as well as rural consumers in Uttar Pradesh has undergone a significant change away from cereals towards horticultural and animal products. While the share of food grains in Urban food expenditure declined from 49 percent in 1977-78 to 35 percent in 2004-05, the shares of high-value food commodities (fruits, vegetables, dairy products, meat, egg and fish) increased from 27 to 34 percent. We regressed the value share of an activity on urban population and other demand and supply side factors such as farm size, wages, credit and infrastructure. Farmers living in urban and urban-surrounded districts have an easy access to markets for high-value commodities, information, technology, inputs and services and hence face lower transaction and transportation costs. Thus we hypothesize that agriculture is more diversified towards high-value food commodities in urban and peri-urban districts. To test this hypothesis we use district level data on key agricultural activities and socio-economic and demographic parameter for Uttar Pradesh. Fruits and vegetables in the total value of agricultural production is 14 percent in the urban and urban-surrounded districts, which is almost twice their share in the hinterland districts. The share of animal products is higher in the urban and urban-surrounded districts, the difference is not as large as for fruits and vegetables. Together, milk, meat and eggs comprises 24 percent of the agricultural output in the urban urban-surrounded districts as compared to 20 percent in the hinterland districts. In the hinterland districts, commercial crops like oilseeds, pulses, coarse cereals and paddy account for a large share. Paddy accounts for a larger in the urban and urban-surrounded districts also, which is an indication of the fact that farmers rarely compromise their households staple foods security. Nonetheless the results clearly reveal that compared to farmers in remote locations, the farmers in urban and peri-urban locations allocate relatively a larger share of their resources to high value perishable commodities because of their proximity to consumption centers, market infra-structure and support services. Urbanization is also associated with dietary shifts towards more processed and pre-prepared foods, in part in response to long working hours and, for a proportion of the urban population, with reduced physical activity. Of course, food demand will also be influenced by how this economic growth changes the distribution of income. How will this influence agriculture around or close to growing urban centres will also vary; it would be expected that a growing role for supermarkets (and transnational corporations) in food sales would bring changes in all aspects of the food chain. This would include favouring larger (and often non-local) agricultural producers and major changes in the distribution and marketing of food. This also means a shift in employment within the food system, with fewer people working in agriculture and more working in transport, wholesaling, retailing, food processing and vending. The high proportion of urban households with electricity in middle-income and some low-income nations also means far more households with refrigeration and this supports shifts in food demand. Many low- and middle-income nations are likely to have a growing share of urban food demand met by imported food and by the kinds of shifts in agriculture evident in high-income nations over the past few decades towards more capital- and energy-intensive and less labour-intensive farming. The result reveals that high-value commodities generate larger returns to land, labour and capital, and an easy market access enables farmers, especially small farmers to enhance their income and employment in high-value agriculture, high-value commodities have considerable potential for value addition and therefore can generate further employment and income opportunities in processing and marketing of value added products for rural as well as urban poor.

Key words : Food commodities, urban population, agricultural activities, horticultural crops, transportation, urban surrounded districts.

Urban and peri-urban population in India is growing rapidly, between 1981 and 2005 the urban population grew at an annual rate of 2.9 percent, higher than the

growth in total population (2.0 percent). The rapid increase in urban population is the outcome of both pull and push factors for example better employment

Table-1 : Composition of food basket in Uttar Pradesh.

Food Item	(Percent share of food expenditure)			
	Urban		Rural	
	2000-01	2012-13	2000-01	2012-13
All cereals	42.7	59.5	55.9	38.2
Pulses	2.8	5.4	4.9	6.0
Milk and milk products	11.2	14.8	7.2	10.6
Edible oils	6.4	7.6	5.2	8.7
Meat, egg, fish	7.8	7.4	6.3	7.8
Vegetables	8.4	13.0	6.7	13.4
Other food items	18.5	23.1	13.8	18.4
Total food	100.00	100.00	100.00	100.00

Source—Various NSS rounds on consumer expenditure survey published by the sample survey organization, Government of India.

opportunities and higher wages in urban labour market, slow growth in rural non-farm sectors and continuously declining land holding size are causing rural to urban migration. In 2005 about 29 percent of the country's total population was urban and it is estimated that by 2030 the urban population will account 41 percent of the total population (1).

The expanding urbanization together with higher economic growth and changes in the tastes and preferences are causing a shift in the food basket in favour of high value food commodities like fruits, vegetables, milk, meat, egg and fish (2). These changes in the food basket are leading to transformation of the agricultural production portfolio away from food grains towards high-value food commodities (3, 4). This process is likely to continue as the trends in the factors (urbanization and economic growth) underlying this process have been quite in the recent past and are unlikely to subside in the near future (5). In recent years, some studies have examined the role of urbanization in augmenting agricultural diversification at the national level (3, 6).

However, the influence of urbanization on agriculture can be better understood if examined at a disaggregated level that is meso/micro level. In this paper we examine the effect of urbanization on composition of agricultural sector in Uttar Pradesh, where 27 percent of the total population lives in urban areas. Specifically, the paper (i) Compares the differences in agricultural activities between urban and hinterland districts and (ii) Identifies key factors in addition to urbanization, responsible for the spatial differences in agricultural activities, farmers living in urban and urban-surrounded districts have an easy access to markets for high-value commodities, information, technology, inputs and services and hence face lower transaction and transportation costs. Thus we hypothesize that agriculture is more diversified towards high-value food commodities in urban and peri-urban districts. To test this hypothesis we use district level data on key agricultural

activities and socio-economic and demographic parameter for Uttar Pradesh.

The paper is organized into four sections. The following section describes the methodology and database for the study. Section III provides a brief overview of the changes in the food basket and agricultural production portfolio in Uttar Pradesh. Section IV examines the influence of urbanization on agricultural activities and concluding remarks in the final section.

RESEARCH METHODOLOGY

This study uses the district level database for Uttar Pradesh from 1980 to 2003. The database includes all relevant and key variables related to crops, livestock, fisheries, land use, input use, infra-structure, agro-climate, socio-economy and demography. For this analysis the districts were divided into two groups: urban and urban surrounded districts and hinterland districts. The shares of different commodities in the total value of agricultural output were compared between these two groups to examine the influence of urbanization on agricultural activities. Besides multivariate analysis was carried out using cross section district level data for the year 2012-13, to further substantiate the role of urbanization in determining the composition of agricultural activities. We regressed the value share of an activity on urban population and other demand and supply side factors such as farm size, wages, credit and infra-structure. Ordinary least squares (OLS), to bit and seemingly unrelated regression estimates (SURE) techniques were used.

Changes in food basket and production portfolio:

During the last four decades, food basket of urban as well as rural consumers in Uttar Pradesh has undergone a significant change away from cereals towards horticultural and animal products. While the share of food grains in Urban food expenditure declined from 49 percent in 1977-78 to 35 percent in 2004-05, the shares of high-value food commodities (fruits, vegetables, dairy products, meat, egg and fish) increased from 27 to 34 percent (Table 1), similar changes are also observed in the rural consumption pattern. The share of high-value food commodities in rural food expenditure increased from 20 percent to 30 percent during this period. Nonetheless, urban consumers spend more on high-value food commodities than do the rural consumers.

The tendency of shift in food basket in favour of high-value commodities is likely to be stronger in the years ahead, income elasticity of demand for high-value food commodities is higher than for staple food grains (2), implying faster growth in demand for these

Table-2: Composition of the Agricultural sectors of Uttar Pradesh (Percent share of total value of agricultural commodities at 2000-01 prices)

Commodities	TE 2004-05	TE 2008-09	TE 20 12-13
Cereals	34.4	28.5	21.4
Pulses	3.2	3.5	3.7
Commercial crops	22.6	27.9	19.6
Fruits and vegetables	11.3	8.7	9.6
Milk	8.9	9.5	12.9
Meat	4.3	7.1	12.1
Eggs	1.2	1.5	3.6
Other animal products	Neg	2.6	2.1
High-value commodities	29.1	33.1	50.3
Total value in million Rs.	1,45,327	2,02,421	2,98,334

Sources—Government of India.

(a) Commercial crops include oilseeds, cotton, chilies, turmeric an sugar, (b) High-value commodities include fruits, vegetables, milk, meat, eggs, fish and other animal products.

commodities with sustained rise in percapita income. The growing demand will have to be met through domestic production and or imports from other states or countries. These changes in food basket have been accompanied by a gradual change in agricultural production portfolio toward high value food commodities. Table 2 presents changes in the agricultural production portfolio in Uttar Pradesh. The share of high-value food commodities in total value of agricultural output increased from 29.1 percent in TE (Triennium Ending) 1998- 99 to 50.3 percent in TE 2010-II, while the share of food grains declined from 37.6 to 25.1 percent. Changes in the production portfolio were more pronounced during 1990s. Amongst high-value food commodities, the share of animal products (including fish) experienced a substantial increase in their share from 17.7 percent in TE 2004-05 to 24.5 percent in TE 2009-10 and further to 40.7 percent in 20 12-13. The growth during 1990s was driven by poultry and fish production. The performance of horticultural crops however was not as bright the share of fruits and vegetables in the total value of agricultural sectors have remained around 10 percent during this period.

Urbanization and agricultural activities : We expect agricultural production to be more diversified towards high-value food commodities in urban and urban surrounded districts because most high-value commodities are perishable and require immediate transportation to the demand centers and the urban and urban-surrounded districts have better transportation and infra-structure facilities. In order to probe this hypotheses we examine and compare the composition of agricultural sector in urban an urban-surrounded group of districts and hinterland districts. A district with more than one million urban populations was classified as urban-surrounded

districts. Rest of the districts was classified as hinterland districts. The physical output of the agricultural sector of each of the district was converted into monetary value by multiplying the production of commodities with their respective prices.

Table-3, presents the shares of different agricultural activities in the total value of agricultural sector of the urban-surround and the hinterland districts. The average share of high-value commodities in the total value of agricultural production is higher in the urban and urban-surrounded districts (39 percent) than in hinterland districts (27 percent).

Value of fisheries sectors is not included. At the commodity level, the share of fruits and vegetables in the total value of agricultural production is 14 percent in the urban and urban-surrounded districts, which is almost twice their share in the hinterland districts. The share of animal products is higher in the urban and urban-surrounded districts; the difference is not as large as for fruits and vegetables. Together, milk, meat and eggs comprise 24 percent of the agricultural output in the urban urban-surrounded districts as compared to 20 percent in the hinterland districts. In the hinterland districts, commercial crops like oilseeds, pulses, course

Table-3 : Share of commodities in the value of Agricultural commodities by level of Urbanization 2000-01 (at 1990-82 prices) (Percent)

Commodity	District group	
	Urban and urban surrounded	Hinterland
Paddy	28.5	25.1
Course-cereals	2.6	7.4
Pulses	4.3	3.2
Oilseeds	4.2	13.0
Sugarcane	5.4	2.1
Cotton	2.9	7.8
Chilies	5.3	5.2
Turmeric	0.9	7.6
Tobacco	2.8	0.4
Food grains & commercial crops	61.0	72.8
Fruits	1.9	6.2
Vegetables	2.2	1.2
Horticultural crops	14.1	7.4
aautoMilk	15.4	11.2
Bovine meat	0.6	0.8
Ovine meat	1.1	1.8
Pig, poultry meat, eggs	7.7	6.0
Livestock	24.9	19.8
High-value commodities	39.0	27.2
Total value (Million Rs.)	68973	19,408

Table-4 : Factors influencing spatial distribution of high-value Agricultural Commodities, 2012-13.

Variables (Units)	HVCs To bit Elasticity coefficient (t-ratio)	Fruits		Vegetables		Poultry, Pig, Meat, eggs	
		Tobit Elasticity coefficient (t-ratio)	SURE Elasticity coefficient (t-ratio)	Tobit Elasticity coefficient (t-ratio)	SURE Elasticity coefficient (t-ratio)	Tobit Elasticity coefficient (t-ratio)	SURE Elasticity coefficient (t-ratio)
Urban Population (percent)	0.16* (2.56)-	0.7** (-3.11)	-0.9** (-3.11)	0.7** (3.69)	1.00** (3.46)	1.1** (7.89)	1.2** (7.26)
Small and marginal farms (percent)	0.85* (2.23)						
Male wages (Rs./day)	-0.46 (-1.04)	-1.5 (-1.64)	-3.1** (-3.75)	-4.1** (-2.8)	-3.5** (-3.09)	-0.1 (-.7)	0.3 (0.41)
Rainfed land covered by watershed programme (percent)	0.19** (3.80)	0.4	0.0				
Agriculture term loan (Rs./ha)		(1.37)	(-0.35)				
Processing and cold storage units (numbers)		0.5** (5.93)	0.6** (6.65)	0.1 (1.71)	-0.1 (-0.77)		
Improved poultry (percent)						0.7** (3.58)	0.6** (3.32)
Number of poor (percent)	-0.09 (-1.02)	-0.7** (-2.78)	-1.0* (-2.59)	0.0 (-0.01)	0.3 (0.78)	0.2 (1.16)	0.3 (1.35)
Normal rainfall (con)		1.3 (1.65)	1.7* (2.35)	-0.4 (-0.58)	-0.02 (-0.04)	-0.4 (1.68)	-0.1 (0.61)
Agricultural credit (Rs./ha) irrigated area (percent of gross cropped area)		-0.6* (-2.28)	-1.0* (-2.73)	-0.3 (-1.17)	-0.2 (0.44)	-0.4 (1.68)	-0.1 (0.61)
Road density (Km/sq.) of geographical area						1.2 (1.79)	1.0 (1.86)
Number of observations	20	20	20	20	20	20	20
R ²	0.58	0.49		0.70		0.83	

(Note : * and ** significant at 5 and 1 percent, respectively).

cereals and paddy account for a large share. Paddy accounts for a larger in the urban and urban-surrounded districts also, which is an indication of the fact that farmers rarely compromise their households staple foods security. Nonetheless the results clearly reveal that compared to farmers in remote locations, the farmers in urban and pen-urban locations allocate relatively a larger share of their resources to high value perishable commodities because of their proximity to consumption centers, market infra-structure and support services.

Although a simple comparison of the values of the shares of different agricultural activities between urban and urban-surrounded and hinterland districts indicate that urbanization is an important factor in land allocation to agricultural activities, there are other factors related to agro-ecological and socioeconomic environment that exert considerable influence on the choice of crops. To further probe the role of urbanization vis-à-vis other factors we estimate Tobit and SURE regression with share of high-value food commodities in the total value of agricultural production as dependent variable and urbanization together with other factors important in crop choice as explanatory variables. These regressions were estimated for fruits, vegetables, monogastric meat

(Poultry and pig) and for combined high-value commodities.

Table 4, presents the results of the Tobit and SURE regressions. For all high-value commodities combined together we find a significantly positive effect of under watershed programme and higher incidence of small holders. Table 4 also contains the results of the individual commodities or commodity groups. Urbanization is observed to have a significantly negative effect on the concentration of fruit production. Fruit production is positively associated with rainfall and negatively with irrigation. This is because fruits find niches in high-rainfall regions but away from districts having intensive agricultural systems under irrigation, availability of an agro-processing facility is an important factor driving fruit production. Fruit production is negatively associated with wages since its production is labour intensive. Vegetable production on the other hand is positively associated with urbanization and like for fruits negatively with farm wages. For vegetables, rainfall and irrigation do not have significant influence on their regional spread indicating that these are grown in all type of agro-climatic situations.

Poultry and pig meat production is largely driven by

urbanization, infra-structure and technology. Credit is significantly negative influence on concentration of poultry and pig activity. This is somewhat surprising. One possible explanation for this could be that pig meat production is concentrated in less endowed regions, while much of the credit is directed towards better endowed region. For poultry it is the increasing incidence of contract farming arrangements which provide all critical inputs to farmers. BIRTHAL *et. al.* (2005) found contract firms sharing as much as 90 percent of the variable cost in broiler production.

CONCLUSION

In this paper we have examined the influence of urbanization on agricultural activities in Uttar Pradesh. Our findings indicate a larger concentration of high-value food commodities in the urban and peri-urban areas than in hinterland /rural areas. Growing urbanization, both in terms of population and income generated demand for agricultural commodities. For perishable commodities whose market are not spatially integrated due to high transportation costs, the growing demand is largely met by urban and urban-surrounded districts, while other agricultural products can be procured from locations farther away from urban centers, besides urban demand a well-developed infra-structure (roads, electricity, cold storage, processing input markets, information source etc.) in urban areas encourages farmers to diversify towards high-value perishable food commodities.

The results have some important implications. First high-value commodities generate larger returns to land, labour and capital, and an easy market access enables farmers, especially small farmers to enhance their income and employment in high-value agriculture. Second high-value commodities have considerable potential for value addition and therefore can generate further employment and income opportunities in processing and

marketing of value added products for rural as well as urban poor. Third, farmer in remote locations however may remain deprived of the benefits of urbanization induced growth in high-value agriculture due to transport and infra-structure bottlenecks. Hence to enable them to benefit from the growing demand for high-value food commodities it is imperative to invest in infra-structure such as roads, cold storages and processing facilities in area farther away from urban centers that have considerable potential of high-value food commodities.

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ALLELOPATHIC EFFECTS OF EUCALYPTUS EXUDATES ON *VIGNA RADIATA* L.

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Abstract

The allelopathic effect of leaf exudates of *Eucalyptus camaldulensis* Labill was examined on germination, growth, morphological and physiological parameters of Green gram (*Vigna radiata* L.). The leaf exudate of Eucalyptus releases toxic substances in the soil which are harmful for water table, soil microbes and fertility.

Key words : Allelopathic effects eucalyptus, dry weight seed germination.

The inhibition of one plant growth by another plant through the release of allelochemicals is a well known phenomenon (1). Allelopathy is an interference mechanism, in which live or dead plant materials release chemical substances, which inhibit or stimulate the associated plant growth. It may also play an eminent role in the intraspecific and interspecific competition and may determine the type of interspecific association. In nature plants have to face various biotic and abiotic stresses. Effects of exudates from plants, plant extracts and decomposing plant residues have been the focus of several investigators concerned with the role of allelopathy in agriculture. Plant residues often contain a variety of toxins that are known inhibitors of seed germination or seedling growth (2). Leachates from plants have been shown to suppress seed germination and vegetative propagules, and early seedling growth and decrease radicle growth. (3) reported that Eucalyptus species have strong allelopathic activity among examined plants. Eucalyptus trees have negative impact on seed germination and growth of native species (4). Indigenous to Australia; Eucalyptus spp. are widely introduced throughout the world (5) because of their rapid growth and the rising demand for paper and plywood (6).

South Africa has the largest area under Eucalyptus plantations of about half a million hectares. *Eucalyptus camaldulensis* L. contain essential oil and flavanoids which may be useful or harmful for plants (7).

MATERIALS AND METHODS

A field experiment was conducted during kharif season in 2009-2010 in the field of Department of Botany, C.C.S. University, Meerut. Exudates from Eucalyptus leaves are prepared by deeping leaves for three days, 1 kg leaves litter in 10 litre water for treatment 1, 2 kg leaf litter in 10 litre water for treatment 2 and 3kg of leaf litter in 10 litre water for treatment 3. Next day leaves were drained and water was used for irrigation. The effect of the exudates on green gram (*Vigna radiata* L.) was studied in natural condition. Experiment contains four plots out of which three plots were of different concentrations of leaf exudates and one plot was for control.

100 seeds of *Vigna radiata* were allowed to germinate in each plot. Control plot was irrigated with tap water while treated plot were irrigated with leaf exudates at an interval of three days. The seed germination percentage was calculated after counting the difference between germinated immergent and ungerminated non immergent seeds. Nodules were detached from the plant roots with the help of forceps. Fresh weight of nodule was measured immediately and dry weight by drying of nodules at 60°C for 24h.

RESULTS AND DISCUSSION

The allelopathic effect of Eucalyptus leaf litter on the seed germination, shoot length, root length, nodular volume, number, fresh and dry weight of nodule of *Vigna radiata* were shown in the table 1 and 2.

Seed Germination : Seed germination was inhibited by all treatments compared to the control. The seed germination percentage was higher in control (81.88%) in respect to treated plants. The treatment 1 gives maximum seed germination (74.11%) compared to treatment 2 and treatment 3 (As shown in table 1). The study revealed that the inhibitory effect of seed germination, shoot length and root length increased with increasing leaf exudates concentration (Table 1).

The results of this study showed that Eucalyptus leaf exudates had allelopathic effects on seed germination. These results agree with those of (8) who studied the effect of leaf extract of *E. Camaldulensis* on sorghum and kidney bean. (9) studied effects of *E. globulus* leaf extract on germination and seedling growth of some vegetable and crop plants. The inhibition of germination depends on the concentration of the extract which may be due to the entry of water soluble allelochemicals in to the seed, inhibiting the germination and growth. It might be due to the changes in enzymatic activities which restricted the conversion of nutritive compounds (10).

Shoot length and Root length : Shoot length reduced significantly as the concentration of the leaf exudates increased (Table-1). The root length was also reduced

Table 1 : Effect of Eucalyptus leaf exudate on seed germination, shoot length and root length of *Vigna radiata* L.

Treatment	Seed germination %	Shoot length (cm)	Root length (cm)
Control	81.88	28.71	9.24
T ₁ 1kg/10L	74.11	23.42	7.61
T ₂ 2kg/10L	63.75	16.12	5.31
T ₃ 3kg/10L	56.88	10.86	3.78

Table-2 : Effect of Eucalyptus leaf litter on nodular number, volume, fresh weight and dry weight of *Vigna radiata* L.

Treatment	Nodule Number	Volume (ml)	Fresh wt. (gm)	Dry wt. (gm)
Control	36	1.1	0.0367	0.0191
T ₁ 1kg/10L	22	0.9	0.0242	0.0122
T ₂ 2kg/10L	17.2	0.7	0.0209	0.0091
T ₃ 3kg/10L	9.8	0.4	0.0154	0.0047

significantly by the treatment of Eucalyptus leaf exudates. The concentration-root length correlation was negative and highest reduction in root length was observed under the highest concentration of leaf litter exudates. These results are correlated with (11) who reported that aqueous extract of *E. camaldulensis* has high est inhibitory effect on root length of *Arachis hypogea*. The aqueous extracts of seeds, leaves and roots of *Ageratum conyzoides* delayed the germination and decreased the root and shoot elongation in chickpea (12). The root leachate of *Anagallis arvensis* also decreased the radicle length of mung bean (13).

The inhibition of shoot length may be due to the presence of higher amount of volatiles chemicals like α -pinene, β -pinene, α -phellandrene and cineole or phenol like ellagic, chorogenic, paracoumaric, gentistic and gallic acid (14). Allelochemicals decreased amount of auxin in roots. (15) reported that many allelopathic compounds could decrease the stimulatory effect of hormones such as gibberellin and acetic acid. Furthermore allelopathic compound could disorder the vital activities of plants by other mechanism such as restriction of nutritive absorption (16), disorder in respiration, oxidative phosphorylation and photosynthesis process (17).

Allelochemicals may kill the plant cells which causes growth reduction (18). The toxins may also reduce the chlorophyll contents of the susceptible plant which lead to the reduction of plant growth (19). The length of root and shoot were greatly reduced in all leaf extracts of *E. globulus* and inhibition increased with increasing concentration. *E. camaldulensis* decreased root and shoot length of tomato (20).

Nodulation : Nodulation was higher in control plants in respect to treated plants. Nodule development involves

the interaction between rhizobia and legume roots (21). The development of root nodule is under the control of nodulation (nod) genes. Legumes roots secrete flavonoids which act as signal to activate the expression of nod gene resulting in the production of rhizobial nod factors that induce root cortical cell to divide and develop into nodule (22). The curling and deformation of root hairs are considered to be early signs of the beginning of nodulation due to rhizobial bacteria infections. Allelochemicals from Eucalyptus may have suppressed any of these processes. Several phenolic compounds such as caffeic, coumaric, gallic, gentisic, hydroxybenzoic, syringic and vanillic acids have been identified in leaf extracts of three Eucalyptus hybrids (23) that have allelopathic potential (24) and can inhibit the activity of gibberellic acid (GA). GA is known to regulate enzymatic activity and conversion of reserved materials to transferable materials during seed germination and embryo growth (25). Therefore, it is possible that this process may be inhibited by Eucalyptus leaf extracts. The allelochemicals compounds in the soil come in contact with the root of tested plant and may alter the observation capacity for water and minerals, cell division and other physiological functions (26).

Fresh weight and Dry weight : The leaf exudates when used as growth medium reduced the fresh and dry weight (Table 2). The interference with nutrient uptake and reduction in nutrient accumulation is one of the most effective mechanisms of phenolic compound action. This concept was confirmed by (27) who reported that dry weights of broad bean and maize were reduced by leaf-litter water extract of Eucalyptus rostrata. Fresh and dry weights of three wheat cultivars decreased in response to aqueous Eucalyptus extract (28).

Many polyphenols have catechol groups and at higher concentration can chelate divalent or trivalent metal ions. Therefore, they inhibit ion uptake and thus cause reduction in seedling dry matter (29). These results agree with those of the earlier authors regarding the litter-mediated allelopathic effects (30, 31).

CONCLUSION

From the present study, it can be concluded that exudates of leaves of Eucalyptus had allelopathic effects on germination, plant growth, nodular number, volume, fresh and dry weight of *Vigna radiata* L. The leaf extracts reduced the germination percentage and growth of seedlings and its inhibitory effect increased with increasing extract concentration. Thus overall adverse effect of Eucalyptus leaf exudates was observed on nodulation and growth of the test plant. Thus it might be possible to use the leaf exudates of Eucalyptus in weed management practices.

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EFFECT OF INORGANIC, ORGANIC AND BIOLOGICAL SOURCES OF NUTRIENT ON PRE HARVEST OBSERVATION OF GARLIC (*Allium sativum* L.) cv. G-323

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ABSTRACT

The experiment was conducted at Horticulture Experimental Field, College of Agriculture, JNKVV, Rewa. (M.P.) during the rabi 2012-13. The experimental material was raised in a Randomized Block Design with three replications. Under pre harvest observation, the plant height, number of leaves, length of leaves per plant, width of leaves and stem girth per plant were studied in garlic at different growth stages (15, 30, 45, 60, 75, 90, 105 and 120) days after sowing. The maximum plant height was recorded in treatment T₁₂ (RDF100 : 75 : 50kg NPK/ha) followed by T₁₁ (FYM 10t/ha + vermicompost 2.5t/ha + Azospirillum 2kg/ha + 50% NPK), maximum number of leaves per plant was recorded in treatment T₁₂ (RDF100 : 75 : 50kg NPK/ha) which was at par with T₁₁ (FYM 10t/ha + vermicompost 2.5t/ha + Azospirillum 2kg/ha + 50% NPK), maximum length of leaves per plant was recorded in treatment T₁₂ (RDF 100 : 75 : 50 kg NPK/ha) followed by T₁₁ (FYM 10t/ha + vermicompost 2.5t/ha + Azospirillum 2kg/ha + 50% NPK) and T₁₀ (Vermicompost 2.5t/ha + Azospirillum 5kg/ha + 50% NPK), maximum width of leaves per plant was recorded in treatment T₁₂ (RDF100 : 75 : 50kg NPK/ha) which was at par with T₁₁ (FYM 10t/ha + vermicompost 2.5t/ha + Azospirillum 2kg/ha + 50% NPK) and stem girth per plant was recorded in treatment T₁₂ (RDF100 : 75 : 50kg NPK/ha) and T₁₁ (FYM 10t/ha + vermicompost 2.5t/ha + Azospirillum 2kg/ha + 50% NPK) and minimum was recorded in the treatment T₁ (FYM 20t/ha).

Key words: Garlic, pre harvest, biological source, inorganic and organic.

Garlic (*Allium sativum* L.), is one of the most important remunerative bulbous spice and medicinal crop grown commercially. Garlic is second most widely used spice after onion. It has long been recognized as a valuable spice for all over the world. Garlic is an herbaceous annual for the bulb production. It is an important foreign exchange earner and consumed by almost all the people who take onion. Garlic has higher nutritive values than other bulb crops. Garlic has some antifungal, antimicrobial, insecticidal and other medicinal properties.

Modern agriculture is based on the use of inorganic manures, which play a major role for producing the good quality and higher yield in per unit area. In India during the past three decades, intensive agriculture involving exhaustive high yielding varieties has led to heavy withdrawal of nutrients from the soil. Chemical fertilizers are quite an expensive input and usage over a long period may deplete the soil fertility and health. It is also considered that their indiscriminate usage may also cause environmental pollution problem, soil sickness, reduce the microbial activities and availability of essential nutrients and deteriorate the product quality. Moreover due to the shortage of chemical fertilizers in the market, the grower are bound to find out an alternate arrangement of supplying essential nutrients to crop without reducing the yield.

MATERIALS AND METHODS

The research was carried out at Horticulture Experimental Field, College of Agriculture, JNKVV, Rewa. (M.P.) during the rabi 2012-13. The experiment consisted twelve

treatment of inorganic, organic and biological sources of nutrient were studied for pre harvest observations. The information and details of the treatments and their sources are given below in the following : T₁-FYM 20t/ha, T₂-Vermicompost 5t/ha, T₃-FYM 10t/ha. + Vermicompost 2.5t/ha, T₄- FYM 10t/ha. + 50% NPK + Biofertilizer 2kg/ha, T₅-Vermicompost 2.5t/ha. + 50% NPK + Biofertilizer 2kg/ha, T₆-FYM 10t/ha. + Biofertilizer 2kg/ha, T₇-Vermicompost 2.5t/ha. + Biofertilizer 2kg/ha, T₈-FYM 10t/ha. + Vermicompost 2.5t/ha. + Biofertilizer 2kg/ha, T₉-FYM 10t/ha. ++50% NPK + Biofertilizer 2kg/ha, T₁₀-Vermicompost 2.5t/ha. + 50% NPK + Biofertilizer 2kg/ha, T₁₁-FYM 10t/ha. + Vermicompost 2.5t/ha. + 50% NPK + Biofertilizer 2 kg/ha and T₁₂-RDF.

RESULTS AND DISCUSSION

The plant height increased significantly with the different treatments of inorganic, organic and biological sources of nutrient. Maximum plant height (5.32, 28.21, 37.19, 45.94, 50.40, 55.35, 59.37 and 66.47) were recorded in treatment T₁₂ (RDF100:75:50kg NPK/ha) followed by T₁₁ (FYM 10t/ha + vermicompost 2.5t/ha + Azospirillum 2kg/ha + 50% NPK) that is (4.88, 26.63, 37.84, 44.85, 49.80, 54.26, 58.75 and 66.05) at 15, 30, 45, 60, 75, 90, 105 and 120 days after sowing as compared to other treatments. While the minimum plant height were observed under the treatment T₁ (FYM 20t/ha). This may be due to application of major and minor nutrients, through different organic, inorganic and bio-fertilizers levels, increased the photosynthetic activity, chlorophyll formation, nitrogen metabolism and auxin contents in the

Table-1 : Effect of different treatments on plant height and number of leaves of garlic at 15, 30, 45, 60, 75, 90, 105 and 120 DAS

Treatments	Plant height (cm)								Number of leaves							
	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	120 DAS	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	120 DAS
T ₁	2.72	19.35	31.30	38.55	44.16	47.35	51.31	56.75	2.00	3.91	4.30	4.47	4.88	4.96	5.08	5.22
T ₂	2.94	19.74	32.15	39.35	45.34	48.47	52.47	57.22	2.11	4.06	4.63	4.71	5.02	5.10	5.23	5.34
T ₃	3.30	20.38	33.10	41.05	46.75	50.54	54.41	60.02	2.31	4.63	5.02	5.08	5.18	5.26	5.43	5.55
T ₄	3.40	20.80	33.60	41.41	47.10	50.93	55.45	61.96	2.35	4.66	5.17	5.25	5.33	5.42	5.54	5.69
T ₅	3.67	21.75	34.40	42.67	48.04	51.62	56.47	62.65	2.40	4.74	5.31	5.41	5.49	5.18	5.69	5.90
T ₆	3.13	20.10	32.75	40.40	46.15	49.25	53.37	59.37	2.25	4.48	4.81	4.90	5.07	5.58	5.27	5.49
T ₇	3.45	21.10	34.05	42.13	47.55	51.25	56.07	62.21	2.38	4.67	5.29	5.36	5.45	5.54	5.66	5.78
T ₈	4.12	23.35	35.45	43.65	48.90	52.95	57.52	64.84	2.47	4.89	5.49	5.59	5.70	5.78	5.91	6.16
T ₉	3.87	22.60	34.84	43.10	48.38	52.35	57.11	63.90	2.45	4.81	5.39	5.48	5.56	5.65	5.76	6.02
T ₁₀	4.51	24.15	36.00	44.25	49.30	53.48	58.26	65.92	3.20	4.92	5.58	5.69	5.83	5.91	6.03	6.15
T ₁₁	4.82	26.63	37.84	44.85	49.80	54.26	58.75	66.05	3.30	5.14	5.85	6.00	6.12	6.20	6.26	6.37
T ₁₂	5.32	28.21	37.19	45.94	50.40	55.35	59.37	66.47	3.50	5.75	6.17	6.33	6.49	6.60	6.69	6.79
SEm±	0.16	0.20	0.33	0.22	0.14	0.05	0.03	0.09	0.07	0.05	0.13	0.13	0.12	0.12	0.12	0.15
CD at 5% levels	0.49	0.61	0.97	0.64	0.41	0.15	0.09	0.28	0.22	0.16	0.38	0.40	0.35	0.36	0.36	0.44

Table-2 : Effect of different treatments on length and width of leaves per plant (cm) of garlic at different growth stages and stem girth (mm).

Treat-ments	Length of leaves per plant (cm)								Width of leaves per plant (cm)								Stem girth (mm)
	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	120 DAS	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	120 DAS	
T ₁	16.27	20.12	25.60	30.45	36.40	41.60	41.30	39.35	0.40	0.50	0.64	0.76	0.90	0.90	0.93	0.96	8.59
T ₂	16.57	20.60	26.40	31.83	37.30	42.65	42.75	40.05	0.43	0.50	0.65	0.77	0.96	1.00	0.93	1.03	9.06
T ₃	20.27	24.32	27.70	32.15	38.40	43.50	45.20	46.75	0.48	0.55	0.68	0.89	1.05	1.27	1.01	1.40	9.66
T ₄	20.38	24.54	28.30	32.40	38.45	43.70	45.70	48.77	0.49	0.58	0.72	0.89	1.10	1.28	1.40	1.47	9.72
T ₅	20.70	24.83	29.10	33.45	40.20	44.40	46.85	49.40	0.54	0.65	0.78	0.91	1.14	1.32	1.45	1.55	9.83
T ₆	18.13	22.18	27.40	32.10	37.55	43.50	44.50	42.95	0.46	0.51	0.66	0.84	0.99	1.23	0.94	1.30	9.18
T ₇	20.90	24.78	28.80	32.50	38.80	43.80	46.30	49.20	0.52	0.61	0.75	0.91	1.11	1.31	1.44	1.50	9.80
T ₈	22.60	26.35	31.25	36.50	41.10	45.45	47.65	50.25	0.60	0.72	0.85	1.01	1.21	1.47	1.51	1.64	9.96
T ₉	21.33	25.05	30.15	34.75	40.30	45.15	47.10	49.70	0.57	0.66	0.80	0.93	1.20	1.41	1.48	1.62	9.87
T ₁₀	24.03	28.05	32.78	36.70	41.50	47.10	47.95	51.45	0.65	0.74	0.88	1.04	1.25	1.49	1.52	1.65	10.38
T ₁₁	24.53	28.68	33.45	39.80	42.60	47.10	48.92	51.70	0.74	0.82	0.95	1.12	1.26	1.60	1.63	1.65	10.67
T ₁₂	25.97	30.93	35.40	40.70	43.00	47.73	49.35	52.83	0.85	1.02	1.03	1.20	1.28	1.62	1.80	2.11	10.82
SEm±	0.19	0.05	0.08	0.14	0.07	0.03	0.11	0.16	0.06	0.05	0.05	0.03	0.01	0.06	0.13	0.01	0.05
CD at 5% levels	0.56	0.16	0.24	0.42	0.21	0.11	0.34	0.49	0.018	0.015	0.015	0.093	0.038	0.018	0.39	0.044	0.16

plants which ultimately improving the plant height. The findings is also in agreement with the findings of (1, 2).

The number of leaves per plant of garlic plants responded significantly to various treatments of inorganic, organic and biological sources of nutrient at all the growth stages (at 15, 30, 45, 60, 75, 90, 105 and 120 days after sowing). The maximum leaves per plant (3.50, 5.75, 6.17, 6.33, 6.49, 6.60, 6.69 and 6.79) were recorded in the treatments T₁₂ (RDF100:75:50kg NPK/ha) which was at par with T₁₁ (FYM 10t/ha + vermicompost 2.5t/ha + Azospirillum 2kg/ha + 50% NPK) (3.30, 5.14, 5.85, 6.00, 6.12, 6.20, 6.26 and 6.37). However, the minimum leaves per plant (2.00, 3.19, 4.30, 4.47, 4.88, 4.96, 5.08 and 5.22) was noted in T₁ (FYM 20t/ha). Probable reasons for enhanced more number of leaves, may be due to promotive effects of macro and micronutrients on vegetative growth which ultimately lead to more photosynthetic activities. The findings of are similar to the present findings (1, 2).

The length of leaves per plant of garlic plants responded significantly to various treatments of inorganic, organic and biological sources of nutrient at all the growth stages (at 15, 30, 45, 60, 75, 90, 105 and 120 days after sowing). Maximum length of leaves (25.97, 30.93, 35.40, 40.70, 43.00, 47.73, 49.35 and 52.83) per plant were exhibited in treatment T₁₂ (RDF100:75:50kg NPK/ha) followed by T₁₁ (FYM 10t/ha + vermicompost 2.5t/ha + Azospirillum 2kg/ha + 50% NPK) (24.53, 28.68, 33.45, 39.80, 42.60, 47.10, 48.92 and 51.70) and T₁₀ (vermicompost 2.5t/ha + Azospirillum 5kg/ha + 50% NPK) (24.03, 28.05, 32.78, 36.70, 41.50, 47.10, 47.95 and 51.45) at 15, 30, 45, 60, 75, 90, 105 and 120 days after sowing as compared to other treatments. The minimum length (16.27, 20.12, 25.60, 30.45, 36.40, 41.60, 41.30 and 39.35) of leaves were observed under the treatment T₁ (FYM 20t/ha). Length of leaf was significantly increased by nitrogen, possibly because nitrogen helps in greater assimilation of food material by the plant which resulted in greater meristematic activities of cells and consequently the length of leaf will increased. The findings is also in agreement with the findings of (3).

The maximum width (0.85, 1.02, 1.03, 1.20, 1.28, 1.62, 1.80 and 2.11) of leaves per plant were recorded in the treatments T₁₂ (RDF100:75:50kg NPK/ha) which was at par with T₁₁ (FYM 10t/ha + vermicompost 2.5t/ha + Azospirillum 2kg/ha + 50% NPK) (0.74, 0.82, 0.95, 1.12, 1.26, 1.60, 1.63 and 1.65) at 15, 30, 45, 60, 75, 90, 105 and 120 days after sowing. The minimum width (0.40, 0.50, 0.64, 0.76, 0.90, 0.90, 0.93 and 0.96) of leaves per

plant was noted in T₁ (FYM 20t/ha). Width of leaf was significantly increased by nitrogen, possibly because nitrogen helps in greater assimilation of food material by the plant which resulted in greater meristematic activities of cells and consequently the width of leaf will increased. These findings are in agreement with the findings of (3, 4).

The significantly maximum (10.82 mm) stem girth were recorded in treatment T₁₂ (RDF 100 : 75 : 50kg NPK/ha) and T₁₁ (FYM 10t/ha + vermicompost 2.5t/ha + Azospirillum 2kg/ha + 50% NPK) (10.67 mm) and which was at par with each other. Whereas, the lowest (8.59 mm) stem girth was recorded with treatment T₁ (FYM 20t/ha). This may be due to application of major and minor nutrients, through organic manure, inorganic and bio-fertilizers, increased the photosynthetic activity, chlorophyll formation, nitrogen metabolism and auxin contents in the plants which ultimately improving the stem girth. The findings is also in agreement with the findings of (2, 4).

CONCLUSION

On the basis of present investigation, it is concluded that the garlic variety G - 323 responded well in terms of pre harvest observation in all the growth stages to treatment T₁₂ (RDF100:75:50kg NPK/ha). Garlic pre harvest observation was significantly affected due to various treatments of inorganic, organic and biological sources of nutrient. The treatment T₁₂ (RDF100:75:50kg NPK/ha) exhibited maximum values and which was statistically superior and followed by T₁₁ (FYM 10t/ha + vermicompost 2.5t/ha + Azospirillum 2kg/ha + 50% NPK) and the minimum values was recorded in treatment T₁ (FYM 20t/ha).

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EFFECT OF FERTILIZER LEVELS ON UPTAKE OF NUTRIENTS AND YIELD OF FRUITS IN MANGO CV. ALPHONSO

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ABSTRACT

Alphonso is the best commercial mango variety because of its excellent flavour and sub acidic taste and long shelf life. Leaf analysis is preferred over soil analysis for assessing the nutrient status of crops. Hence, the present study was carried out. The study revealed that 'N' content found highest (1.63%) in treatment T₅ (i.e. 4.5 kg N + recommended dose of P and K). It is observed that uptake of 'N' increased proportionate to its application. The highest 'P' content (0.094) was observed in T₆ treatment (i.e. 1.5 kg P₂O₅ + recommended dose of N and K). Application of micro nutrient complex along with recommended dose and foliar spray of KH₂PO₄ (2%) with recommended dose increased 'P' uptake in mango trees. The highest 'K' uptake was found in treatment T₇ (i.e. 2 kg K₂O + recommended dose of N and P). Moreover, higher application 'K' fertilizers increased 'K' uptake in mango trees. The highest 'Ca' content (2.08%) was observed when 10 kg calcium carbonate + recommended fertilizer dose was applied. Application of only organic manures kept N, P, K and Ca levels constant after harvest, whereas without fertilizers NPK and Ca levels lowered down after harvest. The production of fruits was more at interior side of the tree (155.500) than any other direction irrespective of fertilizers levels. However, total peripheral (East, West, North and South) fruits was higher than the interior fruits in terms of total fruits or number of fruits per tree. Heavy doses of fertilizers may not prove beneficial as application of double dose of recommended fertilizers (T₄) treatment yielded poorly than rest of the treatments. Indicating heavily fertilized trees may tends to produce more vegetative growth than the reproductive growth.

Key words : Fertilizer levels, leaf analysis, nutrient uptake, yield of fruits Alphonso Mango.

Alphonso is the best commercial mango variety because of its excellent flavour, sub acidic taste and long shelf life. The demand for this variety in internal as well as external markets is increasing. Konkan region of Maharashtra (particularly Ratnagiri and Sindhudurg districts) contributes about 62.20 percent area under mango cultivation. About 90 per cent of the area is covered by Alphonso cultivar. There are some major drawbacks with this cultivar such as alternate bearing, low productivity, spongy tissue etc. which are probably due to lack of nutrients uptake. If proper manuring is done by the growers at the right time, this important crop is saved from deterioration and production can be increased to an appreciable extent. The estimation of nutrient content in soil and leaf nutrient provides an indication of their nutrient status in soil and plant. Which helps to monitor fertilizers application. Leaf analysis is preferred over soil analysis for assessing the nutrient status of crops. Hence, the present investigation was carried out.

MATERIALS AND METHODS

The experiment was conducted at the Department of Horticulture, College of Agriculture, Dapoli, Dist.-Ratnagiri, Maharashtra. The seventy two Alphonso trees of 20 years age having uniform growth and vigour constituted as the experimental material. The experiment was conducted in Randomized Block Design with three replications. The treatment details are given below.

- T₁ = No fertilizers (control)
- T₂ = Recommended dose of NPK*
- T₃ = Recommended dose of NPK + ½ Recommended dose of NPK
- T₄ = Double Recommended dose of NPK
- T₅ = 4.5 kg N + Recommended dose of P and K
- T₆ = 1.5 kg P₂O₅ + Recommended dose of N and K
- T₇ = 2 kg K₂O + Recommended dose of N and P
- T₈ = Soil application of Micro-nutrient complex (i.e. Ormichem 2 kg/tree) + Recommended dose of NPK
- T₉ = Soil application of lime (Calcium carbonate i.e. 10 kg/tree) + Recommended dose of NPK
- T₁₀ = Foliar application of KH₂PO₄ (2% spray) + Recommended dose of NPK
- T₁₁ = Organic manures only (50 kg/tree)
- T₁₂ = Foliar application of multi-nutrient complex (2% spray) + Recommended dose of NPK

*Recommended dose of NPK = 1.5 kg N, 0.5 kg P₂O₅ and 0.6 kg K₂O/tree/year

i.e. 3 kg Urea + 3 kg Single Super Phosphate + 1 kg Muriate of Potash

The leaf samples were collected along with petioles at 1 to 1.5 m (Breast level) height, before application of fertilizers and after harvesting fruits. The mature leaves of

Table-1 : Per cent nitrogen, phosphorus, potash and calcium content in leaves of Alphonso mango before fertilizers application and after harvest stage.

Treatments	N (in %)		P (in %)		K (in %)		Ca (in %)	
	B. A.*	A. H.*	B. A.	A. H.	B. A.	A. H.	B. A.	A. H.
T ₁	1.36	1.17	0.092	0.087	0.52	0.50	1.79	1.74
T ₂	1.32	1.38	0.087	0.090	0.53	0.49	1.85	1.63
T ₃	1.34	1.43	0.088	0.092	0.60	0.56	1.77	1.54
T ₄	1.27	1.48	0.085	0.078	0.53	0.54	1.84	1.47
T ₅	1.38	1.63	0.089	0.068	0.47	0.40	1.92	1.42
T ₆	1.32	1.35	0.088	0.094	0.48	0.33	1.87	1.96
T ₇	1.29	1.32	0.091	0.073	0.32	0.59	1.74	1.59
T ₈	1.35	1.40	0.090	0.091	0.55	0.48	1.81	1.65
T ₉	1.40	1.23	0.087	0.077	0.41	0.32	1.88	2.08
T ₁₀	1.34	1.37	0.081	0.090	0.30	0.35	1.76	1.68
T ₁₁	1.26	1.31	0.088	0.085	0.42	0.49	1.89	1.91
T ₁₂	1.31	1.35	0.083	0.088	0.28	0.34	1.82	1.72
S.E. +	0.073	0.110	0.006	0.004	0.013	0.033	0.031	0.032
C.D. (5%)	N. S.	N. S.	N. S.	0.013	0.037	0.097	0.090	0.094

* B. A. – Before fertilizers application

* A. H. – After harvest

4-7 months age from middle of the shoots are collected for analysis. Leaf sample constitute 20 to 30 leaves from all sides of experimental trees. These leaf samples washed and dried in an oven at 60°C temperature for 12 hours. The dried leaf sample is powdered in Wiley Mill (1). The leaf samples were analysed for nitrogen, phosphorus, potassium and calcium. Nitrogen was estimated by Micro-Kjeldahl method using Kjel Plus instrument (2). In the diacid digest, the phosphorus was analysed by Vanadomolybdate yellow method, potassium by Flame photometer and calcium by Versenate titration method described by (3). Yield of each tree was recorded by counting the total number of fruits per tree in direction wise. The fruits were harvested at the 'C' stage of maturity described as (4).

RESULTS AND DISCUSSION

The data regarding leaf analysis before fertilizers application and after harvest stage are presented in Table 1. It is seen from the data that the highest 'N' (1.63 %) was recorded in T₅ (i.e. 4.5 kg N + recommended dose of P and K) followed by T₄ (1.48 %) treatment (i.e. double recommended dose). However, significant difference in 'N' content among the treatments was not observed. The uptake of nitrogen found slight increased due to the application of N.

The highest 'P' (0.094 %) was observed in treatment T₆ (1.5 kg P₂O₅ + recommended dose) followed by T₃ (0.092%), T₈ (0.091%), T₁₀ (0.090%) and T₂ (0.090%) which are significantly superior over control. Phosphorus content was found increased in these treatments after application of phosphatic fertilizers. Moreover, it is seen that micro nutrient complex along with recommended dose and foliar spray of KH₂PO₄ (2%) with recommended dose helped to increase 'P' content.

Regarding potassium content it is observed that the highest 'K' (0.59 %) was recorded in treatment T₇ (i.e. 2 kg KO + recommended dose of N and P) followed by T₃ (0.56 %) and T₄ (0.54 %) and significantly superior over rest of the treatments. It is seen that additional application of K₂O than recommended dose increased 'K' level in the trees.

Calcium content recorded highest (2.08 %) in treatment T₉ (Calcium carbonate 10 kg/tree + recommended dose) which was significantly superior over rest of the treatments. Similarly 'Ca' uptake found increased (1.96 %) in T₆ treatment (i.e. 1.5 kg P₂O₅ /tree + recommended dose of N and K) which may be due to more application of P₂O₅. Calcium uptake level also found increased in T₁₁ treatment i.e. application of organic manures only.

Merely application of organic manures treatment T₁₁ increased N, K and Ca uptake slightly whereas lowered down P slightly. In treatment T₁ (without fertilizers application) N, P, K and Ca levels lowered down in comparison to previous levels (i.e. after harvest).

Effect of fertilizer levels on yield of fruits : The data pertaining to the effect of fertilizer levels and foliar spray of nutrients on yield of Alphonso mango are presented in Table 2. The direction play a key role on the bearing of the trees. It was observed that irrespective dose of fertilizers, fruits bears on North side had significantly lesser number of fruits than any other direction. However, the inside i.e. interior part of the trees bears much more fruits which was significantly superior to all other direction. The study further indicated that there was non-significant difference on number of fruits present on East, West and South sides. However, little higher number of fruits present on Eastern sides. In general, though the total number of fruits

Table-2 : Effect of fertilizer levels at different directions on yield of fruits (in nos.) in mango cv. Alphonso.

Treatments	Direction wise Yield of fruits (in numbers)					Mean fruit yield
	East	West	North	South	Interior	
T ₁	87.000	95.500	63.000	93.666	156.666	99.166
T ₂	129.500	118.166	108.666	131.833	200.166	137.666
T ₃	104.666	96.833	75.833	105.500	145.500	105.666
T ₄	76.666	67.333	46.000	76.333	114.000	76.066
T ₅	106.500	92.000	62.666	77.000	147.666	97.166
T ₆	113.166	105.833	89.000	103.500	156.833	113.666
T ₇	117.666	95.500	79.666	91.333	152.166	107.266
T ₈	109.500	85.833	66.000	99.166	141.000	100.300
T ₉	136.666	135.500	94.833	138.333	162.333	133.533
T ₁₀	134.333	111.666	83.333	103.000	182.666	123.000
T ₁₁	96.666	132.500	84.166	115.666	163.000	118.400
T ₁₂	80.666	123.000	51.666	116.666	144.000	103.200
Mean	107.75	104.972	75.402	104.333	155.500	109.591
	Direction		Treatment		Direction x Treatment	
S.E. ±	7.139300		11.060155		24.731259	
C.D. (5%)	19.990231		30.968732		69.248191	
	Sig.		Sig.		N. S.	

at interior side was more than East, West, North and South direction, the overall peripheral number of fruits are much more than total fruits in interior side.

The fertilizers also play significant role on bearing of mango trees. The recommended dose of fertilizers (T₂) produces highest number of fruits (137.66) than any other treatments which was significantly superior over the control and it was at par with the trees supplied with soil application of calcium carbonate along with recommended dose (T₉), the trees supplied with foliar spray of KH₂PO₄ along with recommended dose (T₁₀), organic manures only (T₁₁), trees supplied with higher phosphorus and recommended dose of N and K (T₆), higher potash and recommended dose of N and P (T₇) in that order.

The trees which received double dose of fertilizers (T₄) yielded poorly which was at par with the trees do not received fertilizer doses (T₁) and which receives higher doses of nitrogen and recommended P and K (T₅) and the trees supplied with ormichem and recommended dose (T₈) and foliar spray of multi-nutrient spray and recommended dose (T₁₂). The data cannot be compared as such study has not been conducted elsewhere, besides this is being one year data, it will very difficult to draw any conclusion. However, overall result indicate that high N favours more vegetative growth leading to poor crop yield.

CONCLUSIONS

The 'N' content found highest (1.63%) in treatment T₅ (i.e. 4.5 kg N + recommended dose of P and K). More application of Nitrogenous fertilizers increased 'N' uptake in the tree. The highest 'P' content (0.094 %) was

observed in T₆ treatment (i.e. 1.5 kg P₂O₅ + recommended dose of N and K) due to more application of P. Application of micro nutrient complex with recommended dose and foliar spray of KH₂PO₄ (2%) with recommended dose increased 'P' uptake in mango trees. The highest 'K' was found in treatment T₇ (i.e. 2 kg K₂O + recommended dose of N and P). Means higher application 'K' fertilizers increased 'K' uptake in mango trees. The highest 'Ca' content (2.08%) was observed when 10 kg calcium carbonate + recommended fertilizer dose was applied. Application of only organic manures kept NPK and Ca levels slight increased after harvest, whereas without application of fertilizers, NPK and Ca levels lowered down after harvest.

The production of fruits was more at interior side of the tree (155.500) than any other direction irrespective of fertilizers levels. However, total peripheral (East, West, North and South) fruits was higher than the interior fruits in terms of total fruits or number of fruits per tree. Heavy doses of fertilizers may not prove beneficial as application of double dose of recommended fertilizers (T₄) treatment yielded poorly than rest of the treatments. Indicating heavily fertilized trees may tends to produce more vegetative growth than the reproductive growth.

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EVALUATION OF FRONT LINE DEMONSTRATION ON THE YIELD OF MUSTARD VARIETIES IN SOUTH GANGATIC ALLUVIAL PLAINS OF BIHAR

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ABSTRACT

Mustard (*Brassica Juncea* L.) is one of the most important oil seed crops of winter season contributing 28.4% of the total oil production in India having major role in supplementing the income of small and marginal farmers of South Gangatic Alluvial plains of Bihar. Low productivity is one of the major constraints of traditional mustard farming due to non-adoption of recommended package of practices, used of imbalance doses of fertilizer and improved late sown high yielding varieties. To replace this anomaly, Krishi vigyan Kendra, Bhagalpur, Bihar had conducted frontline demonstrations at farmers fields. Full package FLD viz., use of improved high yielding late sown varieties, line sowing, balanced application of fertilizers specially inclusion of sulphur and control of mustard aphid through insecticide at economic threshold level showed that percent increase in the yield of mustard ranged from 47.73% to 50.64% over local check during the course of study from 2010-11 to 2013-14 (4 years). However, the technology gap of 2.80 q/ha as minimum during 2013-14 to maximum of 4.05 q/ha (2012-13) shows the gap in demonstration yield over potential yield. Hence increase in yield over farmers yield was evident which indicated the need of educating farmers through frontline demonstration.

Key words : Frontline demonstration, Extension gap, Mustard, technology gap, technology index.

Brassica (*rapeseed-mustard*) is the second most important edible oilseed crop in India after groundnut and accounts for nearly 30% of the total oilseeds produced in the country. India would need 58 million tones of oilseeds by 2020 for maintaining minimum edible oil requirement of 12 kg/capita/annum (1) from the present level of 8.2 kg (2). Rapeseed-mustard production in our country was 7.30 mt, covering area of 6.7 m ha. The area and production of Bihar was 90.8 thousand ha and 1.10 lakh tones, however, the productivity of rapeseed and mustard in Bihar (959 kg/ha) is much below than national (1151kg/ha) and world average (1635 kg/ha). The basic factors behind this phenomenal low productivity are non-availability of high yielding problem specific varieties, sub-optimal and imbalanced use of fertilizers, lack of irrigation facilities, attack of pests and diseases. The main contributors to such transformations have been (i) availability of improved oilseeds production technology and its adoption, (ii) expansion of cultivated area, (iii) price support policy and (iv) institutional support, particularly establishment of technology mission on oilseeds in 1986 (Hegde, 2004). Since mustard is grown after harvesting of long duration varieties of rice and late recession of moisture from rice fields in Bihar sowing of mustard crop gets normally delayed and the growth and vigour of mustard is not good as timely sown crop. Therefore, in these areas, its productivity is managed only through the selection of appropriate late sown varieties and management of fertility in addition to irrigation (3). In recent years some promising late sown varieties of mustard have been introduced embedded with high genetic yield potentiality. Such varieties are characterized with non spreading bushy morphological frame work and are known to posses

the trait of responsiveness toward fertilizer application. Among the commonly applied nutrients, sulphur is the key element in mustard production which are insufficient in Indian soil. Sulphur is now recognized as the 4th major plant nutrient after N, P, and K. Majority of the Indian soils are deficient in sulphur due to intensive cropping practices in these Indo-Gangetic plain. Sulphur deficiency in soil has been reported from 65 countries including India (4). In Indian mustard, sulphur plays an important role in the formation of amino acid, synthesis of protein, chlorophyll and oils (5). It is also a constituent of mustard oil glucoside which imparts characteristic odour and flavour to the oil and involved in the synthesis of SH sulphydryl linkages provide the source of pungency in the oil. The oil content in mustard increased with the application of sulphur (6). Thus, supplementation of sulphur as fertilizer is necessary along with nitrogen, phosphorus and potassium. The oil content in seed decreased with increasing NPK levels whereas, successive addition of FYM, sulphur, zinc, boron and azotobactor increased oil content (7). The improved technology packages were also found to be financially attractive. Yet, adoption levels for several components of the improved technology were low, emphasizing the need for better dissemination (8). The state-wise yields obtained both under improved technology and farmers' practice ranges from 12 to 110% between states and the national average being 36%. The additional production that can be attained by exploiting the yield gap at national level is about 2 mt (9). Keeping the above point in view, the FLD on mustard using new crop varietal technology with inclusion of sulphur fertilizer were started with the objectives of showing the productive potentials of the new

Table-1 : Effect of nitrogen, phosphorus and potash on growth parameters of golden rod.

Treatments	Plant height (cm)	Plant spread (cm ²)	Fresh weight of plant (g)	Dry weight of plant (g)	No. of suckers per plant
Levels of Nitrogen (kg/ha)					
N ₁ = 200	45.40	397.78	20.13	6.61	5.04
N ₂ = 250	47.50	443.60	21.70	7.29	5.58
N ₃ = 300	51.22	460.75	24.04	8.09	6.30
S.Em. ±	1.18	13.37	0.58	0.20	0.23
C.D. at 5%	3.48	39.20	1.69	0.58	0.69
Levels of Phosphorus (kg/ha)					
P ₁ = 50	47.64	413.13	21.02	7.01	5.49
P ₂ = 100	48.43	454.96	22.89	7.65	5.79
S.Em. ±	0.97	10.91	0.47	0.16	0.19
C.D. at 5%	NS	32.01	1.38	0.48	NS
Levels of Potash (kg/ha)					
K ₁ = 25	47.10	412.53	21.64	7.09	5.75
K ₂ = 50	48.98	455.56	22.65	7.58	5.71
S.Em. ±	0.97	10.91	0.47	0.16	0.19
C.D. at 5%	NS	32.01	NS	0.48	NS
Interactions					
N P	Sig.	NS	NS	NS	NS
P K	NS	NS	NS	NS	NS
N K	NS	NS	NS	NS	NS
N P K	NS	NS	NS	NS	NS
C.V. %	8.55	10.67	9.08	9.43	14.39

production technologies under real field situation over the locally cultivated mustard crop.

MATERIALS AND METHODS

The present study was carried out by the Krishi Vigyan Kendra, Bhagalpur, under Bihar Agricultural University, Sabour, during rabi season from 2010-11 to 2013-14 (4 years) in the farmer's fields adopted at Bhagalpur district, *i.e.* South Gangatic Alluvial Plains of Bihar. In total 116 frontline demonstrations in 32.0 ha area in different blocks of Bhagalpur district were conducted. Materials for the present study with respect to FLDs and farmers practices were given in Table-1. In case of local check plots, existing practices being used by farmers were followed. In general, soils of the area under study were soil is sandy clay loam in reaction and deficient in some of the nutrients required for normal crop growth. The FLDs was conducted to study the gaps between the potential yield and demonstration yield, extension gap and technology index. In the present evaluation study, the data on output of mustard cultivation were collected from FLD plots, besides the data on local practices commonly adopted by the farmers of this region were also collected. In demonstration plots, a few critical inputs in the form of quality seed, balanced fertilizers, agro-chemicals etc. were provided and non-monetary inputs like in lines, thinning, timely weeding and crop management practices were also performed. Whereas, traditional practices were maintained in case of local checks. The demonstration farmers were facilitated by KVK Scientists in performing field operations like sowing, spraying, weeding, harvesting etc. during the course of

training and visits. The technologies demonstrated are mentioned in Table-1 and compared with local practices.

RESULTS AND DISCUSSION

Results of 116 frontline demonstrations conducted during 2010-11 to 2013-14 in 32.0 ha area on farmer's fields in different blocks of Bhagalpur district indicated that the cultivation practices comprised under FLD viz. Use of improved late sown variety (Rajendra Suflam), line sowing, balanced application of fertilizers (80 N, 40 P₂O₅, 40 K₂O, 20 S kg/ha) and control of mustard aphid through insecticide as a preventive method, produced on an average more yield of mustard as compared to local check. The results indicates that the frontline demonstration has given a good impact over the farming community of Bhagalpur district as they were motivated by the new agricultural technologies applied in the FLD plots. Data further showed that the yield of mustard in the following years increased successively which showed the positive impact of FLD over existing practices of mustard cultivation (Table-2). It might be due to improved late sown varieties play important role in increasing yield of crop. The performance of variety depends upon its genetic potential, nutrient management, agro-climatic features and other management practices beside it is possible that varieties of similar genetically make up may differ in their morphological and yield compatibility as well as quality under different situation. However, the seed yield is the cumulative sum of all the yield components. Therefore, the highest seed yield of Rajendra Suflam was observed over local check which is due to the sum total

effect of enhanced growth and increase in yield contributing characters like number of seed/silique, length of silique, number of silique/plant, and 1000-seed weight etc. Similar results were also obtained by (10). Application of sulphur fertilization plays an important role in oil-synthesis and considerable increase in yield and quality of oilseed (11). The similar results were also obtained by (12) with soybean crop. Improvement in seed oil content with increasing rate of sulphur might be due to role of S in formation of acetyl Co-A, a precursor compound for synthesis of long chain of fatty acid. Moreover from first year onwards, farmers cooperated enthusiastically in carrying out of FLDs which lead to encouraging results in the subsequent years. The technology gap observed may be attributed to the dissimilarity in the varietal component and sulphur was applied. Hence, variety wise location specific recommendation appears to be necessary to minimize the technology gap for yield level in different situations. The highest extension gaps which ranged from 3.61 to 4.05 q/ha during the period of study emphasized the need to educate the farmers through various means for the adoption of improved agricultural production technologies to reverse this trend of wide extension gap. More and more use of latest production technologies with high yielding varietal component viz., Rajendra Suflam only with use of varieties will subsequently change this alarming trend of galloping extension gap. The new technologies will eventually lead to the farmers to discontinuance of old varieties with the new technology. The technology index shows the feasibility of the evolved technology at the farmers' fields. The lower the value of technology index more is the feasibility of the technology. As such, increasing of technology index from 18.66% (2010-11) to 27.00% (2013-14) exhibited the feasibility of technology demonstrated (Table-2).

CONCLUSION

By conducting frontline demonstrations of proven technologies, yield potential of mustard can be increased to a great extent. This will substantially increase the income as well as livelihood of the farming community. There is a need to adopt multi-pronged strategy that involves enhancing mustard production through improved technologies in Bhagalpur district and its adjoining place. Hence, on the basis of front line demonstration conducted in previous years, farmers were advised to adapt new high yielding varieties viz. Rajendra Suflam as a late sown in South Gangatic Alluvial Plains of Bihar. However this variety is also given better result in timely sown condition.

This should be brought to the access of farmers through transfer of technology centres like Krishi Vigyan Kendra, State agricultural departments, ATMA etc.

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EVALUATION OF PATHOGENIC MICROBES IN SWEET SAMPLES SOLD IN WESTERN DELHI

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ABSTRACT

Present study was conducted to analyze microbial contamination in the sweet samples collected from the market of western Delhi and compared with laboratory prepared sweets. Total 150 sweet samples from market and 75 samples from laboratory prepared sweets were collected and analyzed for pathogenic count. It was concluded that the average pathogenic count in laboratory made sweets in each season are very low in comparison to market made sweets samples. The unhygienic condition of preparation of these foodstuffs and water used for washing of utensils enhances the bacterial contamination of milk and milk sweets.

Key words : Microbial contamination, pathogenic count, foodstuffs, bacterial contamination.

The diseases transmitted by food are commonly referred to as food poisoning and are characterized by abrupt onset of gastrointestinal disturbances viz. abdominal pain, vomiting and diarrhea and, in India, it is estimated that 20% of deaths among children under five are caused by diarrheal disease, 70% of these being associated with unsafe food or water (1). The foods most commonly involved in food-borne disease are meat and meat products, poultry, eggs, milk and milk products, sweetmeats etc. (2). Milk and milk products have high nutritive value but they are less perennial because different type of microorganisms are often present it due to unhygienic conditions. Approximately 50 percent of the milk produced is consumed as fresh or boiled, one sixth as yoghurt or curd and remaining is utilized for manufacturing of indigenous varieties of milk products and milk made sweets (3). The unsanitary conditions in the preparation, processing, packaging and storage of sweetmeats are often so poor that the product on reaching the consumers have an unbelievable microbial load, which may includes the different strains of pathogens that cause the serious health hazards (4).

Microbial content of khoa and chhana based sweets depends on the temperature and time of preheating evaporation process, contamination and growth during storage. Psychrotrophic bacteria also affect keeping quality and flavor of heat-treated product, some psychrotrophs produce heat tolerant enzymes and cause spoilage, both before and after heating (5). Microbes can produce undesirable effects like change in odor, color, taste, and texture of food. Beside this, contamination of milk products with pathogenic bacteria can result into outbreaks of gastrointestinal infection this pose great threat to consumers.

Contamination of indigenous sweet based product like khoa, gulabjamun, rasgulla, peda, burfi with

pathogenic bacteria can serve as a source of spread of certain harmful human disease like tuberculosis, gastroenteritis, brucellosis, salmonellosis, and staphylococcal food poisoning (6). Among all microorganisms *Escherichia coli* is frequently contaminating organism, and is reliable indicator of fecal pollution generally in insanitary conditions of water, food, milk and other dairy products (7). Presence of *E. coli* in milk products indicates the presence of enteropathogenic microorganisms, which constitute a public health hazard. Enteropathogenic *E. coli* can cause severe diarrhoea and vomiting in infants and young children (8). The rapid growth of pathogens in milk based sweets has been observed with serious concern as consumption of such milk based sweets results in public health hazards. It is therefore essential for the public health authorities to take necessary steps in strictly enforcing the hygienic concept, which is lacking, so as to avoid pathogenic contamination at various stages of processing, storage, handling and transportation of milk based sweets.

MATERIALS AND METHODS

The sweet samples were collected from the market of western Delhi in each season (winter, summer and rainy) and in laboratory same sweets were prepared in each season for comparison with the market sweets. Total 150 sweet samples i.e. burfi, peda, gulabjamun, rasgulla and rasmalai were collected from the shop of sweet makers of western Delhi and 75 samples from laboratory prepared sweets were collected. The collected samples of market and laboratory made sweets were analyzed for pathogenic count. Pathogenic count was determined in *Staphylococcus* medium no. 110. Sweet sample dilution was prepared in normal physiological saline solution. Dilutions vary from 10^{-2} to 10^{-4} . The plates were incubated at temperature of 37°C for 24-48 hours and the viable count determined.

Sample No.	Sample Name (Winter Season)														
	Burfi			Peda			Rasgulla			Rasmalai					
	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer			
1	2	3	4.3	2	4	5.4	4	7	8.7	1	5	6.5	2	4.5	5.4
2	3	12	14.3	4	5.5	7.4	5	21	23.1	4	6.5	9.5	3	8.5	10.9
3	2	4	6	2	6.5	9.3	3	7.5	5.3	2	4.5	6.5	2	9	11.1
4	1	6.5	9	1	7	8.9	9	27	29.2	2	7	10.1	1	12	13.6
5	2	7.5	8.9	2	3.5	5.1	4	4.5	5.4	3	8.5	11.1	4	10.5	15.3
Average	2	6.6	8.5	2.2	5.3	7.2	5	13.4	14.3	2.4	6.3	8.74	2.4	8.9	11.2
S.D.	0.70	3.52	3.81	1.09	1.52	1.93	2.34	9.97	11.07	1.14	1.60	2.12	1.14	2.81	3.75
	Sample Name (Summer Season)														
	Burfi			Peda			Rasgulla			Rasmalai					
	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer			
1	2	3.4	4.3	2	10.1	11.5	4	4	6.5	1	7.7	9.9	2	3.5	5.4
2	1	11.5	12.1	4	9.5	10.5	5	12.3	13.6	3	7.5	10.1	3	7.5	8.3
3	2	4.5	6.5	2	6.5	9.5	3	7.5	9.6	2	6.5	8.1	2	9.4	9.9
4	1	10.5	11.9	1	10.3	12.1	5	23.5	26.5	5	4.7	6.2	1	12.4	16.5
5	2	7.4	9.4	2	6.5	8.8	4	12.5	15.3	3	10.5	12.1	4	13.5	15.3
Average	1.6	7.4	8.8	2.2	8.5	10.4	4.2	11.9	14.3	2.8	7.3	9.2	2.4	9.2	11.0
S.D.	0.54	3.56	3.41	1.09	1.92	1.36	0.83	7.36	7.63	1.48	2.11	2.22	1.14	4.00	4.71
	Sample Name (Rainy Season)														
	Burfi			Peda			Rasgulla			Rasmalai					
	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer			
1	2	4.9	5.4	2	12.1	13.3	4	5	6.5	1	7.3	8.4	2	3.6	4.2
2	3	10.5	11.2	4	8.7	9.8	5	15.3	19.4	3	7.8	9.3	3	6.3	8.3
3	2	7.5	9.4	2	11.5	15.4	3	5.5	8.4	2	6.9	8.5	2	11.1	12.1
4	1	14.5	15.4	1	8.3	9.4	6	17.5	19.1	5	2.9	5.2	3	9.4	10.1
5	2	7.4	10.1	2	6.5	8.9	4	13.5	15.6	3	9.5	10.2	4	15.5	17.1
Average	2	8.9	10.3	2.2	9.4	11.3	4.4	11.3	13.8	2.8	6.8	8.3	2.8	9.1	10.3
S.D.	0.70	3.67	3.59	1.09	2.33	2.84	1.14	5.75	6.02	1.48	2.43	1.88	0.83	4.55	4.76

The presence of pathogens is not only unwanted but harmful to consumers as well. *Staphylococci aureus* can cause life threatening diseases such as pneumonia, meningitis, osteomyelitis, endocarditis, toxic shock syndrome (TSS), bacterimia and sepsis in humans through sweets. Therefore, pathogenic count was determined in each samples of sweets collected from market and prepared in laboratory. In case of market made sweets in the winter season the average pathogenic count was lowest (5.3 CFU/gm inner and 7.2 CFU/gm outer) for peda samples followed by burfi (6.6 CFU/gm inner and 8.5 CFU/gm outer), rasmalai (6.3 CFU/gm inner and 8.7 CFU/gm outer), gulabjamun (8.9 CFU/gm inner and 11.2 CFU/gm outer) and pathogenic count was highest (5.3 CFU/gm inner and 7.2 CFU/gm outer) in rasgulla of market made sweet samples. While in laboratory made sweets in the winter season the average pathogenic count was lowest (2 CFU/gm) for burfi samples followed by peda (2.2 CFU/gm), gulabjamun (2.4 CFU/gm), rasmalai (2.4 CFU/gm) and pathogenic count was highest (5 CFU/gm) in rasgulla of laboratory made sweets (Table-1).

In case of market made sweets in the summer season the average pathogenic count was lowest (7.4 CFU/gm inner and 8.8 CFU/gm outer) for burfi samples followed by rasmalai (7.3 CFU/gm inner and 9.2 CFU/gm outer), peda (8.5 CFU/gm inner and 10.4 CFU/gm outer), gulabjamun (9.2 CFU/gm inner and 11.0 CFU/gm outer) and pathogenic count was highest (11.9 CFU/gm inner and 14.3 CFU/gm outer) in rasgulla of market made sweet samples. While in laboratory made sweets in the summer season the average pathogenic count was lowest (1.6 CFU/gm) for burfi samples followed by peda (2.2 CFU/gm), gulabjamun (2.4 CFU/gm), rasmalai (2.8 CFU/gm) and pathogenic count

was highest (4.2 CFU/gm) in rasgulla of laboratory made sweets (Table-1).

In case of market made sweets in the rainy season the average pathogenic count was lowest (6.8 CFU/gm inner and 8.3 CFU/gm outer) for rasmalai samples followed by burfi (8.9 CFU/gm inner and 10.3 CFU/gm outer), gulabjamun (9.1 CFU/gm inner and 10.3 CFU/gm outer), peda (9.4 CFU/gm inner and 11.3 CFU/gm outer) and pathogenic count was highest (11.3 CFU/gm inner and 13.8 CFU/gm outer) in rasgulla of market made sweet samples. While in laboratory made sweets in the rainy season the average pathogenic count was lowest (2 CFU/gm) for burfi samples followed by peda (2.2 CFU/gm), gulabjamun (2.8 CFU/gm), rasmalai (2.8 CFU/gm) and pathogenic count was highest (4.4 CFU/gm) in rasgulla of laboratory made sweets (Table-1). (9) conducted a research to assess the quality of market milk products available in and around Ludhiana. Among all milk products sample burfi showed the average viable count of 3.1×10^4 cfu/mL/g, rasgulla 2.8×10^4 cfu/mL/g, paneer 6.7×10^4 cfu/mL/g and ice-cream 8.3×10^4 cfu/mL/g. For the bacteriological quality milk products sample ice-cream had 12.5%, rasgulla and paneer had 14.3% *Salmonella*. In rasgulla *Proteus* was absent but was present in burfi and ice-cream (12.5%), paneer (14.2%). *Klebsiella* was isolated from burfi (25%), rasgulla (42.8%), paneer (14.3%) and ice-cream (37.5%). (10) indicated a striking difference of C.F.U/gm of *E. coli* between covered and uncovered foods. Yogurt (dahi) is mostly sold in the open environment where the chances of contaminations are much greater and as a result indicated much higher contents of *Escherichia coli* than those ones that are mostly sold under hygienic conditions. Moreover the results of advanced and backward areas were much variable depicting higher *Escherichia coli* contents in backward areas due to lack of hygienic facilities. (6) conducted a research to determine bacterial contaminants/pathogens in khoa samples. Total 50 samples of khoa brought at random were cultured on several media. The viable counts obtained ranged from 1.3×10^4 to 2.1×10^6 CFU/g. Out of 50 samples, 47 were showing presence of *Staphylococcus* species; 34 were found to be *Streptococci*; 04 were found to be *Proteus*; 04 are showing presence of *Lactobacilli*; 03 showed presence of *Serratia*; *Pseudomonas* sp. was present in 03 while *Enterobacter* and *Klebsiella* were present in one sample only.

It was concluded from the present study that the average pathogenic count in laboratory made sweets in each season is very low in comparison to market made sweets samples because laboratory made sweets were prepared in hygienic conditions and at most care was taken while keeping these sweet samples in laboratory for long time. Among all, heavy bacterial contamination was found in market made sweet samples particularly in rainy season. The unhygienic condition of preparation of these foodstuffs and water used for washing of utensils enhances the bacterial contamination of milk and milk sweets.

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QUALITY ASSESMENT OF MILK PRODUCTS SOLD IN WESTERN DELHI

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ABSTRACT

The milk and milk based sweet products contain moisture and are rich in several nutrients, therefore, provides a favorable environment for the growth and multiplication of microorganisms. Microbiological hazards are responsible for over 90% of the incidents of global foodborne illnesses. Total 150 sweet samples were collected from Western Delhi market and compared with 75 samples of laboratory prepared sweets. The market made and laboratory made sweet samples were analyzed for the comparison of spore forms count. It is concluded that strict measure to prepare and store the product are recommended to be taken seriously by local public health authorities for controlling the bacterial foodborne outbreaks.

Key words : Milk products, quality assessment, sample.

India is the leading producer of milk in the world and therefore, a wide variety of indigenous milk products viz. burfi, rabri, peda, kalakand, kulfi, basundi, rasgulla, gulabjaman, paneer, khoa, rasmalai, chum chum etc. are prepared (1). The milk and milk based sweet products contain moisture and are rich in several nutrients, therefore, provides a favourable environment for the growth and multiplication of microorganisms. The milkborne and milk products borne outbreaks account for 2-6 % of bacterial foodborne outbreaks in several countries (2). The microbiological quality of milk and milk based sweet products is influenced by the initial flora of raw milk, the processing conditions, and post-heat treatment contamination (3). Undesirable microbes that can cause spoilage of dairy products include Gram-negative psychrotrophs, coliforms, lactic acid bacteria, yeasts and molds. In addition, various bacteria of public health concern such as *Salmonella* spp., *Listeria monocytogenes*, *Campylobacter jejuni*, *Yersinia enterocolitica*, pathogenic strains of *Escherichia coli* and enterotoxigenic strains of *Staphylococcus aureus* may also be found in milk and dairy products (4).

Spore-forming microorganisms have a special position among total microflora of milk with regard to their greatest ability to survive thermal treatment of milk and subsequently to propagate in final products (5). Spore-forming microorganisms are either strictly anaerobic (SPAN)-genus *Clostridium*, which cause problems mainly in long lasting ripening of cheeses or they are facultatively anaerobic; it means that they grow under aerobic as well as anaerobic conditions-genus *Bacillus*, which is characteristic by a broad complex of physiological variants that are reflected in a variety of mesophilic, thermophilic and psychrophilic species (6).

Psychrotrophic bacteria caused the spoilage of the heat treated milk and dairy products as the result of post-pasteurization contamination of the products (7) but

all are not pathogenic. Total 65–70% of the psychrotrophs isolated from raw milk are *Pseudomonas* species (8). Other important psychrotrophs associated with raw milk include members of the genera *Bacillus*, *Micrococcus*, *Aerococcus* and *Lactococcus* and of the family Enterobacteriaceae. Psychrotrophic bacteria have the ability to produce heat stable extracellular and/ or intracellular hydrolytic enzymes (9). Many of these enzymes retain their activity even after the conventional heat treatment of milk. However, certain species of these bacteria have the ability to produce toxins and/or show resistance to antibiotics and therefore must be considered as opportunistic human pathogenic bacteria (10, 11).

MATERIALS AND METHODS

The sweet samples (Burfi, Peda, Gulabjamun, Rasgulla and Rasmalai) were collected from the market of Western Delhi and in the laboratory same sweets were prepared for comparison with the market sweets. Total 150 sweet samples, 25 samples (5 samples of each sweet) from showcases (inner) and 25 samples (5 samples of each sweet) from open (outer) were collected from the selected shop of western Delhi market and 75 samples from laboratory prepared sweets were collected in each season (winter, summer and rainy). The market made and laboratory made sweet samples were analysed for the comparison of spore forms count. The spore count in sweet samples was determined in nutrient agar medium. Sweet samples dilutions were prepared in normal physiological saline solution (0.9 % NaCl in distilled water). Dilutions vary from 10^{-2} to 10^{-4} . Saline solution having test product in it was heated at 161°F for 30 seconds to kill all the vegetative cells. It was then diluted to 10^{-4} and then plated. The plates were incubated at $37 \pm 1^\circ\text{C}$ for 72 hours and the viable count was determined.

RESULTS AND DISCUSSION

Sweets are source of nutrition and substrates for the growth of microorganisms. Excess of microorganisms in

Sample No.	Sample Name (Winter Season)																	
	Burfi				Peda				Rasgulla				Rasmalai				Gulabjamun	
	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer	Inner	Outer	
1	2	7	8	2	7.5	12.4	4	9	18	1	9	18	1	8.5	10.7	2	8	17
2	1	15	18	4	14.1	19.4	1	20	27	3	20	27	3	15.5	19.7	3	18	19.4
3	2	12	19.6	2	13.5	17.5	3	18	29.5	2	18	29.5	2	14.5	19.4	2	17.5	27.5
4	1	11	16	1	14.5	16.4	2	22.5	32.5	1	22.5	32.5	1	16	21.6	1	24	29.6
5	2	20.5	23	2	21.5	22.9	3	37	43.4	3	37	43.4	3	22	32	4	26.5	32
Average	1.6	13.1	16.9	2.2	14.2	17.7	2.6	21.3	30.1	2	21.3	30.1	2	15.3	20.7	2.4	18.8	25.1
S.D.	0.54	5.02	5.61	1.09	4.96	3.86	1.14	10.14	9.21	1	10.14	9.21	1	4.80	7.60	1.14	7.16	6.55
	Sample Name (Summer Season)																	
	Burfi				Peda				Rasgulla				Rasmalai				Gulabjamun	
	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer	Inner	Outer	
1	2	8.4	9.3	2	25.5	39.0	4	4.7	9.3	1	19.7	28.4	2	18.6	19.4			
2	3	17.6	19.4	4	15.1	18.4	5	21.7	29.4	3	16.9	21.1	3	18.0	23.0			
3	2	16.1	21.3	2	17.5	19.4	3	17.4	20.9	2	16.1	23.3	2	16.5	29.4			
4	1	16.0	20.0	1	17.5	23.2	5	28.5	31.5	5	17.6	24.2	3	22.6	29.2			
5	2	24.5	29.5	2	15.5	20.2	4	36.0	39.4	3	25.8	29.3	4	27.7	34.5			
Average	2	16.5	19.9	2.2	18.2	24.0	4.2	21.6	26.1	2.8	19.2	25.2	2.8	20.6	27.1			
S.D.	0.71	5.72	7.18	1.09	4.21	8.55	0.83	11.81	11.46	1.48	3.91	3.48	0.83	4.52	5.92			
	Sample Name (Rainy Season)																	
	Burfi				Peda				Rasgulla				Rasmalai				Gulabjamun	
	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer	Control	Inner	Outer	Inner	Outer	
1	2	11.4	12.4	2	19.5	37.6	4	14.7	18.4	1	21.7	26.8	2	23.6	29.0			
2	3	27.6	29.8	4	17.5	25.4	5	20.7	26.5	3	19.9	31.2	4	33.0	37.6			
3	1	17.1	20.1	2	21.5	28.5	3	19.4	24.8	2	12.1	17.5	2	35.5	38.0			
4	1	21.0	25.8	1	16.5	19.5	2	21.5	27.9	5	19.6	29.3	3	25.6	29.0			
5	2	29.5	34.5	2	18.5	23.3	6	39.5	43.8	3	22.8	26.8	4	35.7	43.7			
Average	1.8	21.3	24.5	2.2	18.7	26.8	4	23.2	28.3	2.8	19.2	26.3	3	30.7	35.5			
S.D.	0.83	7.46	8.59	1.09	1.92	6.83	1.58	9.51	9.41	1.48	4.19	5.26	1	5.69	6.37			

In case of market made sweets in the summer season the average spore forms was lowest (16.5 CFU/gm inner and 19.9 CFU/gm outer) for burfi samples followed by peda (18.2 CFU/gm inner and 24.0 CFU/gm outer), rasmalai (19.2 CFU/gm inner and 25.2 CFU/gm outer), gulabjamun (20.6 CFU/gm inner and 27.1 CFU/gm outer) and spore forms was highest (21.6 CFU/gm inner and 26.1 CFU/gm outer) in rasgulla of market made sweet samples. While in laboratory made sweets in summer season the average spore forms was lowest (2 CFU/gm) for burfi samples followed by peda (2.2 CFU/gm), rasmalai (2.8

CFU/gm), gulabjamun (2.8 CFU/gm) and spore forms was highest (4.2 CFU/gm) in rasgulla of laboratory made sweets.

In case of market made sweets in the rainy season the average spore forms was lowest (18.7 CFU/gm inner and 26.8 CFU/gm outer) for peda samples followed by rasmalai (19.2 CFU/gm inner and 26.3 CFU/gm outer), burfi (21.3 CFU/gm inner and 24.5 CFU/gm outer), rasgulla (23.2 CFU/gm inner and 28.3 CFU/gm outer) and spore forms was highest (30.7 CFU/gm inner and 35.5 CFU/gm outer) in gulabjamun of market made sweet samples. While in laboratory made sweets in rainy season the average spore forms was lowest (1.8 CFU/gm) for burfi samples followed by peda (2.2 CFU/gm), rasmalai (2.8 CFU/gm), gulabjamun (3 CFU/gm) and spore forms was highest (4 CFU/gm) in rasgulla of laboratory made sweets. It was concluded from the table 1 that the average spore forms in laboratory made sweets in each season was very low in comparison to market made sweets samples because market made sweets were prepared in unhygienic conditions and kept on shops with uncared.

(12) carried out a research on the enumeration of total viable bacterial count, coliform count, psychotropic count, aerobic spore formers, yeast and mould count of Indian indigenous milk sweets such as khoa, burfi, gulabjamun, kalakand and peda. Sweet samples were collected from local vendors, private manufacturers and organized dairies. The aerobic spore forming bacterial count of khoa based sweet samples obtained from Local vendors, Private manufacturers and organized dairies ranged from 3×10^2 to 1.7×10^4 , 3×10^2 to 1.1×10^3 and 4×10^1 to 5×10^2 respectively. Similarly, the psychrotrophic count of these three sources was ranged from 1.82×10^3 to 5.1×10^4 , 1.9×10^2 to 3.2×10^3 and 3×10^1 to 1.9×10^3 respectively. Aerobic spore forming bacterial count and psychrotrophic count of local vendor's samples higher than private manufacturers and organized dairies due to individual's unhygienic practices, through packaging material and environmental factors. (13) recorded a range of aerobic spore formers count of khoa samples from 2×10^2 to 5×10^4 cfu /gm. (14) recorded the aerobic spore formers of khoa based milk sweets in the range of 1×10^2 to 5.8×10^3 cfu/gm. The higher incidence of spore formers may be due to marketing in dusty, dirty and open environment. It is concluded that strict measure to prepare and store the product are recommended to be taken seriously by local public health authorities for controlling the bacterial foodborne outbreaks.

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HI 8737 (PUSA ANMOL) – A NEW RUST AND KARNAL BUNT RESISTANT, HIGH YIELDING DURUM WHEAT VARIETY FOR HIGH FERTILITY IRRIGATED TIMELY SOWN CONDITIONS OF CENTRAL ZONE

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ABSTRACT

A new durum wheat variety HI 8737 has been recommended for commercial cultivation under high fertility irrigated timely sown conditions of Central zone of India. HI 8713 has yield potential of > 67 q/ha with an average yield of 53.4 q/ha; and shows superiority over checks by giving 2.5% to 7.2% higher yield over durum wheat checks HI 8498 and MPO 1215; and 2.9% to 3.7% yield superiority over bread wheat checks- GW 322 and HI 1544. It showed good levels of field resistance to stem and leaf rusts; and exhibited resistance to all the leaf rust pathotypes indicating presence of 'unique' resistance gene/s, and hence, can contribute to diversification of leaf rust resistance base under wheat cultivation in central India. It showed immunity to flag smut, and better resistance to Karnal bunt and Fusarium head blight, compared to all the checks and the qualifying variety MP 3382. It can serve as a "dual purpose" variety suitable both for making chapati and for pasta preparations due to its moderate SDS-sedimentation value (~36 ml) and high semolina recovery. It can contribute to "nutritional security" in central India, because of its high protein content (~12.0%), good levels of yellow pigment (~5.4 ppm) and essential micronutrients like iron and zinc.

Key words : *Disease resistant, fertility, irrigation, durum wheat.*

The durum wheat variety 'HI 8737' (Pusa Anmol) released vide notification number S.O. 196 (E) dated 28.1.2015 for Central Zone (CZ) of the country which is the largest durum producing zone with respect to area, production as well as productivity. Durum wheat cultivation has several advantages to offer like saving irrigation water due to its high water-use efficiency, minimizing the risk of rust epidemics because of its diverse rust resistance, providing naturally 'biofortified health food' due to its high protein, yellow pigment and micronutrients content, and generating employment opportunities through establishment of durum wheat-based fast food industries. HI 8498, released in 1999, is the only popular durum wheat variety under irrigated, timely sown conditions in Central Zone, and hence, there is an urgent need for few good durum varieties for cultivation under these conditions with high yield potential, bold and lustrous grains having excellent quality traits and resistance to stem and leaf rusts.

Yield potential and adaptation : The newly released variety was tested for three years under 39 trial locations spread all over the Central zone. On the basis of its average yield (weighted mean), it was found better as compared to the checks. HI 8737 has yield potential of > 67 q/ha with an average yield of 53.4 q/ha; and shows superiority over checks by giving 2.5 % to 7.2 % higher yield over durum wheat checks HI 8498 and MPO 1215; and 3.9% higher than the qualifying variety MP 3382. It

also showed 2.9% to 3.7% yield superiority over bread wheat checks-GW 322 and HI 1544 (Table 1).

Stability in agronomic trials : HI 8737 has shown good adaptation and significantly superior performance over the qualifying variety MACS 3382 (+7.7 %), checks MPO 1215 (+4.1 %) and HI 8498 (5.7 %), and bread wheat check HI 1544 (1.9 %). Under late sown conditions, it showed significant superiority over the durum wheat checks MPO 1215 (2.5 %) and HI 8498 (4.1 %). It showed significantly superior performance over the qualifying variety MP 3382 (4.5 %), and checks MPO 1215 (3.4 %) and HI 8498 (5.0 %) to variations in sowing times (pooled). It showed more number of ear heads/sq. m compared to durum check varieties HI 8498 and MPO 1215 under pooled analysis, which has contributed to its yield superiority.

Better disease resistance : HI 8737 possess high degree of resistance against stem and leaf rusts, immunity to flag smut and better resistance to Karnal bunt and Fusarium head blight in comparison of checks and the qualifying variety MP 3382 (Table 3). It also showed high levels of adult plant resistance to prevalent and virulent leaf rust pathotypes 77-5 and 104-2. It exhibited resistance to all the leaf rust pathotypes indicating presence of 'unique' resistance gene/s, and hence, can contribute to diversification of leaf rust resistance base under wheat cultivation in central India. Durum wheat check varieties HI 8498 and MPO 1215 showed

Table-1 : Summarized yield data under coordinated trials over three years (2011-2014).

Parameter	Year of testing	No. of trials/ locations	New Variety HI 8737	National Check HI 8498	Durum Check MPO 1215	Bread wheat Check GW 322	Bread wheat Check HI 1544	Qual. variety MP 3382
Mean yield (Q/ha)	2011-12	8	60.6	57.2	-	-	-	-
a) Zonal	2012-13	15	54.5	53.1	53.2	52.9	52.8	53.1
b) across Zones (If applicable)	2013-14	16	48.8	48.6	46.6	50.9	50.2	49.8
	Weighted Mean	39	53.4	52.1	49.8	51.9	51.5	51.4
% increase or decrease over the checks & qualifying varieties	2011-12			5.9	-	-	-	-
	2012-13			2.6	2.4	3.0	3.2	2.6
	2013-14			0.4	4.7	-4.1	-2.8	-2.0
	Weighted mean			2.5	7.2	2.9	3.7	3.9
Frequency in top group (pooled for 3 years)			14/39	10/39	7/31	16/31	13/31	13/31

Table-2 : Adaptability of durum wheat variety HI 8737 to changes in agronomic conditions.

Item	Sowing condition	New variety HI 8737	National Check HI 8498	Durum Check MPO 1215	Bread wheat Check GW 322	Bread wheat Check HI 1544	Qual. variety MP 3382
Yield (Q/ha) under recommended sowing date	Timely	51.07	48.32	49.05	53.80	50.14	47.42
	Late	41.66	40.03	40.64	45.48	43.77	41.31
	Pooled	46.36	44.17	44.85	49.64	46.95	44.36
Percentage gain or loss when sown	Timely		5.7	4.1	-5.1	1.9	7.7
	Late		4.1	2.5	-8.4	-4.8	0.8
	Pooled		5.0	3.4	-6.6	-1.3	4.5

Table-3 : Disease reaction of HI 8737, qualifying and check varieties against stem and leaf rusts under natural and artificial conditions during 2011-14.

Disease name	Item		Proposed variety HI 8737	National Check HI 8498	Durum Check MPO 1215	Bread wheat Check GW 322	Bread wheat Check HI 1544	Qual. variety MP 3382
Stem rust	Natural	2011-12	-	-	-	-	-	-
		2012-13	10MS	5S	10S	TS	10S	5MS
		2013-14	TS	TS	TMS	TS	0	0
	Artificial	2011-12	20MR (2.6)	20X (3.5)	10X (1.4)	5MR (0.5)	5S (2.0)	30X (9.1)
		2012-13	40MS (9.8)	40MS (8.2)	40S (10.2)	20MR (2.4)	60S (16.8)	20MS (9.2)
		2013-14	10S (3.4)	20S (5.4)	30S (4.8)	10S (3.2)	20S (3.7)	30S (5.9)
Leaf rust	Natural	2011-12	0	-	-	-	-	-
		2012-13	5MR	TMS	TS	TR	10S	TR
		2013-14	TR	TMR	TR	0	0	TR
	Artificial	2011-12	10S (2.7)	5S (1.6)	5MR (0.3)	5MS (0.9)	20S (2.7)	40S (10.2)
		2012-13	40MR (5.7)	60S* (12.1)	20MR (2.3)	5MS (1.3)	40S (12.3)	10S ((3.7)
		2013-14	5S (1.6)	10S (3.7)	10S (2.9)	20S (4.7)	10MS (1.2)	20S (9.0)
Genes postulated		Sr genes	Sr9e+	Sr2+11+	Sr11+	Sr2+11+	Sr2+	Sr9b+11+
		Lr genes	Lr23+	Lr23+	Lr23+	Lr13+	Lr24+	Lr3+13+
		Yr genes	Yr2+	Yr2+	-	Yr2+	Yr2+	YrA+

susceptibility to currently most prevalent and virulent pathotype 77-5. It showed resistance to durum-virulent pathotypes 12-5 and 104B to which HI 8498 was susceptible. In addition, it showed resistance to durum

virulent stem rust pathotype 117-5, to which HI 8498 and MPO 1215 were moderately susceptible. Having rust resistance spectrum different from that of HI 8498 and MPO 1215, it can help in diversifying the resistance base

Table-4 : Data on some important quality parameters.

Parameter	New Variety HI 8737	National Check HI 8498	Zonal Check MPO 1215
Grain appearance	7.0	7.3	7.7
Test weight (kg/hl)	83.4	83.4	83.4
Sedimentation value (ml)	36	34	32
Protein content (%)	12.1	12.3	13.0
Yellow berry incidence (%)	9.6	8.2	10.1
Yellow pigment (ppm)	5.38	4.47 (20.4)	5.02 (7.2)
-gliadin	45	45	45
Iron (ppm)	38.5	39.5	37.7
Zinc (ppm)	40.0	40.2	39.9
Cooking time (min./sec.)	11:10	11:20	11:40
Water absorption (%)	122	116	117
Gruel solid loss (%)	1.53	2.11 (-27.5)	2.23 (-31.4)
Texture	8	7 (14.3)	6 (33.3)
Flavour	7	6 (16.7)	6 (16.7)
Overall Acceptability	7.3	6.3 (15.9)	6.0 (21.7)

*() = percentage increase or decrease.

Table-5 : FLD Demonstrations of durum wheat variety HI 8737 in comparison to Lok-1 and HI 8498: 2014-15

S. No.	Farmer	Variety		Area		Yield (q/ha)		Yield Increase	
		Test	Check	Test	Check	Test	Check	q/ha	%
1	Naushad Patel	HI 8737	Lok-1	0.3	0.5	56	30	26	86.7
2	Aryendra Singh Chauhan	HI 8737	HI 8498	0.3	0.4	64	40	24	60.0

ensuring protection to timely sown wheat cultivation in Central India.

Better quality : HI 8737 is a durum wheat variety with good levels of yellow pigment content (5.38 ppm), essential micronutrients like iron and zinc, less gruel solid loss, and high overall acceptability (7.3), compared to durum checks. It showed superiority for texture and flavor in comparison to check varieties HI 8498 and MPO 1215, and was comparable to qualifying variety HI 8736. It showed parity with the latter in other desired quality traits like grain appearance, protein content, test weight etc. It can be used as a “dual quality” durum suitable both for “chapati making” as well as for excellent pasta preparations.

Performance of demonstrations in farmers’ fields : HI 8737 was grown in demonstrations in farmers’ field during rabi 2014-15 in comparison with popular wheat varieties Lok-1 and HI 8498. HI 8737 had given about 86.7 % and 60.0 % average increase in yield compared to Lok-1 and HI 8498, respectively (Table 5). Farmers had expressed complete satisfaction about this variety in terms of grain production and productivity compared to their local wheat varieties Lok-1 and HI 8498. Even, the farmers had conveyed that HI 8737 had fetched higher price than

Lok-1 in the grain mandis, which in turn increase their profitability in terms of economic returns.

CONCLUSION

HI 8737 showed stable high yield, wider adaptability, high protein content (~12.0 %), high sedimentation value (~36 ml), good levels of yellow pigment (~5.4 ppm) and essential micronutrients like iron and zinc, low mottling (yellow berry incidence), excellent overall acceptability (7.3) and “dual quality” grain with high levels of resistance to stem and leaf rusts. It exhibited resistance to all the leaf rust pathotypes indicating presence of ‘unique’ resistance gene/s, and hence, can contribute to diversification of leaf rust resistance base. Moreover, its distinct rust resistance spectrum from that of HI 8498 and MPO 1215, can enrich and diversify the rust resistance base of wheat cultivation in central parts of India, which serve as “secondary focus of rust infection” for the north-western wheat belt of the country. High hectolitre weight, less gruel solid loss and good grain appearance for good quality chapati as well as pasta add to its advantages. It meets all the requirements of an ideal durum wheat variety for Central Zone, and thus, can help in raising productivity and profitability of durum wheat crop in central parts of the country.



IN VITRO ANTIBACTERIAL ACTIVITY AND MINIMUM INHIBITORY CONCENTRATION OF *OCIMUM SANCTUM* LEAVES AGAINST COMMON BOVINE MASTITIS PATHOGENS

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ABSTRACT

Mastitis, the inflammation of udder, is caused by a wide range of contagious and environmental microbial pathogens. In the present study, hydro-alcoholic extract of *Ocimum sanctum* leaves was evaluated, in vitro, for its antibacterial activity and minimum inhibitory concentration (MIC) against common bovine mastitis pathogens by agar cup and tube dilution method, respectively. In general, extract of *O. sanctum* revealed higher antibacterial activity against gram negative as compared to gram positive mastitis pathogens with inhibitory zones of 17.38 ± 0.92 mm against *Escherichia coli* and 10.88 ± 0.58 mm for *Streptococcus* spp. The corresponding MIC values were 125 mg/ml and 62.5 mg/ml respectively. The evaluation of antibacterial activity of herb in terms of enrofloxacin revealed 72.95% and 58.71% inhibition of *E. coli* and *Staphylococcus aureus* respectively. Overall, the study revealed a good antibacterial activity of the extract against common bovine mastitis pathogens which could be exploited as therapy for treating mastitis in lactating dairy cows.

Keywords : Antibacterial, hydro-alcoholic extract, mastitis, MIC, *Ocimum sanctum*.

Mastitis is one of the most costly diseases of dairy cattle resulting in the reduction of milk yield and quality [1]. The principle incriminate of mastitis is bacterial infection. Appropriate clearance of the pathogens from the bovine udder requires both the effectiveness of the drug and optimum functioning of the immune cells [2] which depends largely, till date, on the use of antibiotics. The use of antimicrobials has, overtime, increased the number of antimicrobial-resistant microbes globally [3]. Further, the antibiotics used for the treatment of mastitis depress the activity of the polymorphonuclear cells (PMNs) that are considered primary cellular defences of the mammary gland [4]; are moderately efficacious requiring prolonged milk withdrawal due to residues in milk and development of hypersensitivity syndromes in human beings and effect on the manufacture of dairy products. For this reason, now-a-days, the concept of using non-antibiotic strategies for controlling mastitis is gaining more attention, based on, enhancement of the animal's natural defence mechanism by use of non-specific immuno-modulators such as plant materials, which constitute a major source of alternative medicine. These being organic in nature, possess less toxicity, lesser side effects, and generally does not pollute the milk and hence there is no milk withdrawal loss, a major problem with antibiotic use. Keeping above facts in view, the present study was planned to evaluate in vitro antibacterial activity of *Ocimum sanctum* (Tulsi) for exploitation of this herb in the therapy of bovine mastitis. The *O. sanctum* is a valuable herbal medicine being used in wide spectrum of animal diseases. The key constituents of *O. sanctum*, were volatile oil (Eugenol 80%), flavonoids and triterpine [5] and the herbal extract possessed immuno-modulatory and anti-inflammatory properties [6]. [7] observed that *O. sanctum* fixed oil has good antibacterial activity against *Bacillus pumilus*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*

and concluded that higher content of linolenic acid in *O. sanctum* fixed oil could contribute towards its antibacterial activity. [8] found eugenol (1-hydroxy-2-methoxy-4-allylbenzene), the active constituent present in *O. sanctum*, to be largely responsible for its therapeutic potentials.

MATERIALS AND METHODS

Collection of Plant materials : *Ocimum sanctum* leaves were collected locally. The materials were shade dried in the laboratory and further dried in the incubator at 40°C to remove any excess moisture. The dried materials were then ground in a Willey Grinder (Arthur H. Thomas type) at room temperature. The powder thus obtained was stored in clean and air tight polythene bags till further use.

Preparation of extract : For preparation of the hydro-alcoholic extract, 100 g powder of herb was weighed and soaked separately in ethanol (absolute) and distilled water in a ratio of 1:1 for 48 hrs with continuous stirring at 37°C. After 48 hrs, the mixture was filtered through several layers of muslin cloth, then Whatman's filter paper using a funnel. The final extract was obtained after drying the filtrate in incubator with fan at 40°C and stored at 4°C till further use. The percent recovery of extract was recorded on dry weight basis (w/w).

Microorganisms : Common bovine mastitis pathogens such as *S. aureus*, coagulase negative *Staphylococcus* (CNS), *Streptococcus* spp., *Escherichia coli*, *Klebsiella* spp., and *Corynebacterium* spp., were isolated as per criteria of [9]. For the preparation of fresh working inoculums a loop full of isolated bacteria was taken and streaked radially on to the sterile agar plates in such a manner that individual colonies could develop. After incubation, five colonies of the test bacteria were taken and emulsified in 5 ml of sterilized nutrient broth and

Table-1 : Antibacterial activity and assessment of MIC against common mastitis pathogens.

Pathogen	Zones of Inhibition in mm (Mean±SE)		% activity	MIC (mg/ml)
	<i>O. sanctum</i>	Enrofloxacin		
<i>Staphylococcus aureus</i>	14.27±0.43	24.30±0.32	58.71	125
CNS	13.88±0.97	27.70±0.34	50.09	125
<i>Streptococcus</i> spp.	10.88±0.58	27.40±0.37	39.69	62.5
<i>Escherichia coli</i>	17.38±0.92	23.82±0.27	72.95	125
<i>Corynebacterial</i> spp.	11.00±0.53	26.90±0.33	40.89	62.5
<i>Pseudomonas</i> spp.	11.75±0.45	24.60±0.24	47.76	125
<i>Klebsiella</i> spp.	17.13±0.48	21.70±0.21	78.92	125

incubated overnight at 37°C to get the required concentration of the pathogens.

Antibacterial activity and assessment of minimum inhibitory concentrations (MIC) : The antibacterial activity of the extract was screened by agar cup method as described by. On sterile agar plates, wells of 8 mm diameter were punched with a sterile gel cutter and wells sealed with molten nutrient agar to prevent escape of extracts through bottom. Stock inoculum of test bacterium was swept over the agar plate and subsequently 100 µl (50mg) of herbal extract was poured into the wells, along with selected antibiotics (amoxycillin-clavulanate-30/15 mcg, ceftriaxone-10 mcg, enrofloxacin-10 mcg, gentamicin-10 mcg and penicillin-2 units) were placed equidistantly on the plate. Plates were incubated at 37°C for 24 hr when zones of inhibition were measured. Eight replicates for each bacterial isolate were made and results were taken as mean ± S.E. Enrofloxacin showed good antibacterial activities against all the tested pathogens and was selected for comparing the antibacterial activity of herbal extract. MIC of the extract was evaluated by tube dilution method as described by (11) with slight modifications. For it, serial dilutions of the extracts were prepared from 500 mg/ml dilution with the help of tween-20.

RESULTS AND DISCUSSION

The final yield (g/100 g powder) of the hydro-alcoholic extract of *O. sanctum* leaves was recorded to be 9.6%. Inhibitory zones of variable diameters were formed by extract of *O. sanctum* were different for different bacteria tested, with the highest (17.38 ± 0.92 mm) value against *E. coli* and lowest (10.88 ± 0.58) for *Streptococcus* spp. during the course of the present investigation. The zone of inhibition shown by *O. sanctum* against *S. aureus* was found to be 14.27 ± 0.43 mm. The hydro-alcoholic extract of *O. sanctum* leaves revealed highest antibacterial activity against gram negative pathogens as compared to gram positive pathogens during the present investigation (Table-1). The MIC of hydro-alcoholic extract of *O. sanctum* leaf for *Streptococcus* spp. and *Corynebacterial* spp. was observed to be lower as compared to other pathogens during the present course of study. Ali and Dixit

[12] observed the zones of inhibition for flavanoids of *O. sanctum* in concentration of 400 mg/ml as 20.12, 20.75, 20.95, 19.55 and 20.1 mm against *E. coli*, *Proteus*, *S. aureus*, *Staphylococcus cohnii* and *Klebsiella pneumonia*, respectively. Also [13] recorded zones of inhibition ranging 12.5-18.3 mm for aqueous extract of *O. sanctum* leaves against *S. aureus*, *Streptococcus agalactiae* and *E. coli* and herb was found to have inhibitory effect on *Aspergillus ochraceous* mycelial growth and ochratoxin production as well [14]. [15] isolated and characterized the components of *O. sanctum* with activity against *Neisseria gonorrhoea*. They found H12c as the active compound which was characterized as eugenol, with a MIC of 85-256 mg/ml. (7) observed that *O. sanctum* fixed oil has good antibacterial activity against *B. pumilus*, *P. aeruginosa* and *S. aureus* and concluded that higher content of linolenic acid in *O. sanctum* fixed oil could contribute towards its antibacterial activity.

The antibacterial activity of *O. sanctum* could be attributed to its key constituents, like volatile oil (Eugenol), linolenic acid, flavonoids and triterpine (Ursolic acid). Preliminary studies revealed that the hydro-alcoholic (1:1) extract, of *O. sanctum* leaves showed greater zones of growth inhibition against common mastitis pathogens and this antibacterial potential of the herb could be used in, in vivo therapeutic trials to validate its beneficial role for prevention of mastitis.

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IDENTIFICATION OF NEW SOURCES OF RESISTANCE AGAINST MAYDIS LEAF BLIGHT (MLB) AND BANDED LEAF AND SHEATH BLIGHT (BLSB) DISEASES IN QUALITY PROTEIN MAIZE

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ABSTRACT

Maydis Leaf Blight and Banded Leaf and Sheath Blight of maize are the most important foliar disease of kharif season, which becoming one of the most important production threat in Haryana state. Both the diseases are of high damaging potential, so 11 newly developed Quality Protein Maize inbred lines were screened against both the diseases during kharif 2013 and 2014 under artificial inoculation conditions. Three inbred lines (DQL 2015, DQL 2031 and DQL 2071) and two inbred lines (DQL 2025 and DQL 2048) were found resistant to MLB and BLSB, respectively. Six lines viz., DQL 2006, DQL 2009, DQL 2024, DQL 2025, DQL 2028 and DQL 2034 were found moderately resistant to Maydis Leaf Blight. Five inbred lines viz., DQL 2006, DQL 2009, DQL 2025, DQL 2031 and DQL 2071 exhibited resistance to both diseases under consideration. Hence, it is suggested that these lines can be used in further breeding program of quality protein maize hybrids for disease resistance.

Key words : Banded Leaf and Sheath Blight (BLSB), Maydis Leaf Blight (MLB), kharif, maize, resistance, reaction, QPM.

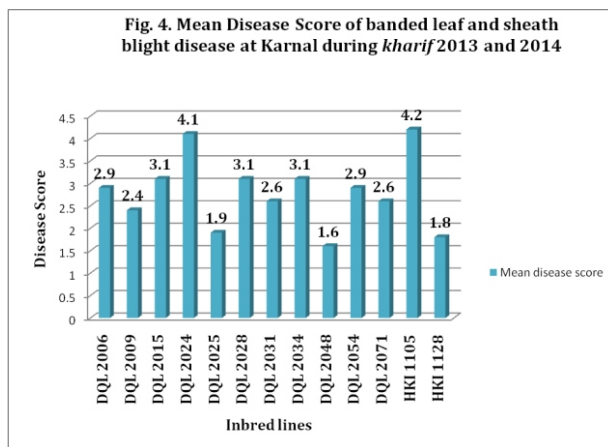
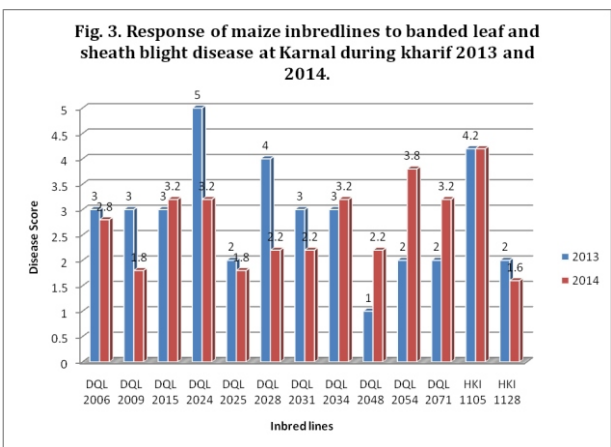
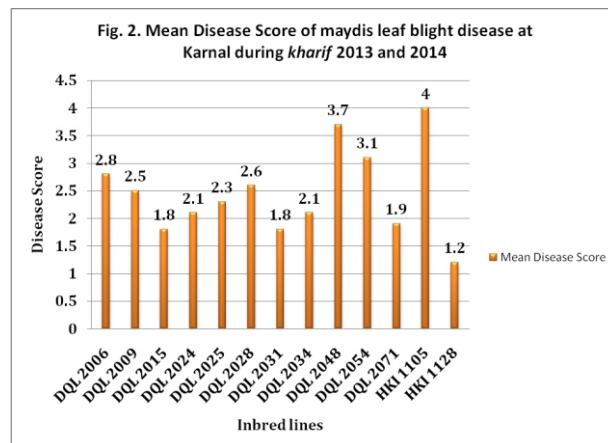
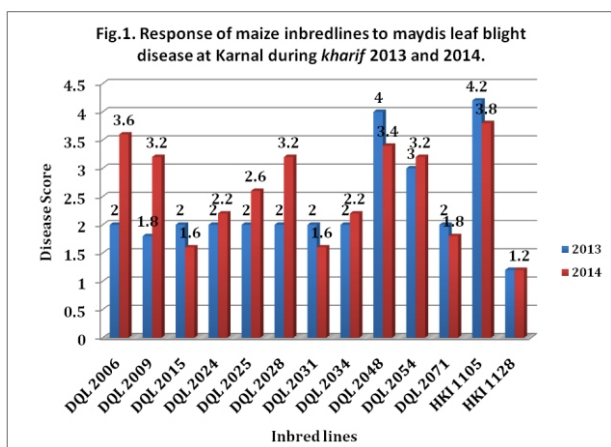
Maize (*Zea mays* L.) is the most versatile crops of the world with wider adaptability having highest yielding potential among the food grain crops. It is consumed as a staple food by the a section of society and is also one of the main crops par excellence for industrial use. As per utilization pattern, it is being used as feed (63 per cent), food (23 per cent), starch industries (12 per cent), seed and miscellaneous use (2 per cent) in India. In India maize occupies an area of 8.78 million hectares having production of 21.76 million tones with average productivity of 2.48 t/ha, while in Haryana, the crop occupies an area of 11 thousand hectares having production of 30 thousand tones with average productivity of 2.73 t/ha (1). The normal maize is deficient to two major amino acids i.e. tryptophan and lysine in its protein content, whereas Quality Protein Maize is rich for these essential amino acids. Therefore, Quality Protein Maize (QPM) is the need of the hour for a balanced diet. In Haryana, maize is grown mainly in Kharif season and due to high humidity and temperature during crop growth period, it is attacked by number of diseases. Maydis leaf Blight (MLB) and Banded Leaf and Sheath Blight (BLSB) are the most important foliar diseases in maize growing areas of Haryana as well Northern which includes Jammu & Kashmir, Himachal Pradesh, Punjab, Rajasthan and Delhi. These diseases cause considerable losses in production and productivity. BLSB has attained damaging status and has rapidly gained economic importance in several parts of the world (2) and this disease has a potential to inflict the economic losses up to 100 per cent (2). Keeping in mind the importance of these diseases the present investigation was carried out to find the new sources of resistance in

QPM lines against both the diseases so that newly identified resistance sources can boost future QPM breeding programme.

MATERIALS AND METHODS

The experimental material consists of 11 newly developed QPM inbred lines and two checks (HKI 1105 - Susceptible and HKI 1128- Resistant). The present study was conducted at CCS Haryana Agricultural University Regional Research Station, Karnal situated at 29°43' North latitude and 76°58' East longitude at an altitude of 245 m above mean sea level. The quality protein maize inbred lines received from Indian Institute of Maize Research, New Delhi were sown in the month of July during kharif 2013 and 2014 in a paired row system with the row length of 4.0 m, spaced at 60 x 20 cm by following recommended package of practices except disease management practices. The material was planted in two separate blocks i.e. one for MLB and another for BLSB screening. Two spreader rows of highly susceptible genotypes, HKI 1105 were planted on either side of the test material.

Inoculation : Inoculum was collected from naturally infected leaves of previous years and sorghum grain culture method (4) was used to inoculate the plants at 40 - 45 cm height in case of maydis leaf blight. In case of BLSB, the infected plant parts were collected from naturally infected plants of previous/current years and the moist sheath blight infected plant bits were placed at the junction of sheath and lower leaf. This procedure was repeated till the symptoms appeared on infector rows.



Disease Score : The diseases score was recorded on 1-5 uniform scale for both diseases, where 1.0 = highly resistant, 1.1-2.0 = resistant, 2.1-3.0 = moderately resistant, 3.1-4.0 = moderately susceptible and 4.1 -5.0 = susceptible (5).

RESULTS AND DISCUSSION

The mean disease score of the test entries ranged from 1.8 to 3.7 for MLB and 1.6 to 4.1 for BLSB whereas the susceptible check HKI 1105 has recorded 4.0 for MLB and 4.2 for BLSB (Fig. 2 and 4).

The evaluated inbred lines exhibited varied reactions against the MLB. Some lines also have also recorded varied disease score for MLB during the study period (Fig. 1 and 2), it may be because of climatic conditions. Three inbred lines viz. DQL 2015, DQL 2031 and DQL 2071 were having a disease score of 1.1 to 2.0 during both years i.e. 2013 and 2014, hence these lines were rated as resistant. Six inbred lines including DQL 2006, DQL 2009, DQL 2024, DQL 2025, DQL 2028, and DQL 2034 were found moderately resistant to maydis leaf blight exhibiting a score between 2.1 to 3.0. Two quality protein maize lines were reported to be moderately susceptible to the disease where maximum incidence was recorded on DQL 2048 (3.7) followed by DQL 2054. None of the line was

observed as highly susceptible to disease. In past also some workers have carried out such studies in normal maize for MLB using open pollinated varieties, hybrids and inbred lines. (6) evaluated twenty inbred lines and reported E-10 as resistant to maydis leaf blight and charcoal rot whereas (7) identified CM 104 and CM 105 as resistance sources to MLB. Recently, (8) has also reported maydis leaf blight in the range of 2.0 to 4.0 on seventeen QPM lines.

In second set also varied reactions (Fig. 3 and 4) were observed for BLSB, some of the lines have recorded different observations in different years. Only two lines i.e. DQL 2025 and DQL 2048 were found resistant having a disease score of 1.1 to 2.0, while five lines including DQL 2006, DQL 2009, DQL 2031, DQL 2054 and DQL 2071 behaved as moderately resistant to this disease. On the other hand inbred lines DQL 2015, DQL 2028 and DQL 2034 were observed under moderately susceptible category exhibiting the disease score between 3.1 to 4.0. The inbred line DQL 2024 exhibited maximum disease score of 4.1 which was very near to the score owned by susceptible check i.e. HKI 1105. The only line exhibiting susceptible reaction in both the years was DQL 2024, whereas the inbred line DQL 2025 was observed under resistant category in both

cropping years. Based on two years screening the lines showing resistance for both diseases are DQL 2006, DQL 2009, DQL 2025, DQL 2031 and DQL 2071. (9) analyzed 29 inbred lines of maize and found only one genotype (CA00106) as moderately resistance to BLSB and the remaining were highly susceptible. (10) also did multilocation screening of different maize genotypes for resistance to BLSB disease under artificial inoculation conditions and recorded 27% and 13% resistant lines at Pantnagar and Udaipur, respectively. Recently, (11) evaluated sixteen maize genotypes, including 12 inbred lines, where inbred line namely BH 11 showed moderate resistance to the disease. (12) have also reported some crosses viz., V348 x CM126, V354 x CM212, V356 x CM200, V356 x CM212 and KI-24 x CM200 as source of resistance to banded leaf and sheath blight.

CONCLUSION

In the present study, among the quality protein maize inbred lines, three lines (DQL 2015, DQL 2031 and DQL 2071) and two lines (DQL 2025 and DQL 2048) were found resistant against maydis leaf blight and banded leaf and sheath blight, respectively. DQL 2048 exhibited maximum susceptibility (3.7) score to MLB. In case of banded leaf and sheath blight maximum disease score (4.1) was exhibited by DQL 2024, hence rated as susceptible. These resistant and susceptible lines can be used for genetic studies or making RIL's for identification of the QTL's responsible for resistance/susceptibility and their use in future resistance breeding programme.

ACKNOWLEDGEMENTS

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PERFORMANCE OF KHARIF MAIZE GERMPLASMS AGAINST BANDED LEAF AND SHEATH BLIGHT DISEASE INCITED BY *RHIZOCTONIA SOLANI* F. SP. SASAKII

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ABSTRACT

Maize is the third most important cereal in India. It is attacked by several foliar pathogens in kharif among which *Rhizoctonia solani* f.sp. sasakii is important one causing severe yield losses. Field and laboratory experiments were conducted to find out source of resistance against the disease. Large number of promising inbred lines along with a few single cross hybrids developed at CCSHAU Regional Research Station, Karnal were screened against banded leaf and sheath blight disease under artificial inoculation conditions. Four inbred lines viz. HKI - 488WG, HKI - C-141, HKI - 1040-5 and HKI - 1347-4LT were found resistant during Kharif 2013 and 2014, while inbred line HKI - 164-7-2-1-2 was recorded as susceptible. Among the single cross hybrids, HM 11 showed resistant reaction to this disease.

Key words : *Rhizoctonia solani*, maize, resistance, banded leaf and sheath blight, inbreds, single cross hybrids

In Indian agriculture, maize occupies an important place. It is grown in more than 150 countries but the major producing countries are USA, China, Brazil, Mexico, France and India. It is being cultivated throughout the year in different seasons in one or the other part of the country. Recently demand of the maize is increasing due to expansion of maize based industries. In India maize occupies an area of 8.78 million hectares having production of 21.76 million tones with average productivity of 2.48 t/ha, whereas in Haryana the crop occupies an area of 11 thousand hectares having production of 30 thousand tones with average productivity of 2.73 t/ha (1). The average productivity of maize is very low in comparison to its potential. Maize crop is becoming popular in some regions in Haryana and replacing upland paddy due to keen attention of planners and farmers. Banded leaf and sheath blight is an important disease of maize and has been reported from states of Himachal Pradesh, Uttar Pradesh, Haryana, Punjab, Madhya Pradesh, Rajasthan, West Bengal, Meghalaya, Assam and Orissa (2). The crop is grown throughout the years where irrigation is available, but kharif maize is important in Haryana state. In recent years, incidence of banded leaf and sheath blight (BLSB) has been observed at many places in kharif season. Now the disease has attained damaging status and is economically very important as compared to other foliar diseases. The disease has rapidly gained importance in several parts of the world (3) and has potential to inflict economic losses up to 100 per cent (4). The Disease caused by *R. solani* is becoming an important disease in maize growing areas and becoming a constraint in cultivation of maize especially in seed production as inbred lines are more sensitive. Therefore, present investigation was carried out to find out sources of resistance against banded leaf and sheath blight disease.

MATERIALS AND METHODS

The performance of various germplasms of maize was tested at CCS Haryana Agricultural University Regional Research Station, Karnal situated at 29°43' North latitude and 76°58' East longitude at an altitude of 245 m above mean sea level. Thirty maize inbred lines and seven single cross hybrids developed at the station along with susceptible and resistant checks were sown during Kharif 2013 and 2014 in a paired row system with the row length of 4 m, spaced at 60 x 20 cm. The crop was raised by following all recommended practices, where recommended dose of fertilizer was applied and weeding was done manually. Two rows with mixture of highly susceptible genotypes HKI 1105 and HKI 536 CBT were planted after every 10th row in between the screening material. The infected plant parts were collected from previous/current years naturally infected plants and the moist sheath blight infected plant bits were placed at the junction of sheath and lower leaf. The diseases incidence was rated at dough stage on 1-5 scale as mentioned below (5) :

Highly Resistant (1.0) : Infection is on one leaf sheath, lesions are one or few, non-coalescent.

Resistant (1.1 – 2.0) : Infection is on two or three leaf sheaths, lesions are few and non-coalescent on third leaf sheath from ground level.

Moderately Resistant (2.1 – 3.0) : Infection is not up to the ear shoot, but on more than two leaf sheaths.

Moderately Susceptible (3.1 – 4.0) : Infection is on all leaf sheaths up to the ear shoot, but shank is not infected.

Susceptible (4.1 – 5.0) : Infection presents beyond the ear shoot, reduced ear size, husk leaves bleached and caked with or without sclerotial development, kernel formation absent or rudimentary.

Table-1 : Disease reaction of different inbred lines of maize against banded leaf and sheath blight disease at Karnal during kharif 2013 and 2014

Inbred lines	Disease score		Average
	2013	2014	
HKI - 1011	3.2	3.2	3.2
HKI - 1040-5	2.4	1.2	1.8
HKI - 1332	3.2	3.2	3.2
HKI - 1344	4.4	3.4	3.9
HKI - 1347-4LT	2.4	1.2	1.8
HKI - 1352	2.2	3.4	2.8
HKI - 1378	2.4	3.2	2.8
HKI - 139	2	3.2	2.6
HKI - 150	2.4	3.2	2.8
HKI - 164-4(1-3)	3.2	4.2	3.7
HKI - 164-7-2	4.4	3.2	3.6
HKI - 164-7-2-1-2	4.4	4.2	4.3
HKI - 164D-3-3	4.2	3.2	3.7
HKI - 191-1-2-5	3.2	3.2	3.2
HKI - 193-1	3.2	3.2	3.2
HKI - 209	3.4	4	3.7
HKI - 288-2	3.4	3.2	3.3
HKI - 295	3.2	3.2	3.2
HKI - 323	2.4	3.4	2.9
HKI - 325-17A	2.8	3.2	3
HKI - 325-17AN	3.2	3.4	3.3
HKI - 488 T-3	3.4	3.2	3.3
HKI - 488WG	1.4	1.4	1.4
HKI - 536YN	3.2	3.2	3.2
HKI - 766-2	3.4	3.2	3.3
HKI - 766RG	2.4	3.2	2.8
HKI - C-323	4.4	3.2	3.8
HKI - LM-16	3.2	3.2	3.2
HKI - C-141	1.4	2	1.7
HKI- MBR-139	2.4	3.2	2.8
Susceptible Check HKI 1105	4.2	4.2	4.2

RESULTS AND DISCUSSION

In total 30 elite inbred lines and 7 single cross hybrid developed at CCS HAU Regional Research Station, Karnal were screened against banded leaf and sheath blight during kharif 2013 and 2014 under artificial inoculation condition. In case of inbred lines, only four lines including HKI - 488WG, HKI- C-141, HKI - 1040-5 and HKI - 1347-4LT were found resistant to banded leaf and sheath blight disease (Table 1). The inbred lines namely HKI - 139, HKI - 1352, HKI - 1378, HKI - 150, HKI - 766RG, HKI- MBR-139, HKI - 323 and HKI - 325-17A were observed under moderately resistant category. The

remaining eighteen entries were found moderately susceptible to susceptible, where maximum disease score was recorded in case of HKI - 164-7-2-1-2 (4.3), followed by HKI - 1344 (3.9) and HKI - C-323 (3.8). The disease was observed in the range of 1.3 to 4.3.

The results presented in Table 2 revealed that the disease score varied in the range of 1.3 to 3.6 on the seven tested single cross hybrids. Only one hybrid namely HM 11 was found resistant to the disease exhibiting the lowest disease score (1.3). Four single cross hybrids including HQPM 1, HQPM 7, HM 6 and HKI 1040-7 X HKI 1128 showed moderately resistant reaction against BLSB caused by *Rhizoctonia solani*. HQPM 4 and HM 12 showed moderately susceptible reaction.

Several types of maize germplasm including cultivars, hybrids, inbred lines etc. have been evaluated by earlier workers also in order to find out the source of resistance. Recently, Madhavi et al. (2012) evaluated twelve inbred lines, where inbred line namely BH 11 showed moderate resistance to the disease. Some crosses viz. V348 x CM126, V354 x CM212, V356 x CM200, V356x CM212 and KI-24 x CM200 have been reported by (7) as source of resistance to banded leaf and sheath blight. Earlier, (8) analyzed 29 inbred lines of maize and observed that most of the lines were found highly susceptible, only one genotype namely CA00106 was found moderately resistance. (9) also did multiplication screening of different maize genotypes for resistance to BLSB disease under artificial inoculation conditions and recorded 27 % and 13 % resistant lines at Pantnagar and Udaipur, respectively. As has been observed in present studies, plant resistance to Indian pathotypes of *R. solani* has also been reported in some of the cultivars and inbred lines (10).

CONCLUSION

It may be concluded that among the inbred lines evaluated against banded leaf and sheath blight, four lines namely HKI - 488WG, HKI- C-141, HKI - 1040-5 and HKI - 1347-4LT showed resistant reaction against banded leaf and sheath blight incited by *Rhizoctonia solani*. Maximum inbred lines were observed under moderately susceptible category. Among the single cross hybrids HM 11 was found resistant to the disease, whereas hybrids like HQPM 7 and HM 6 showed moderately resistant reaction under artificial inoculation condition. HQPM 4 and HM 12 showed moderately susceptible reaction.

ACKNOWLEDGEMENTS

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Table-2 : Disease reaction of different single cross hybrids against banded leaf and sheath blight at Karnal during kharif 2013 and 2014

Single cross hybrids	Disease score		Average
	2013	2014	
HQPM 1	3.2	2.8	3
HQPM 4	3.4	3.8	3.6
HQPM 7	2.8	2.2	2.5
HM 11	1.4	1.2	1.3
HM 12	3.4	3.2	3.3
HM 6	2.4	3.2	2.8
HKI 1040-7 x HKI 1128	2.4	3.2	2.8
Susceptible Check HKI 1105	4.2	4.2	4.2
Resistant Check HKI 1128	2.0	1.6	1.8

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GENETIC VARIABILITY AND CHARACTER ASSOCIATION ANALYSIS FOR YIELD TRAITS IN FIELD PEA (*Pisum sativum* L.)

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ABSTRACT

The present experiment was conducted during November 2014–March 2015 in the department of Genetics and Plant Breeding research farm of College of Agriculture, I.G.K.V. Raipur. The experiment was done to estimate the variability and character association of different quantitative characters on seed yield of 29 field pea genotypes in a randomised complete block design (RCBD). The genotypes showed moderate to high level of genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance. The analysis of variance revealed that the sufficient variability was present in the material studied for almost all the quantitative except number of pods plant⁻¹. The phenotypic coefficient of variation was slightly higher in magnitude than the genotypic coefficient of variation for all the characters, indicating the influence of environment. The genotypic coefficient of variation was high for seeds/plant, seed yield/plant and biological yield. High heritability coupled with expected genetic advance was observed for 100-seed weight, number of seeds/pod, pod length and harvest index, indicating significance of additive genetic variance in genetic control of these traits. The correlation analysis revealed that seed yield plant⁻¹ exhibited a significant positive association with biological yield, number of pods/plant, number of seeds/pod, number of seeds/plant and pod length. Path coefficient analysis for seed yield and its components showed that direct selection for biological yield plant⁻¹, harvest index, number of pods/plant, number of seeds plant⁻¹ and number of seeds pod⁻¹ would likely to be effective in increasing seed yield in field pea.

Key words : Genetic variability, character association, yield traits, field pea.

Field pea (*Pisum stivum* L.) is a self-pollinated *rabi* pulse crop which is grown for food, feed and vegetables. There are two types of peas grown in India viz., grain type and Vegetable type. It is annual crop belongs to family Leguminosae. They are grown in higher altitudes in tropical areas with temperature ranging between 7-30°C. According to Indian Institute of Pulses Research's Vision document, India's population is expected to touch 1.68 billion by 2030 and the pulse requirement for the year 2030 is projected at 32 million tons with anticipated required annual growth rate of 4.2%. Therefore, there is need of high yielding variety of field pea having good quality of seed for the multiple purposes.

MATERIALS AND METHODS

The experimental material consisted of 29 (13 tall and 16 dwarf) field pea genotypes. The experiment was conducted in Randomized Complete Block Design with three replications. The row to row and plant to plant spacing were 30 cm and 10 cm, respectively and plot size of 4.8 m² (4m x 1.2m). The crop was grown in recommended agronomical package of practices. Observations on metric traits were recorded on single plant basis from five randomly selected competitive plants from each genotype in each replication. Thirteen characters days to 50% flowering, days to maturity, number of primary branches, leaflet length, leaflet width, number of pods/plant, number of seeds/pod, number of seeds/plant, 100-seed weight, pod length, seed yield/

plant, biological yield/plant and harvest index were recorded. Heritability in broad sense (h^2_{bs}) was calculated. The expected genetic advance was calculated by the formula given by (1). Path analysis by formula suggested by (2) and further elaborated by (3).

RESULTS AND DISCUSSION

Analysis of variance for all the characters except for number of pods/plant showed significant differences between the treatments viz., days to 50% flowering, days to maturity, primary branches/plant, leaflet length, leaflet width, number pods/plant, number of seeds/pod, number of seeds/plant, 100-seed weight, pod length, seed yield/plant, biological yield/plant and harvest index presented in Table-1. The phenotypic coefficient of variation was higher than genotypic coefficient of variation, which indicates less effect of environment on the expression of characters studied.

The genotypic coefficient of variation was recorded moderate for number of seeds/plant (17.747), seed yield/plant (16.730), biological yield/plant (16.718). number of primary branches/plant (13.970), pods/plant (13.10), 100-seed weight (11.432) and number of seeds/pod (11.010). Similar finding has also been reported by (4) for most of the characters. The phenotypic coefficient of variation was recorded high for number of pods/plant (26.516) followed by number of seed/plant (24.495), biological yield/plant (23.716) and seed yield/plant (23.536). Similar finding has also been reported by (5).

Table-1 : Analysis of variance for seed yield and its components in field pea.

Source of Variation	DF	Mean sum of squares												
		Days to 50% flowering	Days to maturity	No. of primary branches / plant	Leaflet length (cm)	Leaflet width (cm)	No. of pods/ plant	No. of seeds /pod	No. of seeds/ plant	100 seed weight (g)	Pod length (cm)	Seed yield/ plant (g)	Biological yield/ plant	Harvest index
Replication	2	2.625**	0.468	0.119	0.100	0.015	0.704	0.217	181.019**	0.003	0.010	14.842*	48.225*	2.203
Genotype	28	12.587**	8.680**	0.182**	0.530**	0.215**	3.516	1.184**	117.302**	15.162*	0.437**	3.869**	12.689*	51.296*
Error	56	0.156	0.257	0.038	0.132	0.062	3.023	0.086	27.185	0.026	0.023	0.952	3.202	0.731

*, **Significant at 5% and 1% level of probability, respectively.

Table-2 : Mean performance and genetic parameters of variation for seed yield and its components in field pea.

Characters	Mean	Range		GCV (%)	PCV (%)	h^2_{bs} (%)	GA	GA as % of mean
		Min.	Max.					
Days to 50% flowering	64.253	59.333	67.667	3.168	3.227	96.372	4.117	6.407
Days to maturity	95.138	90.00	98.00	1.761	1.840	91.589	3.303	3.472
No. of primary branches/plant	1.570	1.133	2.133	13.970	18.703	55.788	0.337	21.495
Leaflet length (cm)	5.303	4.500	6.133	6.865	9.706	50.021	0.530	10.002
Leaflet width (cm)	2.758	2.247	3.227	8.183	12.175	45.178	0.313	11.331
No. of pods/plant	6.733	5.000	8.933	6.019	26.516	5.153	0.190	2.815
No. of seeds/pod	5.497	4.133	6.600	11.010	12.230	81.056	1.122	20.420
No. of seeds/plant	30.883	16.333	39.867	17.747	24.495	52.494	8.180	26.488
100 seed weight (g)	19.649	16.153	24.759	11.432	11.461	99.489	4.615	23.489
Pod length (cm)	6.105	5.307	7.040	6.083	6.576	85.586	0.708	11.593
Seed yield/plant (g)	5.894	4.417	8.627	16.730	23.536	50.523	1.444	24.496
Biological yield/plant	10.637	7.760	15.853	16.718	23.716	49.689	2.582	24.276
Harvest index	55.727	46.961	63.211	7.367	7.525	95.843	8.280	14.858

High heritability was recorded for the characters viz., 100-seed weight (99.489) followed by days to 50% flowering (96.372), harvest index (95.843) days to maturity (91.58), pod length (85.59) and number of seeds pod⁻¹ (81.056). These are in agreement with the findings of (4) for most of the characters. The moderate heritability was observed for the characters viz., number of primary branches/plant (55.78) followed by seed yield/plant (50.52). Similar results were also reported by (6) branches/plant; (7) for seed yield. Genetic advance as percentage of mean was observed moderately high (20-30%) for number of seed/plant (26.49) followed by seed yield/plant (24.50), biological yield/plant (24.28), 100-seed weight (23.49) and number of primary branches/plant (21.50). Similar results were reported by (5). High heritability coupled with moderate genetic advance was recorded for 100-seed weight number of seeds/pod, pod length and harvest index. The characters showing high heritability estimates coupled with high genetic advance as percentage of mean indicates the preponderance of additive gene action and greater scope for improvement in these traits through selection.

Seed yield/plant had highly significant positive

correlation with biological yield, (0.915; 0.954), number of pods per plant, (0.771; 0.298), number of seeds/pod, (0.554; 0.314), number of seeds/plant (0.720; 0.596) and pod length (0.720; 0.596) at genotypic and phenotypic level respectively. Similar relationship was also reported by for pods/plant. Similar results reported by (6). Thus, it is clear from the present findings that for genetic improvement in seed yield in field pea, selection must be based on component characters viz., biological yield/plant, number of seeds plant, number of pods/plant, number of seeds/pod and pod length which had shown positive correlation with seed yield.

Based on direct and indirect effect recorded for the traits under present investigation, it was observed that the high positive direct effect on seed yield per plant was exhibited by biological yield/plant (0.924) followed by harvest index (0.364), number of seeds/pod (0.081), number of seeds/plant (0.074), days to 50% flowering (0.049), 100-seed weight (0.045) and number of pods/plant (0.002) The above findings of positive direct effect by various traits on seed yield/plant are in accordance with the findings of (7).

Table-7 : Genotypic path coefficient showing direct and indirect effects of different characters on seed yield/plant in field pea.

Characters	Days to 50% flowering	Days to maturity	No. of primary branches/plant	Leaflet length (cm)	Leaflet width (cm)	No. of pods/plant	No. of seeds/pod	No. of seeds/plant	100 seed weight	Pod length	Biological yield/plant	Harvest index	r _{yx}
Days to 50% flowering	0.049	-0.029	0.000	0.000	-0.002	-0.001	-0.027	-0.027	0.016	0.009	-0.057	0.099	-0.168
Days to maturity	0.028	-0.052	0.000	0.000	-0.010	0.001	-0.016	0.013	0.002	0.029	0.171	-0.198	-0.032
No. of primary branches/plant	-0.008	-0.005	0.001	0.000	-0.010	0.002	0.025	0.027	-0.009	0.006	0.080	0.061	0.171
Leaflet length (cm)	-0.005	-0.007	0.000	0.001	-0.035	0.002	0.019	0.033	0.006	-0.011	0.221	-0.119	0.105
Leaflet width (cm)	0.002	-0.013	0.000	0.001	-0.041	0.001	0.005	0.023	0.011	0.004	0.078	-0.190	-0.118
No. of pods/plant	-0.019	-0.020	0.001	0.001	-0.025	0.002	0.010	0.094	-0.042	0.052	0.696	0.022	0.771**
No. of seeds/pod	-0.016	0.010	0.000	0.000	-0.002	0.000	0.081	0.042	-0.004	-0.053	0.404	0.091	0.554**
No. of seeds/plant	-0.018	0.009	0.000	0.000	-0.013	0.003	0.046	0.074	-0.011	-0.018	0.691	-0.026	0.720**
100 seed weight (g)	0.017	-0.002	0.000	0.000	-0.010	-0.002	-0.006	-0.019	0.045	-0.013	0.042	-0.010	0.043
Pod length (cm)	-0.007	0.021	0.000	0.000	0.003	-0.002	0.060	0.019	0.008	-0.071	0.160	0.098	0.290**
Biological yield/plant	-0.003	0.010	0.000	0.000	-0.003	0.002	0.035	0.055	0.002	-0.012	0.924	-0.075	0.915**
Harvest Index	-0.013	0.028	0.000	0.000	0.021	0.000	0.020	-0.005	-0.001	0.019	-0.192	0.364	0.203

Diagonal values are direct effects, Residual effect = 0.0005 and r_{yx} : Genotypic correlation of seed yield components.

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IMPACT OF INTERCROPPING ON POPULATION BUILD-UP OF GRAM POD BORER (*Helicoverpa armigera*) IN PIGEONPEA

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ABSTRACT

Present investigation was planned on farmer's fields of district Deoria (U.P.) under traditional agriculture during 2010-11 and 2011-12. Results revealed sole pigeonpea harboured significantly higher population of *Helicoverpa armigera* larvae and pod damage as compared to intercropped pigeonpea with moong, turmeric, urd, groundnut and sorghum. Among the intercrops, pigeonpea intercropped with turmeric (1:1) recorded minimum pest load at all the days of observations and least pod damage per cent, followed by moong (1:3) and urd (1:3). Pigeonpea intercropped with groundnut (1:1) and sorghum (2:1) were considered least effective in both the respects among the intercrops evaluated.

Key words : Pigeonpea, pod borer, intercropping, pod damage, intercrops.

Pigeonpea pod borer (*Helicoverpa armigera*, Noctuidae: Lepidoptera) is the most dreaded insect pest of pigeonpea. It is present throughout the year completing up to seven generations by feeding on over 200 hosts [1]. It causes heavy losses up to 60 per cent with annual loss estimated to be US \$ 400 million in pigeonpea [2]. Sometimes their infestation level is so high that farmers don't get return even whatever they expend on seed. Insecticides are undoubtedly effective for averting the attack of this pest to some extent, but their widespread and indiscriminate use lead to resistance in insect, increase the cost of plant protection and also poisoning each and every component of the biosphere. Considering these ill effects of insecticides, it is imperative to integrate various alternative strategies and farmer's participation for the management of pod borer.

The agrotechniques play an important role in managing the pest population and favour its natural enemies build-up with least or without disturbing the environment. Farming system can be manipulated in variety of ways to reduce the severity of insect-pests. These manipulations are very much location specific and must be designed to fit within the local practices are customs. Intercropping offers excellent opportunity of ecological manoeuvring by bringing about changes in crop geometry and cropping system which may have economically relevant impact on pest damage.

Farmer's perception and adoption of cultural practices to overcome insect-pests damage are of great importance to develop sustainable management of *H. armigera*. The present work is an attempt in this direction to study the effect of various intercrops on pod infestation due to *H. armigera* in pigeonpea on farmer's fields.

MATERIALS AND METHODS

To know the impact of cultural practices adopted by

farmers to overcome damages due to *H. armigera* in pigeonpea, the experiment was planned on farmer's field under traditional agriculture. Since farmer's perception of the problem and potential solutions are the most important factor. First of all four blocks of district Deoria (eastern U.P.) were extensively surveyed to generate informations towards cultural practices adopted by farmers in pigeonpea. It revealed that most of the farmers relies on intercropping. So, the effort was made to know the role of intercrops in reducing attack of *H. armigera*. For this purpose four villages from each four blocks (Table-1) were selected. So that a total of 16 villages were surveyed. From each village available intercropped or sole pigeonpea fields (at least 4) were selected for observations for two consecutive years (2010-11 and 2011-12). Farmers were advised to avoid insecticide use. Available intercrops with pigeonpea were Sorghum, Moong, Urd, Turmeric and Groundnut (Table-1). Crops were sown in the first fortnight of July. Most popular variety of pigeonpea for this region "Bahar" was grown by farmers.

Observations were recorded after initiation of flower buds. Population of *H. armigera* larvae were recorded at fortnightly interval in intercropped pigeonpea as well as sole cropped pigeonpea from all selected plots of different blocks.

Observations on pod damage per cent were taken at the time of maturity of pigeonpea. About 800-1000 pigeonpea pods were collected from each farmer's field (Intercropped and sole) by stripping 2-3 twigs of 15-20 plants randomly from 10 different places of crop field. The healthy pods and pods damaged by *H. armigera* larvae were separated and on such basis per cent pod damaged were calculated.

The data obtained on larval population and per cent pod damage in various intercrops and sole crop in

Table-1 : Different blocks and villages of district Deoria under investigation.

District	Blocks	Villages	Intercrops (Pigeonpea:Intercrop) adopted by farmers
Deoria	1. Bhatni 2. Baitalpur 3. DesahiDeoria 4. Bhagalpur	Ahirauli, Amwa, Bardiha, Devghat Baitalpur, Badhya, Purwamehra, Luchchapar Haraiya, Dhamur, Sahodarpatti, Nautanhathiyagarh Bagahi, Bagha, Bhagalpur, Deorahi	1-Pigeonpea+Moong (1:3) 1-2-Pigeonpea+Turmeric (1:1) 3-Pigeonpea+Urd (1:3) 4-Pigeonpea+Groundnut (1:1) 5-Pigeonpea+Sorghum (2:1) 6-Sole Pigeonpea

Table-2 : Impact of Intercropping in pigeonpea during 2010-11

Treatment	Average larval population /10 plants							Pod Damage (%) **
	JAN*		FEB*		MAR*		APR*	
	I	II	I	II	I	II	I	
T ₁ = (Pigeonpea + Moong)	1.69 (1.47)	2.17 (1.63)	6.39 (2.62)	7.81 (2.88)	9.49 (3.16)	5.78 (2.50)	2.91 (1.84)	22.79 (28.51)
T ₂ = (Pigeonpea + Turmeric)	0.90 (1.18)	1.15 (1.28)	2.45 (1.71)	3.80 (2.07)	5.17 (2.38)	3.04 (1.88)	1.14 (1.28)	17.07 (24.40)
T ₃ = (Pigeonpea + Urd)	2.10 (1.61)	3.11 (1.90)	7.33 (2.79)	9.39 (3.14)	11.86 (3.51)	7.25 (2.78)	3.07 (1.75)	25.78 (30.51)
T ₄ = (Pigeonpea + Groundnut)	2.64 (1.77)	4.72 (2.28)	9.14 (3.10)	11.45 (3.45)	13.32 (3.71)	8.48 (2.99)	2.92 (1.84)	28.63 (32.34)
T ₅ = (Pigeonpea + Sorghum)	2.86 (1.83)	4.23 (2.17)	11.33 (3.43)	13.65 (3.76)	15.81 (4.03)	8.80 (3.04)	2.79 (1.81)	31.04 (33.85)
T ₆ = (Sole Crop)	4.41 (2.21)	5.96 (2.54)	14.77 (3.90)	19.18 (4.43)	20.87 (4.62)	14.12 (3.82)	6.59 (2.66)	36.38 (37.09)
SE±	0.10	0.18	0.23	0.22	0.20	0.12	0.12	0.89
CD @ (0.05)	0.21	0.39	0.49	0.47	0.42	0.26	0.25	1.89

*Figures in parentheses are

**Figures in parentheses are angular transformed value.

Table-3 : Impact of Intercropping in pigeonpea during 2011-12

Treatment	Average larval population /10 plants							Pod Damage (%) **
	JAN*		FEB*		MAR*		APR*	
	I	II	I	II	I	II	I	
T ₁ = (Pigeonpea+Moong)	2.88 (1.83)	3.73 (2.05)	8.31 (2.96)	10.31 (3.28)	12.32 (3.58)	7.39 (2.80)	2.61 (1.76)	21.48 (27.61)
T ₂ = (Pigeonpea+Turmeric)	1.43 (1.38)	2.26 (1.66)	3.70 (2.04)	5.69 (2.48)	7.04 (2.74)	2.66 (1.77)	1.27 (1.33)	18.79 (25.68)
T ₃ = (Pigeonpea+Urd)	4.07 (2.43)	5.29 (2.40)	10.12 (3.25)	13.09 (3.68)	14.16 (3.88)	7.61 (2.84)	3.52 (2.00)	23.91 (29.27)
T ₄ = (Pigeonpea +Groundnut)	4.93 (2.33)	6.27 (2.60)	11.86 (3.51)	14.65 (3.89)	17.12 (4.19)	8.10 (2.93)	3.39 (1.97)	27.55 (31.66)
T ₅ = (Pigeonpea +Sorghum)	5.85 (2.51)	6.62 (2.66)	14.23 (3.83)	17.47 (4.23)	19.52 (4.47)	9.35 (3.13)	3.04 (1.88)	29.80 (33.08)
T ₆ = (Sole Crop)	7.52 (2.83)	9.91 (3.22)	18.00 (4.30)	23.48 (4.89)	27.47 (5.28)	10.37 (3.29)	3.76 (2.06)	35.84 (36.77)
SE±	0.03	0.07	0.10	0.06	0.14	0.17	0.07	1.02
CD @ (0.05)	0.08	0.15	0.21	0.13	0.30	0.36	0.15	2.19

*Figures in parentheses are

**Figures in parentheses are angular transformed value.

different villages of particular block was pooled. The intercropped and sole pigeonpea of a block was considered one replication. So that four blocks

represented four replications the statistical analysis was done accordingly. The data were transformed before statistical analysis.

RESULTS AND DISCUSSION

Attempt has been made in present investigation to know the effect of different intercrops on population build-up and extent of pod damage in pigeonpea due to *H. armigera*. It is evident from data presented in table-2 and 3 that there were significant variation in population build-up of *H. armigera* among different treatment at all the days of observations in both the years. Initially population level of larvae were low but increased subsequently and reached its peak on first fortnight of March in all the treatments, followed by decreased in both the years.

H. armigera larvae were recorded significantly higher on sole crop as compared to intercropped pigeonpea at all the intervals in both the years. Among the intercrops, pigeonpea intercropped with turmeric recorded minimum pest load at all the days of observations in both the years. This treatment combination was found most promising in present investigation. Lower incidence might be due to a volatile compound "Curcumin" a terpenoid alter the microclimate made unfavourable for the pest. Present findings are greatly supported by [3]. Next effective intercrops in order against pod borer were pigeonpea with mungbean (1:3), urdbean (1:3), groundnut (1:1) and sorghum (2:1). Variation in larval population in pigeonpea intercropped with moong and urdbean were found nonsignificant in almost all the days of observations in both the years. So, both the intercrops of pigeonpea were considered equally effective against pod borer. Other intercrops of pigeonpea viz. groundnut and sorghum were considered comparatively less effective against *H. armigera* in present investigation, but were significantly superior over sole pigeonpea in both the years. These findings are also supported [4] and [5].

Per cent pod damage in pigeonpea also influenced by intercropping. Significantly reduced pod damage per cent were observed in all the intercropped pigeonpea over sole crop in both the years. It was minimum in pigeonpea intercropped with turmeric in both the years (17.07% and 18.79%). It was followed by pigeonpea intercropped with moong and urdbean. Among the intercrops pigeonpea intercropped with sorghum recorded maximum pod

damage in both the years. The impact of intercropping over sole crops in reducing pod damage had also been reported.

The trend of pod damage in sole as well as intercropped pigeonpea exhibited the population build-up of larvae, earlier recorded. According this fact the number of *H. armigera* larvae proportionate the extent of pod damage. So, the population recorded maximum on sole pigeonpea, maximum was the pod damage. Similarly, it was lowest in intercropped pigeonpea with turmeric, resulted in lowest pod damage. Intercroppings influence the pest population build-up by leading a change in crop canopy, constituting a heterogenous agroecosystem against pest survival and offering a better niche for the activities of biotic agents regulating the pest population.

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STUDIES ON INTEGRATED NUTRIENT MANAGEMENT IN WHEAT

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ABSTRACT

Field experiments were conducted at the Agronomy Research Farm, Kisan (P.G.) College, Simbhaoli Ghaziabad (U.P.) during rabi seasons of 2007-08 and 2008-09. The experimental site had a subtropical climate with a hot and dry summer, very cold winter and mild to heavy rains. The soil was sandy loam in texture, well drained and of medium fertility with slightly alkaline in reaction. It was poor in organic carbon with low to medium in fertility status. Among the different sources of nitrogen, application of 150 kg N /ha (T₇) recorded higher grain yield followed by 100 kg N /ha (T₆) and combination of 50 kg N /ha + Azotobactor + 5 t FYM /ha (T₁₀) and 50 kg N/ha + Azospirillum + 5 t FYM /ha (T₁₁). Nitrogen (N) uptake and protein yield were higher with application of 150 kg N /ha (T₇) followed by 50 kg N /ha + Azotobactor + 5 t FYM /ha (T₁₀) and 50 kg N /ha + Azospirillum + 5 t FYM /ha (T₁₁). Azotobactor (T₂) and Azospirillum (T₃) could increase the yield of wheat as compared to control (T₁). But their conjunctive use with nitrogen (N) and farm yard manure (FYM) was found to be more economical. Agronomic efficiency (AEN) and apparent nitrogen recovery (ANR) were higher with 50 kg N /ha + Azotobactor + 5 t FYM /ha (T₁₀) and 50 kg N /ha + Azospirillum + 5 t FYM /ha (T₁₁) and also with lower doses of nitrogen (N) viz. 50 kg N /ha (T₅).

Key words : Integrated nutrient management, azotobactor, azospirillum, farm yard manure, growth and yield attributes, wheat.

Wheat (*Triticum aestivum* L.) is grown in an area of 29.3 million hectares with a total production of 85.9 million tonnes at an average yield of 2938 kg/ha in India. In the Indo-Gangetic plains it is grown with the use of high analysis chemical fertilizers alone in the last several years causing wide spread deficiency of nutrients. The declining nutrient supplying capacity and deficiency of several nutrients in the wheat growing areas has been observed to be one of the major reasons for the lowering of average yield of the crop in many areas in the northern India. The first and most immediate attention should be given to nutrient management to sustain and increase the productivity of wheat and also to reduce the cost of production by reducing the use of costly chemical fertilizers. The technique of soil fertility management is one of the critical components of any cropping system designed to enhance and sustain productivity. Therefore, the technology adaptation for correct dose of fertilizer that can assure economic optimum crop yield as well as sustain soil nutrient reserve, yet not environmentally degrading in the long run is the need of time. Further, the rise in the prices of chemical fertilizers has made them unaffordable to many small and marginal farmers. Even the resource rich farmers are feeling that their use is resulting in reduced factor productivity. Nutrient needs of crop plants can be met through a number of sources viz., chemical fertilizers, organic manures, recycled wastes and by-products, biological nitrogen fixation (BNF), natural minerals and to a lesser extent nutrients recycled through irrigation waters and precipitation. These supplement the soil nutrient reserves for nourishing the crops. The organic and biological sources of nutrients

have low nutrient contents and are usually not abundantly available. An enormous amount of organic fertilizer would be required to maintain soil fertility levels. Therefore, a combination of both inorganic and organic fertilizers is the answer for sustainability. The integrated plant nutrition system (IPNS) involves judicious combination of fertilizer, biofertilizers and organic manures. The conjunctive use of various sources of nutrients including chemical, biological and organic sources of nutrient is one of the options available for mitigating the nutrient deficiencies in many areas. Therefore it is necessary to compare various organic manures with chemical fertilizers to find the most effective combination.

MATERIALS AND METHODS

A two year field experiments were conducted at the Agronomy Research Farm, Kisan (P.G.) College, Simbhaoli Ghaziabad (U.P.) during rabi seasons of 2007-08 and 2008-09. The experimental site had a subtropical climate with a hot and dry summer, very cold winter and mild to heavy rains. The soil was sandy loam in texture, well drained and of medium fertility with slightly alkaline in reaction. It was poor in organic carbon with low to medium in fertility status. The treatments consisted of different combinations of sources and levels of nitrogen viz., control (T₁), Azotobactor (T₂), Azospirillum (T₃), farm yard manure (FYM) @ 5 t/ha (T₄), 50 kg N/ha (T₅), 100 kg N /ha (T₆), 150 kg N /ha (T₇), 50 kg N /ha + Azotobactor (T₈), 50 kg N/ha + Azospirillum (T₉), 50 kg N/ha + Azotobactor + 5 t FYM /ha (T₁₀) and 50 kg N/ha + Azospirillum + 5 t FYM /ha (T₁₁). These 11 treatments were tried in randomized block design replicated thrice.

Table-1 : Growth attributes of wheat at harvest as influenced by nutrient management practices.

Treatment	Plant height (cm)		Tillers/half m row		DM/ half m row (g)		Days to 50% flowering	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Control	94.03	94.77	40.90	40.30	96.17	97.01	122.00	125.33
<i>Azotobacter</i> (Azot.)	99.17	98.71	42.60	44.20	105.63	98.87	126.33	125.99
<i>Azospirillum</i> (Azos.)	99.93	97.86	42.23	45.07	104.37	98.79	127.00	125.66
Farm yard manure (FYM) @ 5 t/ha	101.97	106.97	46.17	49.83	107.62	107.66	128.00	127.82
50 kg N/ha	100.50	107.74	46.50	50.92	108.60	106.35	128.00	128.15
100 kg N/ha	102.53	118.56	51.17	54.60	116.83	117.73	126.00	129.64
150 kg N/ha	106.73	129.68	55.97	55.90	126.95	122.75	127.67	130.67
50 kg N/ha + Azot.	102.77	112.61	48.60	53.73	112.23	112.28	126.67	126.99
50 kg N/ha + Azos.	103.60	110.37	47.63	53.73	110.92	110.97	126.67	127.98
50 kg N/ha + Azot. + 5 t FYM/ha	105.23	117.86	50.87	54.17	116.23	119.68	127.33	129.49
50 kg N/ha + Azos. + 5 t FYM/ha	104.27	117.94	50.90	53.73	115.23	119.02	127.67	128.99
SEm±	0.67	0.77	0.33	0.49	0.97	0.75	0.76	1.89
LSD (p = 0.05)	1.97	2.26	0.98	1.46	2.85	2.21	2.23	5.59

Table-2 : Yield attributes of wheat at harvest as influenced by nutrient management practices.

Treatment	2007-08					2008-09				
	Ears/half m row	Ear wt/half m row	Ear length (cm)	Spikelets/ear	Test weight (g)	Ears/half m row	Ear wt/half m row	Ear length (cm)	Spikelets/ear	Test weight (g)
Control	29.40	69.80	7.87	13.53	41.33	28.68	68.60	6.77	13.57	40.30
<i>Azotobacter</i> (Azot.)	33.33	78.80	8.12	14.60	41.80	32.38	77.78	7.30	15.32	43.56
<i>Azospirillum</i> (Azos.)	33.53	76.67	8.17	14.50	42.40	31.51	78.24	7.25	14.91	42.87
Farm yard manure (FYM) @ 5 t/ha	35.47	85.13	8.28	15.73	44.07	34.99	82.76	7.87	16.55	45.57
50 kg N /ha	34.33	84.40	8.16	17.73	44.70	34.68	80.11	8.87	16.41	47.28
100 kg N /ha	39.40	89.47	8.95	18.93	46.63	36.77	91.93	9.47	17.40	48.20
150 kg N /ha	43.67	100.30	9.70	19.23	48.03	41.22	101.89	9.61	19.50	48.93
50 kg N /ha + Azot.	37.73	84.67	9.09	18.87	46.80	34.79	88.04	9.43	16.46	47.28
50 kg N /ha + Azos.	37.27	85.07	8.89	18.87	46.10	34.96	86.96	9.43	16.54	47.02
50 kg N /ha + Azot. + 5 t FYM /ha	39.87	90.33	9.17	18.84	47.80	37.12	93.02	9.42	17.56	48.20
50 kg N /ha + Azos. + 5 t FYM /ha	39.67	88.33	8.96	18.92	47.53	36.30	92.56	9.46	17.18	48.11
SEm±	0.52	1.33	0.13	0.33	0.33	0.55	1.21	0.16	0.26	0.44
LSD (p=0.05)	1.53	3.92	0.37	0.96	0.97	1.61	3.56	0.48	0.76	1.31

The treatment plots were 8 m x 3.6 m in size. Wheat var. "Shresth (HD 2687)" was used as test crop. The crop was raised as per the recommended package of practices except the treatments. The experiment was carried out as per the normal procedures for standard agronomic trial. The crop was quite normal and the influence of the treatments was not affected by any other extraneous factors like adverse climate or incidence of pests and diseases etc. All the growth and yield parameters were recorded at regular interval as per the standard procedures and they were analyzed as per the analysis of variance (ANOVA) technique and the critical differences between the treatments were worked at 0.05 probability. The economics were worked out using the prevailing market prices for both inputs and outputs. The chemical analysis of plant and soil was carried out to work out the nutrient

uptake and soil nutrient availability status after the harvest of crops in both the years.

RESULTS AND DISCUSSION

Growth attributes : The plant height was significantly influenced by the nutrient management practices (Table 1). The application of 150 kg N /ha recorded higher plant height. As nitrogen is very critical for initial growth, its sufficient availability will play a pivotal role and acts as precursor for many other growth activities. Thus the nutrient management practices involving higher nitrogen content increased the yield. Conversely the plant height was the lowest in the no nitrogen applied control. Similarly the control with no nutrient application recorded the lowest drymatter accumulation among all the treatments. As nutrients play a crucial role in both these parameters, the absence of nutrients in the initial stage

Table-3 : Biological yield, grain yield, straw yield (t/ha) and harvest index (%) of wheat as influenced by nutrient management practices.

Treatment	2007-08				2008-09			
	Biological yield	Grain yield	Straw yield	Harvest index	Biological yield	Grain yield	Straw yield	Harvest index
Control	7913	3085	4829	38.99	8568	3272	5296	38.25
<i>Azotobacter</i> (Azot.)	7961	3236	4725	40.65	9058	3484	5574	38.46
<i>Azospirillum</i> (Azos.)	7860	3224	4637	41.02	9018	3455	5563	38.35
Farm yard manure (FYM) @ 5 t/ha	8169	3432	4737	42.02	10249	4150	6100	40.49
50 kg N/ha	8156	3450	4706	42.30	10319	4070	6249	39.46
100 kg N/ha	9997	4305	5692	43.07	10575	4374	6201	41.37
150 kg N/ha	10416	4621	5795	44.37	10805	4529	6276	41.92
50 kg N/ha + Azot.	10005	4278	5727	42.77	10401	4213	6187	40.51
50 kg N/ha + Azos.	9955	4230	5725	42.50	10402	4199	6202	40.37
50 kg N/ha + Azot. + 5 t FYM /ha	9993	4310	5683	43.13	10542	4342	6200	41.20
50 kg N/ha + Azos. + 5 t FYM /ha	10004	4304	5700	43.03	10594	4326	6268	40.83
SEm+	101	29	83	0.32	180	60	143	0.53
LSD (p=0.05)	298	86	244	0.95	533	177	423	1.56

Table-4 : Total N, P and K uptake (kg/ha) of wheat as influenced by nutrient management practices.

Treatment	2007-08			2008-09		
	N	P	K	N	P	K
Control	93.69	12.39	75.20	100.83	13.39	82.37
<i>Azotobacter</i> (Azot.)	95.48	12.81	74.28	106.87	14.34	86.65
<i>Azospirillum</i> (Azos.)	94.01	12.88	72.94	105.70	14.37	87.26
Farm yard manure (FYM) @ 5 t/ha	100.26	13.70	75.31	124.35	17.10	97.52
50 kg N/ha	100.73	13.71	74.87	124.74	16.84	98.75
100 kg N/ha	125.92	16.85	91.24	131.52	17.70	98.51
150 kg N/ha	134.31	18.01	93.66	136.84	18.34	100.42
50 kg N/ha + Azot.	123.71	16.86	91.54	126.46	17.22	98.17
50 kg N/ha + Azos.	122.75	16.74	90.73	126.24	17.17	98.42
50 kg N/ha + Azot. + 5 t FYM /ha	125.55	17.02	91.23	130.55	17.75	99.25
50 kg N/ha + Azos. + 5 t FYM /ha	123.55	16.87	91.12	128.74	17.60	99.40
SEm+	1.15	0.13	1.08	2.03	0.27	2.13
LSD (p=0.05)	3.39	0.37	3.18	5.98	0.80	6.29

itself affected both plant height and drymatter accumulation. This was further confirmed when both plant height and drymatter accumulation were observed to be significantly higher with the application of nutrients in the treatments viz. 150 kg N/ha, 100 kg N/ha (T_6), 50 kg N/ha + *Azotobacter* + 5 t FYM/ha and 50 kg N/ha + *Azospirillum* + 5 t FYM/ha. This is in conformity with the findings of (1). The seed treatment with biofertilizers viz. *Azotobacter* and *Azospirillum* although increased the plant height and drymatter accumulation as compared to control it was not comparable with other treatments. Since the biological nitrogen fixation starts after initial growth and ceases early, it may not be sufficient alone. However its conjunctive use could be more effective as observed in 50 kg N/ha + *Azotobacter* and 50 kg N/ha + *Azospirillum* showing higher plant height and drymatter accumulation. Likewise the farm yard manure (FYM) as source of nutrients is another factor that also influences the other

soil biological as well as chemical conditions leading to higher growth. The number of tillers in a plant is another indicator as to how the plant growth system is conditioned by the nutrient management practices. As the tillering habit follows a particular phasic manner, within that the nutrient application shows the response. The nitrogen being a major nutrient it recorded higher tiller number at the highest level of nitrogen, indicating the higher requirement of nitrogen for cereals. The biofertilizers, farm yard manure (FYM) and conjunctive use of nitrogen and biofertilizers however could not match the nutrient demand of the crop for effecting higher tillers per half meter row. The days to 50% flowering and physiological maturity in wheat were affected significantly by the nutrient management practices. The days to flowering and physiological maturity also got influenced by the overall pattern of growth and growing conditions prevailing. The control recorded significantly fewer days to 50% flowering

Table-5 : Protein content (%), protein yield (kg/ha) in grains of wheat and agronomic efficiency of nitrogen (AEN)(kg grain/kg N) and apparent nitrogen recovery (ANR) (%) as influenced by nutrient management practices

Treatment	2007-08		2008-09		2007-08		2008-09	
	Protein content	Protein yield	Protein content	Protein content	AEN*	ANR*	AEN*	ANR*
Control	9.04	278.71	9.01	294.84	-	-	-	-
Azotobactor (Azot.)	9.05	292.75	9.03	314.68	-	-	-	-
Azospirillum (Azos.)	9.01	290.37	9.01	311.43	-	-	-	-
Farm yard manure (FYM) @ 5 t/ha	9.16	314.29	9.11	377.94	-	-	-	-
50 kg N/ha	9.20	317.35	9.14	371.94	17.31	47.81	15.96	44.06
100 kg N/ha	9.34	402.22	9.29	406.49	12.20	30.68	11.03	32.22
150 kg N/ha	9.47	437.82	9.46	428.61	10.24	24.00	8.38	27.07
50 kg N/ha + Azot.	9.18	392.66	9.16	386.07	23.87	51.25	18.83	60.03
50 kg N/ha + Azos.	9.18	388.36	9.16	384.84	22.91	50.81	18.55	51.38
50 kg N/ha + Azot. + 5 t FYM/ha	9.32	401.60	9.30	403.82	24.51	59.43	21.41	63.72
50 kg N/ha + Azos. + 5 t FYM/ha	9.17	394.62	9.18	396.96	24.39	55.81	21.08	59.72
SEm+	0.04	2.81	0.03	6.02				
LSD (p=0.05)	0.11	8.29	0.09	17.77				

*Mean of 3 replications.

Table-6 : Organic carbon (OC), N, P and K balance in soil after the harvest of wheat as influenced by nutrient management practices.

Treatment	2007-08				2008-09			
	OC	N	P	K	OC	N	P	K
Control	-0.037	-19.00	-0.12	-0.36	-0.012	-19.00	-0.14	-1.59
Azotobactor (Azot.)	-0.030	-12.67	-0.02	1.59	-0.013	-12.82	-0.10	-0.54
Azospirillum (Azos.)	-0.032	-11.33	-0.01	1.82	-0.014	-14.82	-0.05	-0.32
Farm yard manure (FYM) @ 5 t/ha	0.003	-10.00	0.16	5.26	0.001	9.78	0.15	2.98
50 kg N /ha	-0.028	-12.33	-0.02	1.69	-0.008	-11.48	0.10	-0.45
100 kg N /ha	-0.027	-6.67	-0.06	0.71	-0.002	-10.64	0.23	-1.39
150 kg N /ha	-0.021	1.00	0.04	2.84	-0.001	2.85	0.27	1.84
50 kg N /ha + Azot.	-0.028	-8.33	-0.04	1.31	-0.008	-11.76	0.11	-0.82
50 kg N /ha + Azos.	-0.029	-10.00	0.02	2.34	-0.007	-12.04	0.13	0.18
50 kg N/ha + Azot. + 5 t FYM /ha	0.006	-1.33	0.14	4.88	0.003	8.81	0.23	2.61
50 kg N/ha + Azos. + 5 t FYM /ha	0.005	-2.00	0.07	3.33	0.001	7.36	0.13	1.13
SEm+	0.003	1.66	0.07	1.35	0.003	2.77	0.10	1.12
LSD (p=0.05)	0.009	4.92	NS	NS	0.010	8.17	NS	NS

as compared to all other treatments. The rest of the treatments recorded statistically similar number of days to 50% flowering. And among them the highest number of days for 50% flowering was noticed in treatments 150 kg N /ha and 50 kg N /ha + Azospirillum + 5 t FYM /ha. This is in conformity with the findings of (1).

Yield attributes : All the yield attributes under observation viz. number of ears per half meter row, weight of ears per half meter row, ear length, number of spikelets per ear and test weight in wheat were significantly influenced by the application of nutrients as compared to control (Table 2). Wheat is basically a very exhaustive crop needing sufficient nutrient supply for full expression of its potential. Thus the application of 150 kg N/ha showed the highest values in all these parameters. The conjunctive use of nitrogen, biofertilizers and farm yard manure (FYM)

further recorded higher values of these parameters. The biofertilizers alone or farm yard manure (FYM) alone could not really match the nitrogen requirement of the crop thus were able match the performance of yield attributes observed in the 150 kg N/ha or the 50 kg N/ha + Azotobactor + 5 t FYM/ha or 50 kg N/ha + Azospirillum + 5 t FYM /ha. The control with no added nitrogen showed the lowest values of these parameters. However the magnitude of difference was not as expected it may be due to the fact that the control also received same quantum of other nutrients at par with other treatments except the nitrogen.

Yield and harvest index of wheat : The biological yield, grain yield, straw yield and harvest index were all significantly influenced by the nutrient management practices (Table-3). The highest biological yield was

Table 7 : Cost of cultivation, gross return, net return and benefit-cost ratio in wheat as influenced by nutrient management practices.

Treatment	2007-08				2008-09			
	Cost of cultivation	Gross return	Net return	B : C ratio	Cost of cultivation	Gross return	Net return	B : C ratio
Control	19100	41845	22745	1.19	19100	44557	25457	1.33
<i>Azotobacter</i> (Azot.)	19100	43553	24453	1.28	19100	47382	28282	1.48
<i>Azospirillum</i> (Azos.)	19100	43321	24221	1.27	19100	47027	27927	1.46
Farm yard manure (FYM) @ 5 t/ha	19100	45921	26821	1.40	19100	55896	36796	1.93
50 kg N /ha	19100	46110	27010	1.41	19100	55087	35987	1.88
100 kg N/ha	19100	57352	38252	2.00	19100	58695	39595	2.07
150 kg N/ha	19100	61247	42147	2.21	19100	60629	41529	2.17
ar50 kg N/ha + Azot.	19100	57063	37963	1.99	19100	56745	37645	1.97
50 kg N/ha + Azos.	19100	56489	37389	1.96	19100	56594	37494	1.96
50 kg N/ha + Azot. + 5 t FYM /ha	19100	57407	38307	2.01	19100	58304	39204	2.05
50 kg N/ha + Azos. + 5 t FYM /ha	19100	57352	38252	2.00	19100	58178	39078	2.05
SEm±		398	398	0.02		798	798	0.04
LSD (p=0.05)		1174	1174	0.06		2356	2356	0.12

recorded by the application of 150 kg N/ha. The lowest biological yield was recorded by control. The grain yield was higher with the application of 150 kg N /ha followed by application of 100 kg N /ha, 50 kg N /ha + Azotobacter + 5t FYM/ha and 50 kg N/ha + Azospirillum + 5t FYM/ha. The control recorded the lowest grain yield in both the years of experimentation. The highest straw yield was observed with the application of 150 kg N/ha in both the years and it was par with 100 kg N/ha, 50 kg N/ha + Azotobacter, 50 kg N /ha + Azospirillum, 50 kg N/ha + Azotobacter + 5t FYM/ha and 50 kg N/ha + Azospirillum + 5t FYM/ha. The harvest index too was significantly higher with the application of 150 kg N/ha. Under ideal conditions of nutrient management practices, the crops extract the nutrient to reach maximum yielding potential as was observed with 150 kg N/ha. The yield is the culmination of all the growth and yield attributes. Since this treatment did consistently well in growth and yield parameters it got translated in to high yielding as well. Further, the higher harvest index indicates as how much a crop can translocate to economic parts, in this case the grains of wheat. The higher harvest index due to conjunctive use of nitrogen, biofertilizers and farm yard manure (FYM) clearly indicated the usefulness of the combined application of organic and inorganic sources of nutrients as compared to only sole nutrient source even under higher levels as in 100 kg N /ha.

N, P and K uptake : The total uptake of N, P and K was significantly influenced by the nutrient management practices (Table 4). Application of 150 kg N /ha recorded higher values as compared all other treatments. The application of 100 kg N /ha, 50 kg N /ha + Azotobacter + 5 t FYM /ha and 50 kg N /ha + Azospirillum + 5t FYM/ha

were next in order. The biofertilizers recorded higher values as compared to control. The application of farm yard manure (FYM) @ 5 t/ha and 50 kg N/ha being at par recorded higher values over biofertilizers. The conjunctive use of 50 kg N/ha + Azotobacter and 50 kg N/ha + Azospirillum being at par recorded significantly higher N, P and K uptake as compared to application of 100 kg N /ha alone. This clearly shows that combination of sources would be more useful as compared to individual sources. The lowest N, P and K values were observed in control. This is mainly due to the fact that this treatment did not provide the sufficient quantity of nutrients and also did not achieve higher yields. As the uptake is the function of higher nutrient content and yield, lower values observed in both the factors resulted in lower uptake of nutrient in this treatment. Similarly higher nutrient uptake with higher levels of nitrogen (2,3).

Protein content and yield; agronomic efficiency and apparent nitrogen recovery : The protein content in grains of wheat was significantly higher in treatment receiving 150 kg N/ha (Table 5). It was closely followed by 100 kg N /ha and 50 kg N/ha + Azotobacter + 5 t FYM/ha. The protein yield was highest with the application of 150 kg N /ha it was followed by 100 kg N/ha and 50 kg N/ha + Azotobacter + 5 t FYM/ha. The lowest protein yield was observed in control. As nitrogen is the base material for the protein synthesis, application of higher quantity of nitrogen in 150 kg N /ha recorded higher N content and also incidentally the same treatment recorded higher yield, both protein content and higher protein yield were observed in this treatment. Although other treatments recorded higher protein content and yield they could not match this treatment. The agronomic efficiency was

higher with 50 kg N/ha + Azotobacter + 5 t FYM/ha. It was followed 50 kg N/ha + Azospirillum + 5t FYM/ha and 50 kg N /ha + Azotobacter. The lowest agronomic efficiency was recorded with the application of 150 kg N/ha. As the nitrogen dose increases the yield per nutrient decreases, thus although the 150 kg N /ha recorded higher yield the agronomic efficiency was lower. On the contrary, the 50 kg N /ha + Azotobacter + 5 t FYM /ha and the 50 kg N /ha + Azospirillum + 5 t FYM /ha with lower amount of nitrogen recorded higher agronomic efficiency. The apparent nitrogen recovery too exhibited similar trend as observed in the agronomic efficiency. This is again due to the fact that higher uptake of nitrogen was possible in lower doses and while higher doses did not match the uptake proportionately.

OC, available N, P and K balance in soil : The highest organic carbon and available nitrogen balance in soil were observed with the application of nutrients as combination of organic and inorganic sources as in the of treatments 50 kg N/ha + Azotobacter + 5 t FYM/ha, 50 kg N /ha + Azospirillum + 5 t FYM/ha (Table-6). The lowest values were observed in control where no nutrients were applied. It clearly indicated the fact that in the presence of supplemented nutrients, the depletion of nutrients from the soil will be less. The highest negative balance observed in control could be attributed to the fact that the crop removed a large quantity of nutrient albeit less as compared to other treatments but entirely from the soil's own sources depleting it considerably. The nutrient management treatments did not affect the balance of P and K after the harvest of wheat as the crop received all the nutrients viz., P and K at par in all the treatments. There could not be much of a difference.

Economics : The gross expenditure remained same for both the years this is attributed to the fact that there was

no cost variation in the treatments in both the years (Table 7). The gross returns, net returns and B:C ratio were higher in treatment receiving 150 kg N /ha. It was followed by application of 100 kg N/ha, 50 kg N/ha + Azotobacter + 5 t FYM /ha and 50 kg N /ha + Azospirillum + 5 t FYM/ha. The lowest values of gross returns, net returns and B:C ratio were recorded in control. The highest returns and B:C ratio in 150 kg N/ha could be attributed to the fact that it recorded higher grain yield that too with the lowest cost of cultivation. Further the conjunctive use of biofertilizers, nitrogen and farm yard manure (FYM) could yield fairly well, but the fact that the cost of farm yard manure (FYM) was relatively higher and that resulted in higher cost of cultivation and reduced the B:C ratio. Similarly higher nutrient uptake with higher levels of nitrogen (4,5).

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BODY CONDITION SCORES AND BLOOD BIOCHEMICAL PROFILE IN NORMAL AND REPEAT BREEDING CROSSBRED DAIRY COWS

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The priority of modern breeding programmes is keeping dairy cows in high lactation and healthy state. Repeat breeding has been a major hindrance in the breeding programmes of crossbred dairy cows leading to high culling rates of valuable germplasm. Higher production has been associated with lower reproductive function in cattle (1). The reasons may be multifarious including negative energy balance, nutrient intake/assimilation leading to reproductive system malfunctioning. Serum glucose is an index of energy status while transaminases and phosphatases maintain homeostasis (2). BCS is an important indicator of animal health and nutrition. It was reported that BCS and body weights were fair indicators for postpartum reproductive performance in cattle (3). The present investigation was undertaken to assess the BCS, body weight, blood metabolites and enzymes in the repeat breeding and normal crossbred dairy cows.

The present studies were conducted at the Dairy Research Farm, GADVASU, Ludhiana (Punjab). Fifteen normal and eight repeat breeding crossbred dairy cows with $82.92 \pm 2.03\%$ exotic inheritance at the same lactation stage were taken for the experiment. Animals having undergone >3 services and failed to conceive were termed as repeat breeders. All the animals were maintained under similar managemental conditions. Body condition scores were recorded by making a skin fold in the loin region and rated as (0-5 scale). Three samples of 10 ml of blood for each animal were collected at weekly intervals from jugular vein at 100-120 days post partum. Serum was separated by centrifugation at 1700 g for 15 min and frozen at -20°C till analysis. Serum samples were analyzed for SGOT, SGPT, ALP and glucose by Chemistry Analyzer, using Autopak reagent kits (Bayer Diagnostic Pvt. Ltd.). Records of milk production corresponding to the previous fortnight were used for the studies. The data were analyzed for analysis of variance and correlation coefficients using SPSS.

Normal reproducing cows had significantly higher ($P < 0.01$) BCS (3.56 ± 0.15) than repeat breeders (2.70 ± 0.26). The findings were in agreement with (4) who also observed significant effect of BCS at calving on consequent reproductive performance in cattle and better metabolic status in cows having BCS > 3.25. In the

present investigation, BCS in the normal animals were found to be quite close to the recommended value of 3.5 (5). It was reported that cows losing one unit or more BCS during early lactation are at greater risk for low fertility and conception rates (6) and the BCS after parturition could be used as a management tool to prevent reproductive problems in top production dairy herds (7).

Least square means for fortnightly milk yield were higher in repeat breeders (262.32 ± 20.89 kg) and lower in the normal animals (245.56 ± 16.49 kg). Lower fertility in dairy cows with increasing production has been reported by (1) which is in agreement with higher milk yield in the repeat breeders observed in present studies. At the same time lower body weights were observed in repeat breeders (443.33 ± 12.32 kg) than normal ones (483.50 ± 10.62 kg). Body condition scores were found to be significantly and positively correlated with body weight ($r = 0.763$, $P < 0.01$).

Serum glucose concentration was lower in the repeater breeder cows (50.67 ± 2.86 mg %) than the normal ones (53.37 ± 1.29 mg %) which was in agreement with the findings of (8) who observed higher levels of serum glucose in normal compared to anoestrus heifers. It was professed that hypoglycemia affects hypothalamic function and release of gonadotropins from hypophysis which may reduce ovarian activity (9). Lower BCS, blood glucose level and body weights in repeat breeder than normal ones indicate negative energy balance/malnutrition in the former. The results were in conformity that negative energy balance leads to long ovarian inactivity (10) and delayed resumption of cyclicity (11). It was also reported that lower energy balance reduces serum progesterone concentrations and fertility (12).

A positive correlation of serum glucose with BCS ($r = 0.478$) and milk yield ($r = 0.555$, $P < 0.05$) reflects that higher blood glucose level is an indicator of proper dietary energy level so essential for production and reproduction. Therefore, serum glucose can be assumed to be a strong indicator of reproductive function in cattle.

SGOT was higher in repeat breeders (16.17 ± 1.05 U/L) than normal cows (13.50 ± 0.98 U/L), though the differences were non-significant. The activity of SGOT

may rise in case of insufficient protein availability as well as dietary energy deficiency (13). The higher activity of SGOT has clinical importance as the enzyme is liberated into plasma after tissue damage (14). The values of SGPT and alkaline phosphatase in the normal and repeat breeders were 8.63 ± 1.21 U/L; 19.13 ± 1.14 U/L and 8.50 ± 1.38 U/L; 19.67 ± 1.05 U/L, respectively, indicating minor differences.

It can be concluded that BCS could be taken as an index of health and nutritional status under the field conditions, where it may be difficult to weigh the animals. BCS may be taken as a fair indicator of body weight under the field conditions. A positive correlation between serum glucose, BCS and milk yield indicates that serum glucose could be an index of energy balance status and production potential in crossbred dairy cows. Repeat breeder crossbred cows had higher milk yield and SGOT, lower BCS, SGPT and serum glucose. This is also an indicator of negative energy balance. Higher SGOT activity in the repeat breeder cows is an indicative of liver malfunctioning. This must be given due weightage while administering treatment for repeat breeding.

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EFFECT OF NITROGEN, PHOSPHORUS AND POTASH ON GROWTH OF SECOND RATOON GOLDEN ROD (*Solidago canadensis* L.) CV. LOCAL UNDER LATE KHARIF SEASON IN SAURASHTRA REGION

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Solidago canadensis L. is commonly known as 'golden rod', which belongs to family Asteraceae. Golden rod is perennial flower crop cultivated for its flower stalk. Yellow panicles are very attractive as cut flowers and also used in bouquet and table decoration purpose. It is used as filler material in floral arrangement. The crop does well in tropical climate. Division of stools, suckers or seeds propagate golden rod. It is the flower crop with greener biomass and it expands as a ratoon crop also, hence, it requires more amounts of different nutrients. In India, very little work has been carried out for various aspects particularly nutrient requirement of golden rod because it is minor flower crop and not much popular in the country. Therefore, the present investigation is undertaken to find out proper dose of nitrogen, phosphorus and potash fertilizer for second ratoon golden rod crop under late kharif season in Saurashtra climatic condition.

The present investigation entitiled "Effect of nitrogen, phosphorus and potash on growth of second ratoon golden rod (*Solidago canadensis* L.) cv. Local under late kharif season in Saurashtra region" was carried out at Instructional farm, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh during year 2011. Twelve treatment combinations consisting of three levels of nitrogen viz., 200 (N_1), 250 (N_2), 300 (N_3) kg/ha, two levels of phosphorus viz., 50 (P_1) and 100 (P_2) kg/ha, two levels of potash viz., 25 (K_1) and 50 (K_2) kg/ha were tried in randomized block design with factorial concept. All twelve treatment combinations were replicated three times. Statistical analysis of the data of various characters studied in the experiment was carried out as per Factorial Randomized Block Design. Significance of difference was tested by "F" test.

The results obtained from the present investigation as well as relevant discussion have been summarized under following sub heads :

Effect of Nitrogen : The data presented in Table-1 indicated that higher dose of nitrogen, 300 kg/ha (N_3) significantly increases the growth parameters viz., plant height (51.22 cm), plant spread (460.75 cm²), fresh weight of plant (24.04 g), dry weight of plant (8.09 g) and number

suckers per plant (6.30). However, plant spread was found at par with application of 250 kg nitrogen per hector (N_2). The poorest response was found in application of 200 kg nitrogen per hector (N_1). The above beneficial effect of nitrogen on promoting growth was mainly due to enhanced synthesis and accumulation of proteins, amino acids and enzymes, which are responsible for cell division and cell elongation hence growth of the plant was increased. Similar results are in agreement with the findings of (2) in golden rod, (3) in gaillardia.

Effect of phosphorus : The data on growth parameters on Table-1 shows that, the higher dose of phosphorus 100 kg/ha (P_2) gave maximum plant spread (454.96 cm²), fresh weight of plant (22.89 g) and dry weight of plant (7.65 g). While the other factor remains non-significant. The result may be due to vital role of phosphorus in plant growth as it is an essential constituent of cell components such as phosphoproteins and phospholipids, which are indispensable constituents of the various cell membranes and are also important for the maintenance of cell structure. The findings are with confirmed with (4) in golden rod, (5) in marigold.

Effect of potash : The data presented in Table-1 shows that, the application of potash @ 50 kg/ha (K_2) gave significantly higher plant spread (455.56 cm²) and dry weight of plant (7.58 g) over the application of potash @ 25 kg/ha (K_1). While the other factor remains non-significant. It might be due to potassium is not a constituent of any organic compound; however it is required as a cofactor for 80 or more enzymes. It controls movement of stomata and maintains electro-neutrality of plant cells (6). These results were in conformity with those obtained by (7) in golden rod, (8) in gaillardia and (9) in chrysanthemum.

Effect of interaction : The data presented in Table-2 shows that, the highest plant height (52.90 cm) was recorded with an application of 300 kg N + 50 kg P/ha (N_3P_1). However, it was observed statistically at par with treatment combinations N_3P_2 and N_2P_2 . The lowest plant height (44.76 cm) was recorded with treatment combination N_2P_1 which was statistically at par with treatment combination N_1P_2 and N_1P_1 .

Table-1 : Effect of nitrogen, phosphorus and potash on growth parameters of golden rod.

Treatments	Plant height (cm)	Plant spread (cm ²)	Fresh weight of plant (g)	Dry weight of plant (g)	No. of suckers per plant
Levels of Nitrogen (kg/ha)					
N ₁ -200	45.40	397.78	20.13	6.61	5.04
N ₂ -250	47.50	443.60	21.70	7.29	5.58
N ₃ -300	51.22	460.75	24.04	8.09	6.30
S.Em. ±	1.18	13.37	0.58	0.20	0.23
C.D. at 5%	3.48	39.20	1.69	0.58	0.69
Levels of Phosphorus (kg/ha)					
P ₁ -50	47.64	413.13	21.02	7.01	5.49
P ₂ -100	48.43	454.96	22.89	7.65	5.79
S.Em. ±	0.97	10.91	0.47	0.16	0.19
C.D. at 5%	NS	32.01	1.38	0.48	NS
Levels of Potash (kg/ha)					
K ₁ -25	47.10	412.53	21.64	7.09	5.75
K ₂ -50	48.98	455.56	22.65	7.58	5.71
S.Em. ±	0.97	10.91	0.47	0.16	0.19
C.D. at 5%	NS	32.01	NS	0.48	NS
Interactions					
N P	Sig.	NS	NS	NS	NS
P K	NS	NS	NS	NS	NS
N K	NS	NS	NS	NS	NS
N P K	NS	NS	NS	NS	NS
C.V. %	8.55	10.67	9.08	9.43	14.39

Table-2 : Effect of nitrogen, phosphorus and potash on growth parameters of golden rod.

Nitrogen levels (kg/ha)	Phosphorus levels (kg/ha)	
	P ₁ -50	P ₂ -100
N ₁ – 200	45.27	45.53
N ₂ – 250	44.76	50.23
N ₃ – 300	52.90	49.53
S.Em. ±	1.68	
C.D. at 5%	4.92	

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ECONOMIC AND COMMUNICATIONAL CONSTRAINTS IN ADOPTION OF HONEYBEE MANAGEMENT PRACTICES AMONG THE BEEKEEPERS

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Beekeeping is ecologically sound, economically viable and socially acceptable enterprise. Beekeeping is an ideal activity to the rural people for his socio-economic development. In India majority of people are small or marginal farmers or even landless. Beekeeping has a special advantage for this type of farmers. Beekeeping is agriculture based enterprise but does not compete for any resource with agriculture (1). Besides bringing direct income by way of production and sell of valuable and nutritive hive products like honey, bees wax, pollen, propolis, bee venom and royal jelly, the practice of apiculture helps also in increasing yield and quality of seeds/fruits through cross pollination in crops like apple (180 to 695%), onion (354 to 987%), broadbeans (7 to 90%), sunflower (72 to 82%), mustard (13 to 122%) etc. Among insect pollinators of different crop, 80 per cent cross pollination is done by honeybees (1).

For the study 100 beekeepers was randomly selected in two blocks namely Kalyanpur and Warisnagar of Samastipur district of Bihar. The data were collected through personal interview. The interview schedule was prepared by keeping the objectives of the study in mind. The necessary was taken to collect the un-biased and correct data. The data were collected, tabulated and analysed to find out the findings and draw conclusion. The statistical tool was employed to analyse the data.

Economic constraints associated with non-adoption of honey bee management practices : Table-1 indicated the various economic constraints and rank pattern experienced by beekeepers for non-adoption of honey bee management practices. Out of six constraints perceived by them, first rank was assigned to the constraints, lack of finance (87%). The other constraints perceived by the beekeepers in order to their importance in descending order were : non-availability of loan facilities for the purchase of inputs (76%), high price of bee colonies (66%) difficult and costly maintenance/management of beekeeping (47%), lack of Government/NGO support (38%). However, involvement of middleman in getting loan from bank ranked sixth in order of importance as it was perceived by 34 per cent of beekeepers.

This finding was in conformity with the findings of (2, 3), who reported that major constraints for non-adoption or partial adoption of technology was lack of finance. The

similar trend was also reported by (4). The findings were also in agreement with the findings of (1), who suggested that in order to generate more income, it is important to diversify beekeeping by exploiting honeybees to produce royal jelly, pollen, propolis, bee venom and bee wax which will add to the income of beekeepers as these have great demand in the world market. He further suggested that bank loan should be financed and made available to the beekeepers at low rates of interest and tax benefits be extended to beekeeping.

The Government, NGOs and educational institutions should come forward to popularize beekeeping through effective training, mass media and financial assistance. Bank loan should be made available to beekeepers at easy interest and in time. Besides, this grant and subsidise should also be provided by the govt., for motivation and adoption of research based technology. The beekeepers should be supplied with various inputs at reasonable cost and management techniques through effective training for rapid diffusion and adoption of honey bee management practices in the rural areas.

Communicational constraints associated with non-adoption of honey bee management practices :

Table-2 revealed the four communicational constraints, experienced by the beekeepers in respect of non-adoption of honey production technology. Inadequate access to training programme was ranked first by the beekeepers. The second rank was assigned to the constraints “poor infrastructure particularly transport and communication facilities” as perceived by beekeepers. The other constraints in descending order of importance were : poor rapport to extension agencies, low social mobility of rural women. There is need to create more awareness and interest in honey bee management practices people engaged in traditional practices be motivated to adopt modern practices by organizing regular and proper training programme and providing technical guidance. Therefore, adequate skilled manpower and trained field workers should be developed for improving the knowledge and upgradation of skills of beekeepers at village, block and district level. The Government, NGOs and educational institutions should come forward to popularize, beekeeping through effective training, mass media, extension agencies and financial assistance. The finding was in line with the finding of (6, 7).

Table-1 : Economic constraints associated with non-adoption of honey bee management practices.

Economic constraints	Beekeepers (n=100)		Rank
	Frequency	Percentage	
High price of bee colonies	66	66	III
Lack of finance	87	87	I
Lack of Government/NGO support	38	38	V
Difficulty and costly maintenance/ management of beekeeping	47	47	IV
Non-availability of loan facilities for the purchase of inputs	76	76	II
Involvement of middleman in getting loan from bank	34	34	VI

Table-2 : Communicational constraints associated with non-adoption of honey bee management practices

Communicational constraints	Beekeepers (N=100)		Rank
	Frequency	Percentage	
Poor rapport of extension agencies	40	40	III
Inadequate access to training programme	84	84	I
Low social mobility	30	30	IV
Poor infrastructure particularly transport and communication facilities	60	60	II

CONCLUSION

The findings revealed that there were so many constraints in adoption of beekeeping management practices. Under economic constraints lack of finance, high price of bee colonies and facilities for the purchase of inputs was main constraints of beekeepers and among communicational constraints inadequate access to training programme, poor infrastructure facilities and poor rapport of extension agencies were main constraints.

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MICROBIOLOGICAL PROFILE OF ORGANISMS FROM CLINICAL AND SUBCLINICAL MASTITIS IN DAIRY ANIMALS

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Mastitis is a major infectious disease affecting high yielding dairy animals resulting in the reduction of milk yield and quality (1). Mastitis, an inflammation of the mammary gland, is accompanied by physical, chemical and microbiological changes, and characterized by an increase in the number of somatic cells in the milk and by pathological changes in the mammary tissue. Mastitis can occur either in subclinical form or clinical form and aetiology has been classified into contagious and environmental pathogens. The prevalence of major contagious pathogens such as *Staphylococcus aureus* and *Streptococcus agalactiae* has drastically reduced worldwide due to the implementation of standard mastitis control practices (2), while share of opportunistic bacteria such as coagulase-negative staphylococci (CNS), Gram-negative bacteria (GNB) and other non contagious bacteria have increased in well-managed dairy herds (3). Microbiological culture of milk samples from individual cows is the only effective way to identify causative agents to make a proper diagnosis and to develop an effective mastitis control program. The present study was therefore planned to identify the different bacterial pathogens in the mastitic milk samples to understand their relative distribution.

Sampling : A total of 1232 milk samples from 270 cows (clinically mastitic cows = 157, apparently healthy cows = 113) and 98 buffalos (clinical n = 21 and apparently healthy n = 77) from Nov 2012 to May 2013 were subjected to microbiological examination at Mastitis Laboratory of Department of Veterinary Medicine, GADVASU, Ludhiana. The diagnosis of sub clinical mastitis was made based on history, California mastitis test and electrical conductivity.

Isolation and biochemical characterization of mastitis pathogens : Procedures described by National Mastitis Council (4) were followed for culturing the milk samples and identification of mastitis pathogens. Briefly, each blood agar plate was divided into four equal parts marked for individual quarters, and 0.05 ml of quarter milk sample was streaked with sterilized Platinum loop. The plates were incubated aerobically at 37°C and examined after 18-24 hours for the presence of any bacterial growth. The representative colonies of the microorganisms were purified by streaking onto fresh brain heart infusion agar plates. Preliminary identification of organisms was done on the basis of colony characteristics and hemolytic patterns on blood agar and Gram staining, catalase test to

differentiate *Streptococcus* spp. and *Staphylococcus* spp. The staphylococci were further identified on the basis of clumping factor, tube coagulase test, growth characteristics on manitol salt agar, DNase agar, and Baird parker agar. Organisms other than staphylococci were also identified as per the procedures recommended by National Mastitis Council (4).

A total of 1232 milk samples collected from 270 cows (clinically mastitic cows n = 157, apparently healthy cows n = 113) and 98 buffalos (clinical n = 21 and apparently healthy n = 77) were subjected to microbiological examination. The most frequently isolated pathogens from clinical samples were CNS (38.8%) followed by *S. aureus* (22.4%), streptococci (15.2%), corynebacteria (7.8%), *E. coli* (5.5%) and other minor pathogens (10.3%). In case of subclinical mastitis, CNS were the chief pathogens followed by *S. aureus* (21.9%). while the relative share of streptococci (18.7%) and corynebacteria (13.2%) was slightly higher and that of *E. coli* (1.4%) was lower in comparison to clinical mastitis (Table1).

In the present study CNS spp. were found to be the most common mastitis-causing agents in clinical as well as subclinical mastitis, both in cows and buffaloes, which is in agreement with previous studies conducted in dairy cows in different countries (2). In the present study, the prevalence of CNS in clinical (38.8%) mastitis was lower than subclinical (42%) mastitis which is in agreement with findings of (5). CNS possesses traits of both environmental and contagious pathogens. Although they are not normal inhabitants of the mammary gland, they commonly colonize the skin of the teat, the teat end, teat injuries, and the hands of milkers. Therefore they can spread mechanically and present major risks for cows with teat-end injuries.

Many infective agents have been implicated as the causes of mastitis, however trends over the last 40 years suggest that there is a relative decrease in the number of clinical cases of mastitis due to the contagious pathogens and a relative increase in the importance in the environmental pathogens as a cause of mastitis due to the implementation of standard mastitis control practices (2), with *S. aureus* still remaining the principal cause of sub-clinical mastitis as evidenced by different studies (5). The high prevalence *S. aureus* may be associated with its ability for intracellular existence, colonization of teats, and

Table-1 : Frequency distribution of pathogens recovered from clinical and subclinical mastitis from cows and buffaloes.

Pathogen	Cow		Buffalo		Total	
	CM	SCM	CM	SCM	CM	SCM
<i>Coagulase Negative Staphylococci</i>	34.44 (62)	29.69 (38)	58.97 (23)	59.34 (54)	38.81 (85)	42.01 (92)
<i>Staphylococcus aureus</i>	25.56 (46)	24.22 (31)	7.69 (3)	18.68 (17)	22.37 (49)	21.92 (48)
<i>Streptococci</i>	15.56 (28)	28.13 (36)	15.39 (6)	5.49 (5)	15.53 (34)	18.72 (41)
<i>Corynebacteria</i>	7.22 (13)	11.72 (15)	10.26 (4)	15.38 (14)	7.76 (17)	13.24 (29)
<i>Escherichia coli</i>	6.11 (11)	2.34 (3)	2.56 (1)	nd	5.48 (12)	1.37 (3)
<i>Pseudomonas</i> spp.	3.89 (7)	1.56 (2)	nd	nd	3.20 (7)	0.91 (2)
<i>Klebsiella</i> spp.	2.22 (4)	1.56 (2)	5.13 (2)	1.11 (1)	2.74 (6)	1.37 (3)
<i>Bacillus</i> spp.	2.22 (4)	0.78 (1)	nd	nd	1.83 (4)	0.46 (1)
<i>Proteus</i> spp.	1.11 (2)	nd	nd	nd	0.91 (2)	nd
Yeast	1.67 (3)	nd	nd	nd	1.37 (3)	nd

± Figures in parentheses indicate number of isolates. CM: Clinical mastitis, SCM: Subclinical mastitis, nd: not detected.

to localize within micro abscesses in the udder, and resistance to antibiotic treatment.

Also, the prevalence of streptococci (18.7%) and corynebacteria (13.2%) was higher whereas prevalence of *E. coli* (1.4%) in subclinical mastitis was found to be lower as compared to clinical mastitis in this study. The increasing frequency of coryneform and other environmental pathogens has been noted elsewhere (2,10) and could be probably related to changes in herd management and consequent bacteriological ecology in the herd environment and suboptimal post milking teat disinfection.

CONCLUSION

The findings in the present study reflect the fact that standard mastitis control practices have substantially reduced the incidence of contagious mastitis and presently, mastitis caused by environmental pathogens is the predominant in well-managed dairy herds. Teat dipping and dry cow therapy appear to have lesser impact on the environmental bacteria and these pathogens can be controlled by better management practices, such as clean bedding, clean housing, avoidance of wet environment,

proper udder preparation, fly control, decreasing teat-end injuries, and implementation of proper milking procedures.

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SENSORY EVALUATION OF THE HERBAL KALAKAND USING ASHWAGANDHA (*Withania somnifera*)

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Milk and milk products have been recognized as significant contributors of important nutrients to the human diet. Among the indigenous milk products, Kalakand occupies an important place and found to be attractive product amongst all the classes of consumers. Kalakand is partially desiccated milk product with caramelized flavour and granular texture prepared from acidified milk (1). The granular mass is fused and held together in loosely compact body. The colour of Kalakand varies from off-white to light caramel colour. Being a whole milk concentrate, Kalakand is a good source of protein, mineral, energy giving fat and lactose. It is 4-6 times more nutritious in terms of per unit weight and calorific value. Ashwagandha (*Withania somnifera*) is rare and endangered plant. Ashwagandha (*Withania somnifera*) possess immune modulatory anti-inflammatory, anti-tumor, antioxidant, anticancer properties and having many pharmacologically and medicinally important chemicals, that protect the cells from oxidative damage and disease (2). Ashwagandha (*Withania somnifera*) is widely used in Ayurvedic medicine and it is one of the ingredients in many formulations to increase energy, improve overall health and longevity and prevent disease. Supplementation of Ashwagandha (*Withania somnifera*) with milk is recommended in treatment of stress-oriented hypertension (3). Ashwagandha (*Withania somnifera*) are effective in prevention and treatment of different kinds of cancer like colon cancer, lung cancer, blood cancer, breast cancer, prostate cancer, skin cancer, renal cancer, fibrosarcoma and pancreatic cancer (4).

Control Kalakand (T₀) was made from buffalo milk without addition of Ashwagandha. For experimental Kalakand, buffalo milk was filtered and clarified at 35-40°C, and then it was cooled at 5°C, standardized to 6% fat and 9% SNF. Then the milk was boiled for 15 minutes and citric acid (1%) was added. It was then desiccated up to 30% moisture. The technique of manufacturing Kalakand was as recommended by (5). Sugar was added @ 6% and further desiccated. Kalakand was set and allowed to cool at room temperature. The samples were analyzed for physiochemical, microbial and organoleptic qualities as per (6, 7).

Details of different treatments using Ashwagandha

Materials	Different treatments (herbalkalakand)				
	T ₀	T ₁	T ₂	T ₃	T ₄
Ashwagandha extract	-	1%	2%	3%	4%

Organoleptic Evaluation of the prepared product : Freshly prepared herbal Kalakand were served for evaluation to panel members consisting of 5 experienced persons. 9 point hedonic scale proforma was used as suggested by (8).

Statistical analysis : The data obtained on different aspects as per plan were tabulated and statistically analyzed as per (9).

RESULT AND DISCUSSION

Organoleptic attributes and Overall acceptability of control and herbal kalakand using Ashwagandha

Flavour and Taste : The highest mean value for flavour and taste in herbal Kalakand using Ashwagandha was T₁ (8.16), followed by T₀ (8), T₂ (7.44) and T₃ (6.75). There were significant differences found among the treatments which may be attributed to the addition of *Ashwagandha*. F Value was 15.02, indicating significant effect of treatment on flavour and taste (Fig.-1).

Body and texture : The highest mean value for body and texture in herbal Kalakand was found in T₁ (8.08), followed by T₀ (7.92), T₂ (7.64) and T₃ (7.38). There were significant differences found among the treatments which may be attributed to the *Ashwagandha*. F Value was 3.49, indicating significant effect of treatment on body and texture (Fig.-1).

Colour and Appearance : The highest mean for colour and appearance was found in T₁ (8.24), followed by T₀ (8.10), T₂ (7.64) and T₃ (7.48). There was significant difference found among the treatments. There were significant differences found among the treatments which may be attributed to the *Ashwagandha*. F-Value was 15.02, indicating significant effect of treatment on colour and appearance (Fig.-1).

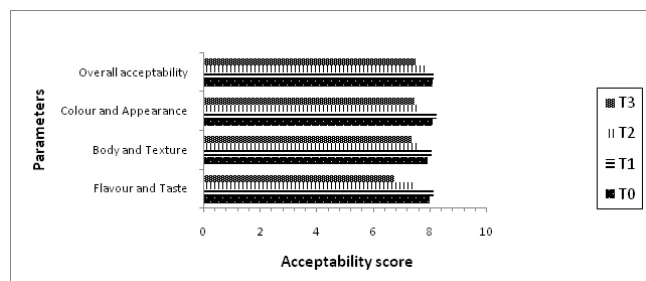
Overall acceptability : The highest mean value for overall acceptability in experimental Kalakand was found in T₁ (8.16), followed by T₀ (8.11), T₂ (7.70) and T₃ (7.50). There was significant difference observed among the

Table-1 : Organoleptic attributes and Overall acceptability of control andherbalkalakand using Ashwagandha.

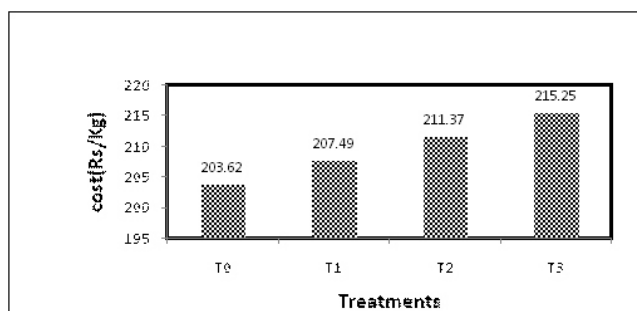
Parameters	Control and treatment ofherbalkalakand.				F-Value	C.D.
	T ₀	T ₁	T ₂	T ₃		
Flavour and Taste	8.00	8.16	7.44	6.74	15.02*	0.51
Body and Texture	7.92	8.08	7.64	7.30	5.52*	0.45
Colour and Appearance	8.10	8.24	7.64	7.43	15.02*	0.34
Overall acceptability	8.11	8.16	7.70	7.50	2.39**	-

*Significant at 5% level.

**Non-significant at 5% level

**Fig.-1.** Organoleptic attributes of control and herbal kalakand using Ashwagandha.**Table-2:** Cost Analysis of control andherbalkalakand.

Parameters	Control and herbalkalakand.			
	T ₀	T ₁	T ₂	T ₃
Cost (Rs/Kg)	203.62	207.49	211.37	215.25

**Fig-2:** Cost Analysis of control andherbal kalakand using Ashwagandha.

treatments which may be attributed to the addition of ashwagandha. F Value was 2.39, indicating no significant effect of treatment on overall acceptability (Fig.-1).

Cost Analysis of control and herbal kalakand using Ashwagandha : The data regarding cost of herbalkalakand was found as expensive in T₃ (215.25

Rs/Kg), followed by T₂ (211.37 Rs/Kg), T₁ (207.49 Rs/Kg) and T₀ (203.62 Rs/Kg) (Fig. 2).

CONCLUSION

The results obtained from the statistical analysis revealed that the Ashwagandha (*Withania somnifera*) can be satisfactorily used for Kalakand making. As per experimental Kalakand, T₁ with 1% Ashwagandha (*Withania somnifera*) was found to be best among the three treatments.

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BIOFUELS : AN ALTERNATIVE SOURCE OF ENERGY

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A biofuel is a hydrocarbon which is defined as any fuel whose energy is obtained through a process of biological carbon fixation. Biofuels can be derived directly from plants, or indirectly from agricultural, commercial, domestic, and/or industrial wastes from living organisms or from metabolic by-products (organic or food waste products). In order to consider a biofuel; the fuel must contain over 80 percent renewable materials. It is originally derived from the photosynthesis process which involves Carbon fixation and converts it into a number of different compounds, like carbohydrates, proteins, fats, and alcohols organic compounds. So it can therefore often be referred to as a solar energy source. The above definition of a biofuel is general. Rather than a biofuel is defined as any hydrocarbon fuel that is produced from organic matter (living or once living material) in a short period of time (days, weeks, or even months) in contrasts with fossil fuels, which take millions of years to form and with other types of fuel which are not based on hydrocarbons e.g. nuclear energy.

Biofuels are produced through contemporary biological processes, such as agriculture and anaerobic digestion, rather than a fuel produced by geological processes such as those involved in the formation of fossil fuels, such as coal and petroleum, which were formed from prehistoric biological matter. It is not necessary that a biofuel is made only from living/ dead organism, though they can be but a biofuels can also be made through chemical reactions, carried out in a laboratory or industrial setting, which use organic matter (*called biomass*) to make fuel.

Renewable biofuels are made by using or converting the biomass in three different ways: thermal conversion, chemical conversion, and biochemical conversion resulting in fuel in solid, liquid or gas form. This new biomass can also be used directly for biofuels. For example Bioethanol a biofuel, is widely used in the USA and in Brazil is made from the fermentation of carbohydrates such as sugar, starch crops such as corn, sugarcane, or sweet sorghum, and also from Cellulose biomass, derived from non-food sources, such as trees and grasses. The production of biofuel worldwide reached 105 billion liters and 2.7% of the world's fuels are used for road transport, by blending with bioethanol and biodiesel [1].

In 2010 Global ethanol fuel production reached 86 billion liters and the world's top producers are the United States and Brazil making 90% of global production. The European Union, are the world's largest biodiesel producer is accounting for 53% of all biodiesel production in 2010. The International Energy Agency has set a goal by 2050 for biofuels to meet more than a quarter of world demand for transportation fuels to reduce dependence on petroleum and coal. The production of biofuels also led into a flourishing automotive industry, where by 2010, 79% of all cars produced in Brazil were made with a hybrid fuel system of bioethanol and gasoline.

Biomass : Biomass is simply dead organic material. Before global warming related to burning fossil fuels became a major factor in determining where energy came from, the major concern was that fossil fuels, which are considered limited in supply, would run out over the next century. A fossil fuel is not considered renewable because it takes millions of years to form and humans really can't wait that long. Biofuel, on the other hand, comes from biomass, which can be produced year after year through sustainable farming practices. This means biomass and biofuel are renewable (we can replace used biofuel over a very short period of time). One of the advantages of biomass fuel is that it is often a byproduct, residue or waste-product of other processes, such as farming, animal husbandry and forestry. A significant problem arises with the combustion of raw biomass is considerable amounts of pollutants, such as particulates and polycyclic aromatic hydrocarbons. Even modern pellet boilers generate much more pollutants than oil or natural gas boilers. [2, 3, 4].

Types of Biofuels : The chemical structure of biofuels can differ in the same way that the chemical structure of fossil fuels can differ. For the most part, our interest is in liquid biofuels as they are easy to transport. The fuels that are easiest to burn cleanly are typically liquids and gases. They are easy to transport. Thus, liquids meet the requirements of being both energy-dense and clean-burning. In addition, liquids (and gases) can be pumped, which means handling is easily mechanized, and thus less laborious. High energy density can also be provided by an internal combustion engine. These engines require clean-burning fuels.

Ethanol : From biological sources [alcohols](#) are produced by the action of [microorganisms](#) and [enzymes](#) through the fermentation of sugars or starches (easiest), or cellulose (which is more difficult). The most common alcohols are [ethanol](#), and less commonly are [propanol](#) and [butanol](#). [Biobutanol](#) which is also called biogasoline, often claimed to provide a direct replacement for gasoline, because it can be used directly in a gasoline engines. [Ethanol fuel](#) which can be used in petrol engines as a replacement for gasoline is the most common biofuel worldwide, particularly in [Brazil](#). [Alcohol fuels](#) are produced by fermentation of carbohydrates. [5]

Most existing car petrol engines can run on blends of up to 15% bioethanol with petroleum/gasoline. An advantage of ethanol is that it has a higher [octane rating](#) than ethanol-free gasoline available at roadside gas stations, which allows an increase of an engine's [compression ratio](#) for increased [thermal efficiency](#). In high-altitude (thin air) locations, some states mandate a mix of gasoline and ethanol as a winter [oxidizer](#) to reduce atmospheric pollution emissions.

Ethanol is used in counterpart of gasoline and ethane. Ethanol has about half the energy per mass of gasoline, which means it takes twice as much ethanol to get the same energy. Ethanol burns cleaner than gasoline, however, producing less carbon monoxide. However, ethanol produces more ozone than gasoline and contributes substantially to smog. Engines must be modified to run on ethanol.

Biodiesel : Biodiesel is prepared from [transesterification](#) of oils or fats and is the most common biofuel in Europe. In pure form, [Biodiesel](#) can be used as a fuel for vehicle but it is usually used as a [diesel](#) additive which reduces the levels of particulates, [carbon monoxide](#), and [hydrocarbons](#) from diesel-powered vehicles. Biodiesel is also an [oxygenated fuel](#), meaning it contains a reduced amount of carbon and higher hydrogen and oxygen content than fossil diesel. This improves the [combustion](#) of biodiesel and reduces the particulate emissions from unburnt carbon. However, using neat biodiesel may increase NO_x-emissions. Biodiesel is also safe to handle and transport because it is non-toxic and [biodegradable](#).

Chemically, it consists mostly of fatty acid methyl (or ethyl) esters ([FAMES](#)). It is the most common biofuel in Europe. It is produced from oils or fats by [transesterification](#). It is similar in composition to fossil/mineral diesel. Oils and fat used in the preparation of biodiesels are obtained from the animal fats, vegetable

[oils](#), [soya](#), [rapeseed](#), [jatropha](#), [mahua](#), [mustard](#), [flax](#), [sun flower](#), [palm oil](#), [hemp](#), [field pennycress](#), [Pongamia pinnata](#) and [algae](#).

It has only slightly less energy than regular diesel. It is more corrosive to engine parts than standard diesel, so engines should be designed to take biodiesel effectively. It burns cleaner than diesel, producing less particulate and fewer sulfur compounds. Biodiesel can be used in any [diesel engine](#) when mixed with mineral diesel. Since biodiesel is an effective [solvent](#) and cleans residues deposited by mineral diesel, [engine filters](#) may need to be replaced more often, as the biofuel dissolves old deposits in the fuel tank and pipes. It also effectively cleans the engine [combustion chamber](#) of carbon deposits, helping to maintain efficiency.

Methanol: Methanol has about one third to one half as much energy as methane. Methanol is a liquid and easy to transport whereas methane is a gas that must be compressed for transportation. [Methanol](#) is currently produced from [natural gas](#), a non-[renewable](#) fossil fuel. The [methanol economy](#) is an alternative to the [hydrogen economy](#), compared to today's [hydrogen](#) production from natural gas.

Apart from Methanol, [Butanol](#) is formed by [ABE fermentation](#) of acetone, butanol, ethanol also called as [ABE fermentation](#) and experimental modifications of the process show potentially high [net energy gains](#) with butanol as the only liquid product. Butanol will produce more energy and allegedly can be burned "straight" in existing gasoline engines (without modification to the engine or car), and is less corrosive and less water-soluble than ethanol, and could be distributed via existing facilities. *E. coli* strains have also been successfully engineered to produce butanol by modifying their [amino acid metabolism](#).

Socio-economic Issues with Biofuel versus Fossil Fuel

Fuel : The uses of biofuels are not new. There are several factors that decide the balance between biofuel and fossil fuel use around the world. Those factors are cost, availability, and food supply; and these three factors listed above are actually interrelated. As we are aware that the availability of fossil fuels is depleting, expensive due to pumping from ground and also fossil fuels are not renewable. Thus its alternative is the demand of the present era.

Initially scientist believed that biofuels could be produced in almost limitless quantity because they are renewable. But, our energy needs far billions of people

worldwide require a lot of biomass to grow to make biofuels creating concern about land area. As the population grows, our demands for both energy and food grow. However, for developing countries, the use of land for biofuels, which increases the cost of food, can have a tremendous impact.

From right beginning it has been felt that production and use of biofuel may have various social, economic, environmental and technical issues which include: the effect of moderating oil prices, the “food vs. fuel” debate, poverty reduction potential, carbon emissions levels, sustainable biofuel production, deforestation and soil erosion, loss of biodiversity, impact on water resources, the possible modifications necessary to run the engine on biofuel, as well as energy balance and efficiency. The International Resources Panel, assessed the issues relating to biofuel use in its first report Towards sustainable production and use of resources: Assessing Biofuels. “Assessing Biofuels” outlined the wider and interrelated factors that need to be considered when deciding on the relative merits of pursuing one biofuel over another. In its conclusion it has been mentioned that not all biofuels perform equally in terms of their impact on climate, energy security and ecosystems, and it has been suggested that environmental and social impacts need to be assessed throughout the entire life-cycle. [6]

Prospect of Biofuel : Different countries throughout the world have given subsidies for biofuel growth and development. However, better understanding of global warming, increased awareness of the fragility of the food supply, and a general trend toward “greener” alternatives have all led to a decline in the popularity of biofuels. In 2011, The U.S. Senate voted 73 to 27 to end tax credits and trade protections for corn-based ethanol production and as the second largest producer of ethanol shifted focus to environmentally friendly energy sources.

India’s total biodiesel requirement is projected to grow to 3.6 million tones in 2011–12, with the positive performance of the domestic automobile industry. It has been found that the market is an emerging one and has a long way to go before it catches up with global competitors. In India an initiative has been taken by the Government in implementing an ethanol-blending program and considering initiatives in the form of mandates for biodiesel. Due to these strategies, the rising population, and the growing energy demand from the transport sector, biofuels can be assured of a significant

market in India. On 12 September 2008, the Indian Government announced its ‘National Biofuel Policy’.

Biodiversity and Biofuels : The balance between food and biofuel is what keeps the relatively simple process of growing and making biofuels from being substantially cheaper than fossil fuel. When this factor is combined with an increased ability due to better technology to extract oil from the ground, the price of fossil fuel is actually lower than that of biofuel for the most part.

Biodiversity refers to the variety of different living things in an environment. Growing a single type of corn is easier for producing biofuels because we can select that type that yields the best raw product, is easiest to grow, and which requires the least amount of water and other resources. This sounds great, but then down side to this is that pests that eat this type of corn will begin to proliferate and in due course of time they will be resistant to the pesticide.

Biodiversity is important to ensuring that pests do not grow out of control. The type of farming needed to produce large quantities of biofuels is generally not amenable to high levels of biodiversity. Jatropha oil is used as fuel in India from century. In fact, this biodiesel has been fuelling remote rural and forest communities for many years now. The Jatropha plant can easily be cultivated in wastelands. Hence, unlike other sources of biodiesel, growing this crop will not encroach upon valuable farmland, and will also serve as an additional means of income for Indian farmers. Jatropha oil is cost effective, since it can be used directly after extraction, without the need for any additional refining.

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ANTIMICROBIAL ACTIVITY OF A PEPTIDE FROM THE FLOWERS OF *LANTANA INDICA* ROXB.

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Living organisms constantly have a threat of infection from various microbes. But the living organisms are not defenceless against these microbes. They produce a myriad of molecules against these microbes. One of these molecules is antimicrobial peptides. These are ubiquitous molecules that are present among all eukaryotes like mammals, amphibians, insects and plants [1]. They have been isolated from a wide range of organisms. Most of these peptides are synthesized as a propeptide consisting of a N-terminal signal sequence, a pro segment and a C-terminal cationic peptide that demonstrate antimicrobial activity after it is cleaved from the rest of the protein [2]. Antimicrobial peptides have been isolated from a wide range of organisms. They are prevalent in plants also. One of the well known and studied antimicrobial peptides in plants are defensins, they were first isolated from wheat and barley. They have structural and functional similarities with insect and mammalian defensins [3]. They are known to exhibit antibacterial and antifungal activities especially against phytopathogenic bacteria [4]. In this paper we describe the isolation and biological properties of a flower derived defensin from *Lantana indica*.

Biological materials : The plants were purchased from the nursery of Sam Higginbottom Institute of Agriculture, Technology and Sciences, (ICAR), Allahabad, India. The bacterial strains against which the antimicrobial activity was monitored were *E. coli* (MTCC 1687) and *S. aureus* (MTCC 7443). The bacterial strains were provided by Microbial Type Culture Collection and Gene Bank (MTCC), Institute of Microbial Technology, IMTECH, Chandigarh, India and the monitoring of the antimicrobial activity of the *Lantana indica* extracts was carried out.

Extraction of floral defensins : Defensins were extracted from flowers of *Lantana indica* by using a modification of the procedure for extraction of thionins from barley (*Hordeum vulgare*) flour [5] and further modification of the procedure used for isolation of floral defensins from ornamental tobacco and petunia [6]. Whole of *Lantana indica* flowers up to petal colouration stage of flower development were grounded to a fine powder with liquid nitrogen by using a mortar and pestle and were further processed in a homogenizer in 50mM sulphuric acid. After stirring for 1 hr at 4°C, the insoluble material was removed by filtration through Whatman No. 4 filter paper, followed by centrifugation (12,000 rpm, 15 min, 4°C). The slurry was adjusted to pH 7.8 by slow addition of 10 M NaOH and was stirred for 1 h at 4°C

before removal of precipitated material by centrifugation (12,000 rpm, 15 min 4°C). Solid ammonium sulphate 80% (w/v) saturation was added and the mixture was stirred for 3 to 4 h at 4°C to precipitate the defensin protein. The precipitate was collected and was dissolved in 50 ml of gel filtration buffer (150 mM KCl and 10 mM Tris-HCl, pH 8.0) before heating at 90°C for 10 min. The supernatant was loaded onto a glass column containing Sephadex G-50 (Sigma) media and gel chromatography was carried out.

Fractions with highest antibacterial activity were selected and were purified by Reverse Phase HPLC (RP-HPLC), (Waters) on a C18 silica column using a pump (model 515, Waters) and photodiode array detector (UV; Waters). Samples were eluted with linear gradient of 0.1% (v/v) trifluoroacetic acid to 60% (v/v) acetonitrile for 20 min at a flow rate of 2 ml/min. The absorbance was measured till 700nm.

Antimicrobial screening : The purified protein extracts of *Lantana indica* were screened against two bacterial strains. The test organisms were *E. coli* (MTCC 1687) and *Staphylococcus aureus* (7443).

Preparation of inoculums : Slopes of nutrient agar were prepared in which stock culture were maintained at 4°C. The active cultures of bacteria were prepared for experiments by transferring a loopful of bacteria from stock cultures to test tubes of Mueller-Hinton Broth (MHB). A turbidity standard for inoculum preparation was used, a BaSO₄ turbidity standard, equivalent to a 0.5 McFarland standard.

Antimicrobial Susceptibility test : Kirby-Bauer disc diffusion method was used to screen the antimicrobial activity of the peptide extracts. In this test the antimicrobial activity was screened by using Mueller Hinton Agar (MHA) as media, obtained from (Himedia, Mumbai). The MHA plates were prepared by pouring 15 ml of molten media into the sterile petri plates. The plates were allowed to solidify for 5 minutes and inoculum suspension was swabbed uniformly and the inoculum was allowed to dry for 5 minutes. Sterile discs (6mm) were loaded with 50 µl of peptide extract. The loaded disc was placed on the surface of media and the compound was allowed to diffuse for 5 minutes and then the plates were kept for incubation at 37°C for 24 hrs. At the end of incubation, inhibition zones were formed around the disc, they were measured with a transparent ruler (Himedia) in millimetre.

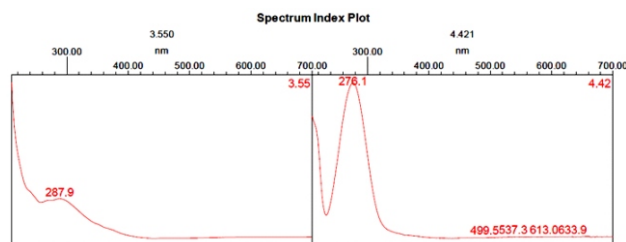


Figure 1: Spectrum Index Plot of *Lantana indica* extract.

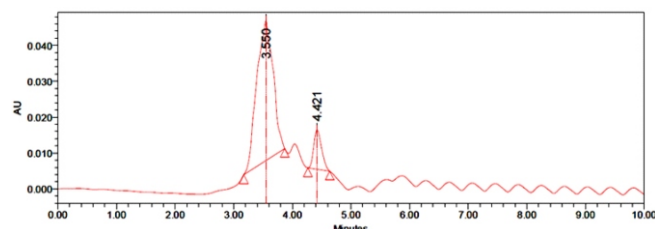


Figure-2 : Retention time of *Lantana indica* extract in

The protein was extracted from flowers of *Lantana indica* in 50mM sulphuric acid and purified using ammonium sulphate precipitation, heat treatment and gel filtration. Proteins in the fractions were resolved further by Reverse Phase HPLC (RP-HPLC). The highest peak was identified as a floral defensin (Figures 1 and 2). The highest peak was observed at a retention time of 3.550 minutes. Antimicrobial activity of the purified extracts : The purified peptide extracts of *Lantana indica* showed a zone of clearance against both the bacteria *E. coli* and *S. aureus*. A zone of clearance (14 mm) was observed against *E. coli* and a zone of clearance of (15 mm) was observed against *S. aureus* (figures 3 and 4) respectively.

This observation has lead towards the isolation of an antimicrobial peptide and the detection of the antimicrobial activity of this compound from *Lantana indica* flowers. The extracted compound shows antimicrobial activity. This is a compound which can have various applications in agriculture as well as medicine. Plants prove to be a source of antimicrobial compounds of peptide nature. Further investigation is required for screening of this compound in other parts of the plant like seeds and leaves.

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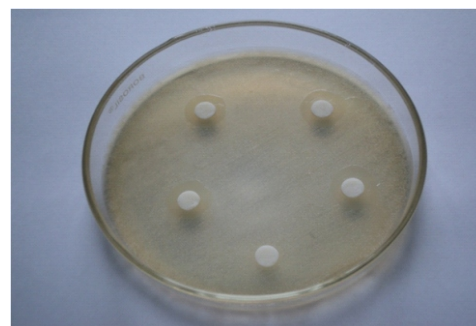


Figure-3: The antimicrobial activity of *Lantana indica* extracts against *E.coli*.



Figure-4 : The antibacterial activity of *Lantana indica* extracts against *S.aureus*.

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ANTIMICROBIAL ACTIVITY OF A PEPTIDE FROM THE FLOWERS OF *HIBISCUS ROSA-SINENSIS*

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The nature has provided plants and all the other living organisms with wide range of compounds to fend themselves against wide range of infections. Of these compounds the secondary metabolites are widely known and studied in plants. But now studies conducted over the last decade have shown the wide production and applicability of peptides which are produced against a wide range of microorganisms. These antimicrobial peptides are widely distributed in the plant Kingdom. At least four different classes of cysteine rich antimicrobial peptide have been isolated from the seeds of barley and wheat. These peptides have been mostly isolated from the seeds of plants. These peptides have marked biological activity, which includes inhibition of α amylase [1] and antimicrobial activity [2]. These antimicrobial peptides from plants have homology towards insect defensins. In this paper we describe the isolation and biological properties of a flower derived defensin from *Hibiscus rosa-sinensis*.

Biological materials : The plants were purchased from the nursery of Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, India. The bacterial strains against which the antimicrobial activity was monitored were *E. coli* (MTCC 1687) and *S. aureus* (MTCC 7443). The bacterial strains were provided by Microbial Type Culture Collection and Gene Bank (MTCC), Institute of Microbial Technology, IMTECH, Chandigarh, India and the monitoring of the antimicrobial activity of *Hibiscus rosa-sinensis* was carried out.

Extraction of floral defensins : Defensins were extracted from flowers of *Hibiscus rosa-sinensis* by using a modification of the procedure for extraction of thionins from barley (*Hordeum vulgare*) flour [3] and further modification of the procedure used for isolation of floral defensins from ornamental tobacco and petunia [4]. Whole of *Hibiscus rosa-sinensis* flowers upto petal colouration stage of flower development were grounded to a fine powder with liquid nitrogen by using a mortar and pestle and were further processed in a homogenizer in 50mM sulphuric acid. After stirring for 1 hr at 4°C, insoluble material was removed by filtration through Whatman No. 4 filter paper, followed by centrifugation (12,000 rpm, 15 min, 4°C). The slurry was adjusted to pH 7.8 by slow addition of 10 M NaOH and was stirred for 1 h at 4°C before removal of precipitated material by centrifugation (12,000 rpm, 15 min 4°C). Solid ammonium sulphate 80% (w/v) saturation was added and the mixture

was stirred for 3 to 4 h at 4°C to precipitate the defensin protein. The precipitate was collected and was dissolved in 50 ml of gel filtration buffer (150 mM KCl and 10 mM Tris-HCl, pH 8.0) before heating at 90°C for 10 min. The supernatant was loaded onto a glass column containing Sephadex G-50 (Sigma) media and gel chromatography was carried out. Fractions with highest antibacterial activity were selected for each peak and were purified by RP-HPLC (Waters) on a C18 silica column using a pump (model 515, Waters) and photodiode array detector (UV; Waters). Samples were eluted with linear gradient of 0.1% (v/v) trifluoroacetic acid to 60% (v/v) acetonitrile for 20 min at a flow rate of 2 ml/min. The absorbance was measured 700nm.

Antimicrobial screening : The purified protein extracts of *Hibiscus rosa-sinensis* were screened against two bacterial strains. The test organisms were *Escherichia coli* (MTCC 1687) and *Staphylococcus aureus* (MTCC 7443).

Preparation of inoculum : Slopes of nutrient agar were prepared in which stock culture were maintained at 4°C. The active cultures of bacteria were prepared for experiments by transferring a loopful of bacteria from stock cultures to test tubes of Mueller-Hinton Broth (MHB). A turbidity standard for inoculum preparation was used, a BaSO₄ turbidity standard, equivalent to a 0.5 McFarland standard.

Antimicrobial Susceptibility test : Kirby-Bauer disc diffusion method was used to screen the antimicrobial activity of the peptide extracts. In this test the antimicrobial activity was screened by using Mueller Hinton Agar (MHA) as media, obtained from Himedia, Mumbai. The MHA plates were prepared by pouring 15 ml of molten media into the sterile petri plates. The plates were allowed to solidify for 5 minutes and inoculum suspension was swabbed uniformly and the inoculum was allowed to dry for 5 minutes. Sterile discs (6mm) were loaded with 50 μ l of peptide extract. The loaded disc was placed on the surface of media and the compound was allowed to diffuse for 5 minutes and then the plates were kept for incubation at 37°C for 24 hrs. At the end of incubation, inhibition zones were formed around the disc, they were measured with a transparent ruler (Himedia) in millimetre.

The protein was extracted from flowers of *Hibiscus rosa-sinensis* in 50mM sulphuric acid and purified using ammonium sulphate precipitation, heat treatment and gel

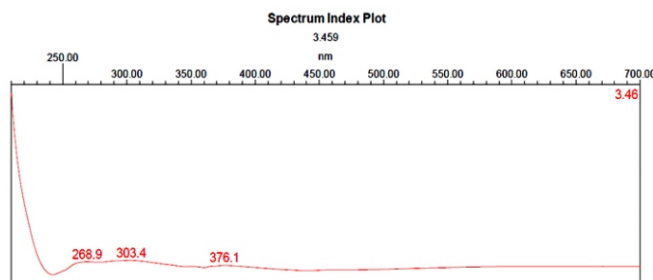


Figure 1: Spectrum Index Plot of *Hibiscus rosa-sinensis*

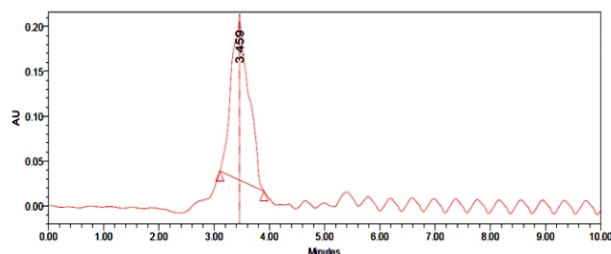


Figure 2: Retention time in minutes of *Hibiscus*

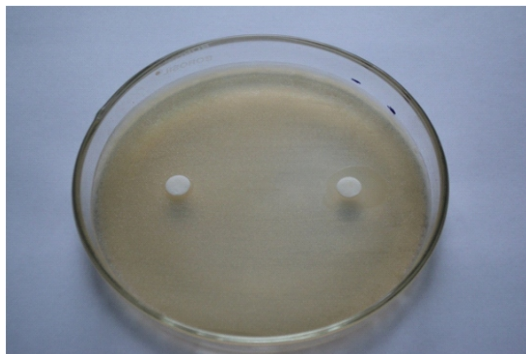


Figure 3 : The antimicrobial activity of *Hibiscus rosa-sinensis* extracts against *E. coli*.

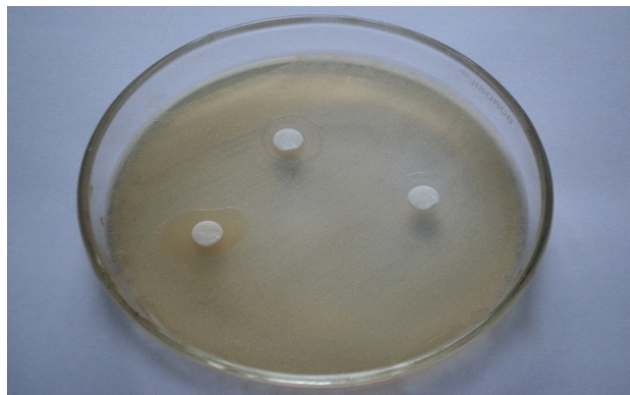


Figure 4 : The antimicrobial activity of *Hibiscus rosa-sinensis* extracts against *E. coli*.



Figure-5 : The antimicrobial activity of *Hibiscus rosa-sinensis* extracts against *S. aureus*.

filtration. Proteins in the fractions were resolved further by reverse phase RP-HPLC. The highest peak was identified as a floral defensin (figures 1 and 2). The highest peak was observed at a retention time of 3.459 minutes.

This study has lead towards the isolation and screening of the antimicrobial activity of this compound from *Hibiscus rosa-sinensis* flowers. The extracted compound shows antimicrobial activity. This is a promising compound which can have various applications in agriculture as well as medicine. Plants prove to be a source of antimicrobial compounds of peptide nature. Further investigation is required for screening of this compound in other parts of the plant like seeds and leaves.

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VARIATION OF ULTRASONIC VELOCITY AS A FUNCTION OF FREQUENCY IN SOME EDIBLE OILS

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Edible oils play an important role in human food because of their characteristic nutritional, organoleptic, heat transfer and rheological properties [1]. The chemical constituents of fats and oils are triglycerides. These triglycerides are basically esters of glycerol and three fatty acid molecules. By definition, a fat is solid, while an oil is liquid at room temperature. The physico-chemical properties of oils are determined principally by the type and amount of the triglyceride present in it [2]. A variety of analytical techniques have been used to characterize oils, including nuclear magnetic resonance, refractive index, microscopy, X-rays, density measurements, neutron scattering and differential scanning calorimetry. The characterisation of oils by ultrasound has been realised by researchers for many years. [3]. The determination of the triglyceride composition [4], dynamic rheology [5] and the size and concentration of droplets in emulsions [6], are the important applications of ultrasonic velocity measurements. Ultrasonic studies in edible oils gives an insight into the Physico Chemical and Dynamic properties of vegetable oils. With the help of compressibility data, fat content in solids can be determined. Ultrasonic study reveals that the dipole-dipole interaction is less at higher concentration of heavy fuel oil in the binary mixture. [7]. Variation of ultrasonic velocity and absorption with temperature in high viscous vegetable oils were measured and it is observed that ultrasonic velocity of vegetable oils decreases with the increase in temperature. [8]

Samples of five pure edible oils are collected from their production units. A variable frequency ultrasonic interferometer (Mittal make F-81m) operating at the frequencies 1,2,3 and 5 MHz with a least count of 0.0001 cm was used to measure the ultrasonic velocity (with accuracy 0.001%) in these oils samples taken into the ultrasonic measuring cell attached with a constant temperature water bath at room temperature (with

accuracy 0.1%) [12]. The ultrasonic Interferometer consists of an ultrasonic cell with double walled brass column with chromium plated surfaces. In the bottom of cell a piezoelectric quartz crystal of varying resonant frequency (1,2,3, & 5 MHz) is placed with a metallic reflector attached to the shaft which moves up or down by the action of spring and a micrometer screw. The standing waves will be formed between the crystal and the reflector which is filled with the oil sample. The measurement of velocity is based on the determination of wave length in the medium if the distance between the crystal and reflector is increased or decreased and the variation is one half the wave lengths or multiple, the current in the micro ammeter increases to a maximum. The maxima and minima in the standing waves were measured using a differential amplifier which is fed to micrometer.

The values of ultrasonic velocities in various edible oils at 1, 2, 3 and 5 MHz are shown in table-1. A marked difference is observed in ultrasonic velocity of all edible oils when we go from 1MHz to 5MHz, however, the difference is most significant when we move from 1MHz to 2MHz. The observed increase in velocity is about 5m/s or more in the oils under investigation except sunflower oil and mustard oil in which the increase is 0.147 and 3.771 m/s respectively. The ultrasonic velocity investigations at 3MHz frequency showed an increase in velocity by about 1 to 1.5 m/s in coconut, sunflower and groundnut oils whereas this is less than 1 m/s in mustard and palm oils. Further investigations at 5MHz showed an increase in the velocities in all the edible oils. The variation of ultrasonic velocities of these samples with frequencies is shown in Fig.-1. The observed lowest and highest values of ultrasonic velocities at 1MHz in coconut and mustard oils, respectively may be attributed to the percentage of UFA

Table-1 : Ultrasonic velocities at different frequencies.

Sl. No.	Common Name of Edible Oils	Scientific Name of Edible Oil	Ultrasonic Velocity (m/s) at frequencies			
			1MHz	2MHz	3MHz	5MHz
1.	Coconut Oil	Cocos nucifera	1400.970	1406.076	1407.650	1405.407
2.	Palm Oil	Elaeis guinensis	1414.035	1420.041	14120.229	1418.417
3.	Sunflower oil	Helianthus annuus	1423.884	1424.031	1425.620	1431.430
4.	Groundnut Oil	Arachis hypogaea	1436.949	1441.986	1442.991	1443.442
5.	Mustard Oil	Brassica juncea	1446.195	1449.966	1450.778	1452.451

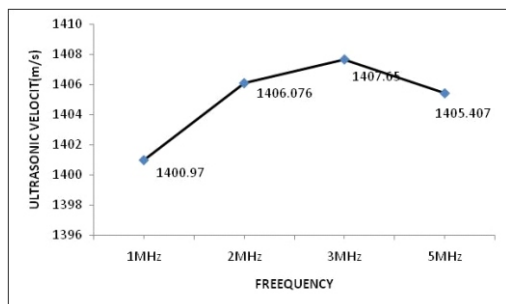


Fig.1 (a) Coconut oil

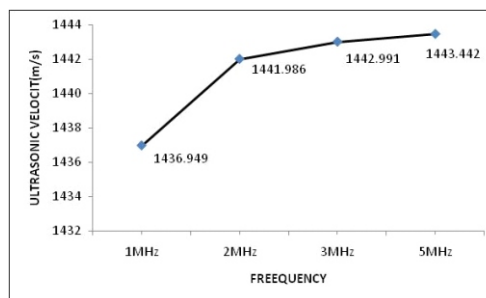


Fig.1 (d) Groundnut oil

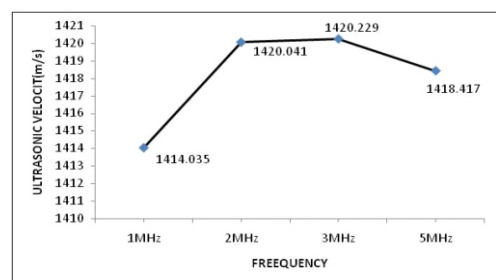


Fig.1 (b) Palm oil

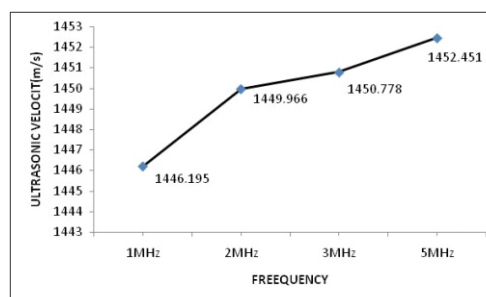


Fig.1 (e) Mustard oil

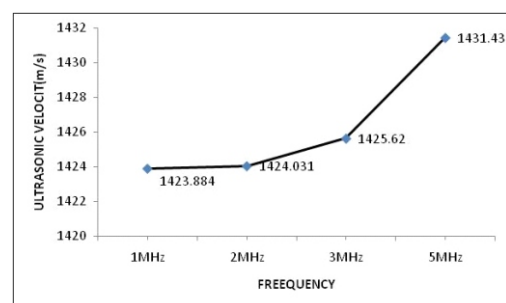


Fig.1 (c) Sunflower oil

(Unsaturated fatty acid) and SFA (saturated fatty acid) contained by it.

CONCLUSION

Ultrasonic velocity is related to the changes in physical and chemical properties of composition of oil that determine the quality of edible oils. The present study reveals that the ultrasonic velocity depends on the percentage of UFA and SFA contained by the different edible oils and the ultrasonic velocities at 1 and 2 MHz may be helpful in detecting any adulteration in these edible oils.

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EFFECT OF DIFFERENT DOSES OF GAMMA IRRADIATION ON GERMINATION, PLANT SURVIVAL AND POLLEN STERILITY OF WHEAT (*Triticum aestivum* L.) IN M₁ GENERATION

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The main purpose of using mutagens has been to induce genetic variation, which is the first step in a breeding programme. Since wheat is a polyploid plant, duplication of genes allows a greater number of primary induced changes to be preserved and transmitted to the next generation (1). In mutation breeding studies, it is important to determine a suitable dose/concentration of mutagen for a crop plant which can be employed for inducing maximum variability through point mutations. Seed germination, seedling growth, pollen sterility and chromosomal aberration are the commonly used criteria for studying radio-sensitivity in plants (2). Germination and survival was linearly decreasing with increase of radiation dose in case of gamma rays and fast neutron. Induced mutations in wheat have been obtained for morphological and quantitative characters by treatment with different mutagens.

The 1000 seeds sample of wheat var. K-7903 (Halna) were got irradiated each with dry 00 kR, 05 kR, 10 kR, 15 kR, 20 kR, 25 kR, 30 kR, 35 kR, 40 kR and pre-soaked seeds of the same was exposed to 00 kR, 05 kR, 10 kR, 15 kR, 20 kR doses of CO⁶⁰ gamma rays at 2.2 kR per minute intensity from NBRI, Lucknow. The irradiated seeds along with control were sown on November, 2010 to raise M₁ generation by dibbling method at the distance of 5 cm seed to seed and 20 cm

row to row. M₁ generation was raised without replication at Central Research Field, Department of Genetics and Plant Breeding, SHIATS, Allahabad, India. The data were recorded for germination percent (lab condition), plant survival, seedling height at 4th days, 8th days and 14th days, pollen sterility and LD₅₀.

As is apparent from the table 1 that germination has been reduced in higher doses as compared to lower doses as percentage of control. Statistically maximum germination percent of control was recorded under 15kR (98.00%). The lab germination percentage higher as compared to field germination percentage. In general it was noted that germination was delayed with the increase in the radiation intensity. The results coincide with those of (3). The maximum plant survival as percent (table 4.1) of control was resulted under 15kR dry (91.56%) followed by 05kR dry (91.21%). The present results confirm these earlier report in wheat (4). The 15kR dry treatment showed that maximum mean seedling height in M₁ generation on 4th (1.27cm), 8th (9.67cm) and 14th (18.32) days of sowing. The magnitude of mean pollen sterility has been found to range from 10.49 per cent to 54.63 per cent through different doses. Therefore, it may be concluded that the pollen sterility has been found to increase with increase gamma rays doses. Similarly (2)

Table-1 : Per cent nitrogen, phosphorus, potash and calcium content in leaves of Alphonso mango before fertilizers application and after harvest stage.

Treatments	N (in %)		P (in %)		K (in %)		Ca (in %)	
	B. A.*	A. H.*	B. A.	A. H.	B. A.	A. H.	B. A.	A. H.
T ₁	1.36	1.17	0.092	0.087	0.52	0.50	1.79	1.74
T ₂	1.32	1.38	0.087	0.090	0.53	0.49	1.85	1.63
T ₃	1.34	1.43	0.088	0.092	0.60	0.56	1.77	1.54
T ₄	1.27	1.48	0.085	0.078	0.53	0.54	1.84	1.47
T ₅	1.38	1.63	0.089	0.068	0.47	0.40	1.92	1.42
T ₆	1.32	1.35	0.088	0.094	0.48	0.33	1.87	1.96
T ₇	1.29	1.32	0.091	0.073	0.32	0.59	1.74	1.59
T ₈	1.35	1.40	0.090	0.091	0.55	0.48	1.81	1.65
T ₉	1.40	1.23	0.087	0.077	0.41	0.32	1.88	2.08
T ₁₀	1.34	1.37	0.081	0.090	0.30	0.35	1.76	1.68
T ₁₁	1.26	1.31	0.088	0.085	0.42	0.49	1.89	1.91
T ₁₂	1.31	1.35	0.083	0.088	0.28	0.34	1.82	1.72
S.E. +	0.073	0.110	0.006	0.004	0.013	0.033	0.031	0.032
C.D. (5%)	N. S.	N. S.	N. S.	0.013	0.037	0.097	0.090	0.094

* B. A.–Before fertilizers application

* A. H.–After harvest

Table-2 : Mean performance of seedling length (cm) in M₁ generation of wheat (R 2010-11).

S.N.	Treatments	Seedling height at					
		4th days		8th days		14th days	
		Mean seedling height (cm)	Seedling height as % of control	Mean seedling height (cm)	Seedling height as % of control	Mean seedling height (cm)	Seedling height as % of control
1.	Control	1.25	-	8.23	-	17.65	-
2.	05 kR(dry)	1.22	97.60	8	97.20	17	96.31
3.	10 kR "	1.14	91.20	7.23	87.84	16.65	94.33
4.	15 kR "	1.27	101.60	9.67	117.49	18.32	103.79
5.	20 kR "	1.2	96.00	7.36	89.42	15.98	90.53
6.	25 kR "	1.08	86.40	7.03	85.41	13.18	74.67
7.	30 kR "	1.00	80.00	6.54	79.46	11.42	64.70
8.	35 kR "	0.85	68.00	5.27	64.034	8.85	50.14
9.	40 kR "	0.63	50.40	3.56	43.25	7.54	42.71
10.	Wet control	1.26	-	9.33	-	18.06	-
11.	05 kR (Presoaked)	1.20	95.23	7.86	84.24	16.42	90.91
12.	10 kR "	1.17	92.85	7.02	75.24	15.97	88.42
13.	15 kR "	1.12	88.88	6.58	70.52	13.28	73.53
14.	20 kR "	0.85	67.46	5.32	57.02	11.35	62.84

Table-3 : Mean performance of pollen sterility in M₁ generation of wheat (R 2010-11).

S.N.	Treatments	Mean sterility %	(%) reduction
1.	Control	5.39	94.61
2.	05 kR (dry)	10.76	89.24
3.	10 kR "	12.81	87.19
4.	15 kR "	10.49	89.51
5.	20 kR "	16.96	83.04
6.	25 kR "	13.94	86.06
7.	30 kR "	32.81	67.19
8.	35 kR "	44.60	55.4
9.	40 kR "	54.63	45.37
10.	Wet control	5.01	94.99
11.	(Presoaked)	11.98	88.02
12.	10 kR "	13.48	86.52
13.	15 kR "	17.27	82.73
14.	20 kR "	25.67	74.33

also reported a declining tendency in seedling length and pollen sterility of wheat when exposed to higher doses of gamma radiation. Prepared on the bases of damage on the biological parameter i.e. germination, that LD₅₀ value of gamma rays for germination was middle of 30 kR to 35kR dry. The without pre-soaked seeds were recorded highest germination percent, seedling length and plant survival as compared to pre-soaked seeds. Higher exposures of gamma rays may cause injury in seeds (5) and usually shows inhibitory effects on seeds of angiosperms and gymnosperms (6). It can be calculated that found to be

higher germination percent, seedling length and plant survival as percent of control under 15 kR dry gamma rays.

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SYSTEMIC INVESTIGATIONS OF VARIOUS POST HARVEST DISEASES OF POTATO AFTER UNLOADING FROM THE COLD STORAGE

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Potato (*Solanum tuberosum* L.) is one of the most nutritious sources of food in the world. Besides cereals, the potato is one of the crops, which can supplement food needs of a country. Tubers harvested from plants which were infected during the growing season may develop a various rot in storage. Among the various diseases of potato, dry rot, charcoal rot, soft rot and potato cut seed piece decay are the major potato tuber rot diseases. Potato growers of Gujarat state mainly use cut seed pieces with single eye for planting without any seed treatment and thus provide avenue for microbial invasion leading to rottage which resulting in gappy germination and poor yield per unit area. *Fusarium sambucinum* (teleomorph *Giberella pulicaris*) is the most common pathogen causing dry rot of stored tubers, but other *Fusarium* species are also known to cause dry rot, particularly *F. solani* var. *coeruleum* and *F. avenaceum*. However, *F. sambucinum* is may be the probably the main causal agent of dry rot, but *F. solani* var. *coeruleum* may also be present and affect the potato crop. *Fusarium* dry rot is both seed and soil-borne and is present in most potato growing areas. However, average annual crop losses attributed to dry rot have been estimated at 6 to 25 per cent (1) and found that more than 60 per cent of tubers in storage can be affected (2). *Fusarium* sp. that causes dry rot and spread readily among tubers during handling and planting which results in seed tuber rots and poor plants stand (3). However, other diseases as charcoal rot (*Macrophomina phaseolina*) may cause 10-70 per cent tuber rottage in eastern plains depending upon the period of harvest and presence of predisposing factors (4). Blackleg begins from a contaminated seed piece, but the symptoms can occur at several stages of plant development. In severe cases, entire seed pieces and developing sprouts may rot in the ground prior to emergence, resulting in a poor stand. Stem infection can occur through wounds or through natural openings such as leaf scars. Most internal tuber tissues may be consumed by soft rot organisms, sometimes leaving only a shell of skin remaining in the soil. Blackleg, aerial stem rot, and tuber soft rot are caused by two closely related bacteria, *Erwinia carotovora* sub sp. *atroseptica* and

Erwinia carotovora sub sp. *carotovora*. These bacteria are capable of multiplying and persisting in the root zones of many host and non-host crop and weed species. Hence, it is found essential to conduct the systemic investigation of cold storage diseases before it gets to the field.

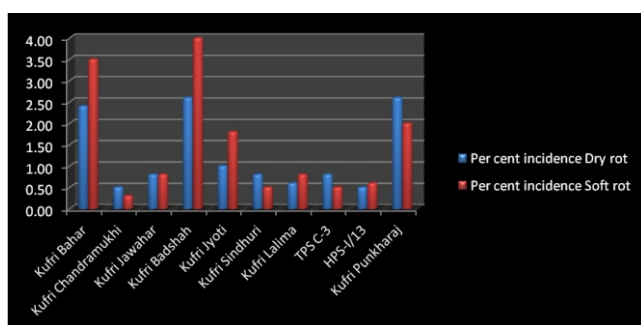
A survey was made for various post harvest diseases of potato at the time of unloading from cold storage. Four random samples were taken each containing 400 tubers of ten recommended varieties individually. The rotted tubers were sorted out and counted.

Rotted tubers from Potato Research Station, Deesa were taken to the laboratory of Department of Plant Pathology, C.P. College of Agriculture, Sardar Krushinagar. In the laboratory, the diseased tubers were first examined under microscope and subsequently, pathogens associated with the post harvest diseases of potato were isolated. Observations on incidence of dry rot, charcoal rot and soft rot diseases were recorded individually in each variety.

A survey was conducted for various post-harvest diseases of potato. Data on tuber rot was collected from each variety by examining 400 tubers after unloading from cold storage and are presented in Table-1 and Graph-1. Results from the survey of post-harvest tuber rot diseases revealed that incidence of dry rot and soft rot were common in occurrence in almost all the varieties. Maximum incidence of dry rot and soft rot was observed in variety Kufri Badshah as 2.6% and 4.0% respectively followed by variety Kufri Bahar which recorded dry rot as 2.4 per cent and soft rot as 3.5 per cent. This path was followed by cvs. Kufri Punkharaj and Kufri Jyoti, which recorded 2.6 and 1.0 per cent dry rot and 2.0 and 1.8 per cent soft rot, respectively. Minimum incidence of dry rot was recorded in cvs Kufri Chandramukhi (0.5%) and HPS-I/13 (0.5%) followed by cvs Kufri Lalima (0.6%), Kufri Sindhuri (0.8%), Kufri Jawahar (0.8%) and TPS C-3 (0.8%). Minimum incidence of soft rot was also recorded in cv. Kufri Chandramukhi (0.3%) followed by cvs Kufri

Table-1 : Incidence of dry rot and soft rot disease of potato after unloading from cold storage.

Locality	Varieties	Tuber s Observed	Per cent incidence	
			Dry rot	Soft rot
Potato Research Station, S. D.A.U., Deesa.	Kufri Bahar	400	2.4	3.5
	Kufri Chandramukhi	400	0.5	0.3
	Kufri Jawahar	400	0.8	0.8
	Kufri Badshah	400	2.6	4.0
	Kufri Jyoti	400	1.0	1.8
	Kufri Sindhuri	400	0.8	0.5
	Kufri Lalima	400	0.6	0.8
	TPS C-3	400	0.8	0.5
	HPS-I/13	400	0.5	0.6
	Kufri Punkharaj	400	2.6	2.0

**Graph-1** : Indicates the per cent disease incidence of dry rot and soft rot of potato

Sindhuri (0.5%), TPS C-3 (0.5%), HPS-I/13 (0.6%), Kufri Jawahar (0.8%) and Kufri Lalima (0.8%). Similarly, (5) studied ten potato cultivars and showed that rotting was maximum in Kufri Bahar and Kufri Sherpa under ambient storage conditions. Shekhawat et al. (1992) reported that potato soft rot incidence ranged from 0.48 – 8.80 % in cold

storage and it was highest (8.8%) in the cultivar Kufri Badshah. Kang and Gopal (1993) stored ten hybrids and varieties of potato at ambient temperature in North-western plains of India and it was found that hybrid JI 5857 was at par with commercial variety Kufri Badshah and Kufri Bahar in recording tuber rot diseases.

CONCLUSION

Survey of post-harvest diseases after unloading from cold storage showed that tubers of all the cultivated varieties were more or less found infected with dry rot and soft rot diseases. Maximum incidence of dry rot and soft rot was observed in variety Kufri Badshah as 2.6% and 4.0%, respectively.

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USE OF DIFFERENT DRUGS (*Addiction material*) BY ADDICTS PERSON

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Drug addiction is a chronic disease affecting the brain and just about every one is different. Drugs affect different people in different ways. One person can take and abuse drugs, yet never become addicted, while another merely has one experience and is immediately hooked. Addiction is a strong, uncontrollable need to drugs, drink alcohol or carryout a particular activity such as gambling. It becomes the most important thing in your life and leads to problems at home, work and school. There's no single reason why addictions develop. Regularly drinking alcohol or using other substances, or spending time gambling or on the internet (including porn sites), may be pleasurable or relaxing. Some people experience these feelings particularly intensely and have a strong desire to repeat them more often.

To complete the above objective by employing the appropriate research methodology, the study was purposively conducted in district Kanpur Nagar. Two blocks Kalyanpur and Chaubeypur were selected in this study area. From these selected block three village from Chaubeypur i.e. Rajarampur, Amiliha and Gabdaha and three villages from Kalyanpur i.e. Ramel Nagar, Gambhirpur and Singhpur were selected. Twenty Five respondent were selected randomly from each village. Thus 150 respondents were selected. Dependent and independent variables, age namely age, caste, education, annual income, occupation, family size, family type and dependent variables, opinion of addicts and family members and social or economic effects of alcoholism on affected families etc were used. The data so collected were subjected to statistical analysis for which statistical tools, such as average, percentage, weighted mean, rank and correlation coefficients were used.

Table-1 shows that distribution of respondents according to age group, 40.7 percent of respondents were belonged to 41-50 years age group, whereas, 37.3 of respondents belonged to 31-40 years age group, 14.0 percent of respondents were belonging to between the age group of 51 years and above. The lowest percentage is seen for the age group was belonging up to 30 years. Thus, age group is an important factor effecting alcoholism and drug addiction on families.

Table 2 respondents the distribution of respondents according to educational qualification. It was found that 22.7 percent of respondents were educated up to High School, while 22.0 percent were educated upto

intermediate. The same percentage i.e. 22.0 percent were also educated upto graduate and above level and 17.3 percent respondents were educated upto secondary level, followed by 8.7 percent respondents educated upto primary level. Only 7.3 percent respondents were found illiterate.

Table-1 : Distribution of respondents according to age group. (N=150)

Age group	Number of respondents	Percent
Up to 30 years	12	8.0
31 to 40 years	56	37.3
41 to 50 years	61	40.7
51 and above	21	14.0
Total	150	100.00

Table-3 reveals that 94.67 per cent of addicts are using alcohol which hold the I rank with mean score 1.95 followed by II rank has 91.33 per cent of respondents are using cigarettes with mean score 1.91. Further 50.67 percent addicts using other drug materials like pan masala, tobacco and pan (betel) hold III rank with mean score value of 1.51 while 14.00 per cent of addicts using charges hold IV rank with mean score value of 1.14. 13.33 percent of addicts using smoke hold V rank with mean score value of 1.33, where as 12.00 per cent of addicts using hemples hold VI rank with mean score 1.12 and 10.67 percent of addicts using cannabis hold VII rank with mean score of 1.11 while minimum 1.33 percent of addicts using opium hold VIII rank with mean score value of 1.01 is obvious from the above table that uses of alcohol is on the first, cigarettes at second, other drug materials like pan masala, tobacco and pan at third, charas at fourth, smoke at fifth, hemples at sixth, cannabis at seventh and opium at eighth.

Table-2 : Distribution of respondents according to education. (N=150)

Education Level	Number of respondents	Percent
Illiterate	11	7.3
Up to Primary	13	8.7
Up to Secondary	26	17.3
High School	34	22.7
Intermediate	33	22.0
Graduate & Above	33	22.0
Total	150	100.00

Table-3 : Distribution of respondents according to use of different drugs (addiction material) N=150

Sl. No.	Material	Sym bol	Yes	No	Mean Scores	Rank
1	Alcohol	A	94.67	5.33	1.95	I
2	Cigarette (Bidi)	B	91.33	8.67	1.91	II
3	Opium	C	1.33	98.67	1.01	VIII
4	Charas	D	14.00	86.00	1.14	IV
5	Smack	E	13.33	86.67	1.13	V
6	Cannabis	F	10.67	89.33	1.11	VII
7	Hempleaues	G	12.00	88.00	1.12	VI
8	Others	H	50.67	49.33	1.51	III

CONCLUSION

Alcoholism is the most popular and widely spread addiction among the addicts followed by using alcohol. It was also found that there are too many reasons which make the person twin towards use of drugs and then by an addicts. Out of them the most common are using drug materials for enjoy, fun and pleasure and taken for relief from every day fatigue, to feel tight and easy, relief from pain, taken it for sleep, relaxation from tension, increase alertness and mental concentration, avoid problems, improve working efficiency, for status symbol, gain courage and confidence and improve sex efficiency and capability etc. Drug addiction is not an ordinary commodity. While it carries connotations of pleasure and sociability in the minds of many, harmful consequences of its use are diverse and widespread.

SUGGESTIONS

Addict should have treatment under medical supervision of doctors.

Avoid company of addicts can omit addiction if he be repartee from addict friends.

Motivate the addicts with sympathy and good feeling for quitting addiction persons of family.

Government should can the drugs and other addictive materials.

There are de-addiction institutions in the country. They must be asked for help to get rid of abuse and addiction of different drugs.

Make the addicts and other persons of family regularly aware of harmful effects of drugs and their addiction.

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SEASONAL PROBLEMS OF FARM WOMEN IN FARM ACTIVITIES

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The role of women in agricultural production is largely determined by the life cycle of the house hold, location of house hold fields and other tasks that women undertake during the agricultural year. Their traditional role as primary seed-keepers and seed processors is well known in our society. They have conventionally been both experts and producers of food from seed to kitchen and as globalization shifts agriculture into capital-intensive mod; women bear the disproportionate eats of both displacement and health hazards. They carry the heavies work burden in food production and because of gender discrimination, get lower returns of their cool. To identify the problems of farm women in farm activities.

To complete the above objective by employing the appropriate research methodology, the study was purposively conducted in district Jalaun during the year 2014-2015. Six villages selected in this study area. Forty five respondents were selected randomly from each village. Thus, 270 respondents were selected. Dependent and independent variables, homely, age, caste, education, occupation, religion, family type, family size and dependent variables problem of farm women in farm activities and causes of problems faced by farm women etc were used. The data so collected were subjected to statistical analysis for which statistical fools, such as, average, percentage, weighted mean, rank and correlation coefficients were used Table 1 shows that distribution of respondents according to age, group, 45.9 percent of respondents were belonged to 35 to 50 years aged group, whereas, 29.6 of respondents belonged to 18-35 years age group, 24.5 percent of respondents were belonging to between the age group of 50 years and above. The highest percentage is seen for the age group was 35 to 50 years (Middle) busy of form activities.

Seasons too, affect widely, the health, the working efficiency, the potential of doing work etc. Seasonal problems may easily be seen in the workers. In summer season, problems like dehydration, head exhaustion, sub burn, headache, and skin cancer may be seen. In rainy season problems like bacterial or fungal infection may easily be seen among workers. In cold season, problems like freezing hand, cold etc may be seen.

Table 2 Indicates that 80.0 percent women told that there are suffering of Headache in summer season and with a mean score value of 1.80, they ranked it I among all

summer season problems, followed by II rank has 77.4 percent of women faced dehydration with mean score 1.77. Further 74.1 percent respondents faced sun burn hold –III rank with the mean score value of 1.74 while 67.4 of farm women facing Heat exhaustion hold IV rank with mean score value of 1.67, 17.8 percent of respondents suffering skin cancer hold V rank with mean score value of 1.18.

65.2 percent women accepted bacterial infection as most common problem of rainy reason with mean score value 1.65, it placed I rank. 58.5 – 1.59 hold rank II. While 40 percent of women accepted fungal infection with mean score 1.40, it placed III rank.

Problem of common cold was declared most common of winter season by 78.9 percent women with mean score 1.79 ranks- I. 4.1 Percent accepted fever with mean score 1.44 hold rank-II and freezing hand &

Table-1 : Distribution of respondents according to age group.

S. No.	Age group	Frequency	Percent
1.	18 to 35 years (Young)	80	29.6
2.	35 to 50 years (Middle)	124	45.9
3.	50 and above	66	24.5
	Total	270	100.0

feet's as third common problem of winter season was placed III rank by them with a mean score of 1.37.

CONCLUSION

Agriculture is one of the most hazardous occupations worldwide in several countries the total accident rate in agriculture is double the average for all other industries. Heavy work during crop cultivation and harvesting is frequent. Diseases and accidents caused by agricultural work are also conditioned by a range of factors such as climate, fauna, population density, living conditions, level of education, technological development etc.

SUGGESTIONS

Knowledge about extreme hot/cold temperature, their effect/side effect.

Farm women need to be educated about how to operate different equipments.

Table-2 : Distribution of respondents according to seasonal problems of farm women in farm activities.

The Summer Season Problems	Yes	No	Mean Score	Rank
Dehydration	209 (77.4)	61 (22.6)	1.77	II
Heat exhaustion	182 (67.4)	88 (32.6)	1.67	IV
Sun burn	200 (74.1)	70 (25.9)	1.74	III
Headache	216 (80.0)	54 (20.0)	1.80	I
Skin cancer	48 (17.8)	222 (82.2)	1.18	V
In rainy Season Problems				
Skin Infection	158 (58.5)	112 (41.5)	1.59	II
Bacterial Infection	176 (65.2)	94 (34.8)	1.65	I
Fungal infection	108 (40.0)	162 (60.0)	1.40	III
In Winter Season Problems				
Freezing hand & feet's	99 (36.7)	171 (63.3)	1.37	III
Cold	213 (78.9)	57 (21.1)	1.79	I
Fever	119 (44.1)	151 (55.9)	1.44	II

They need to be educated about chemicals, chemical use, and their effects/side effects.

They should communication among each other so they can share their experience, thoughts.

Farm women should participate meticulously in extension programs of government.

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