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RESIDUAL EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH AND YIELD OF SUCCEEDING OAT CROP

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ABSTRACT

A field experiment was conducted at Shalimar Campus during *Kharif,* 2007 to study the residual effect of organic and inorganic fertilizer levels on the growth and yield of succeeding oats crop. The treatments consisted of five organic fertilizers and three inorganic fertilizer levels (50% RFD, 75% RFD and 100% RFD) in a randomized block design replicated thrice. A uniform dose of N, P and K @ 80, 40 and 20 kg N, P_2O_5 and K_2O/ha, respectively was applied to each plot of succeeding oats crop. The residual effect of organic fertilizers and inorganic fertility levels on the succeeding oats crop, it was found that the plant height and dry matter accumulation at flowering and maturity of oats was significantly higher with organic fertilizer combination of FYM and poultry manure over FYM and biofertilizer combination. The fertility levels of 75 and 100 % RFD significantly improved plant height and dry matter accumulation at flowering and maturity of oats compared to 50 % RFD. The yield contributing characters were higher with application of organic fertilizer combination of FYM and poultry manure compared to FYM and biofertilizer combination. The grain yield of oats was significantly higher with application of FYM + poultry manure combinations over FYM + biofertilizer combination.

Key words : *Azospirillum, biofertilizer, FYM, grain, manure, oat, sheep, vermicompost, yield.*

Forages have been recognized as one of the most important component in present farming systems for increased rural economy. At global level the total area under cultivated fodders and permanent pastures is 3.5 billion hectares with a production of 964.03 million tonnes (Panunizi, 2008). However, in India 12.6 million hectare area is under cultivated fodders with less than 4 per cent of cultivated area under permanent pastures and as such the availability of green forages to feed livestock population is around 69 per cent of the requirement (Tripathi, 2003). Oats can provide green fodder after 60-70 days in emergency to tide over the scarcity period but after 90-100 days to get large quantity of fodder. Oats is mostly fed as green and surplus is converted into silage or hay for use during the fodder deficit periods. It is preferred feed of all animals and its straw is soft and superior to wheat and barley. It is high in TDN, protein, fat, vitamin B1 and minerals as phosphorus and iron. The oats grain is particularly valuable feed for horses, dairy cows, poultry and young breeding animals of all kinds (Hussain *et al.*, 2002).

Jammu & Kashmir state has livestock population of 99.9 lakh with fodder requirement of 4.04 million tonnes (dry matter basis). However, there is fodder deficit of 0.78 million tonnes as against the availability of 3.26 million tonnes (Anonymous, 2005) which includes 1.55 million tonnes of crop residues of maize and paddy as well. No doubt, an area of 0.3 and 0.054 million hectares is under permanent pastures/grazing lands and cultivated fodders, respectively, the fodder deficit continues to increase year after year. The main reasons for such a scenario are the non availability of high potential and quality forages in pastures, availability of less than 2 % of total cultivated area under fodder production and limited availability of quality fodder seed. In order to increase the production, productivity and quality of cultivated fodders so as to make up the fodder deficit on sustainable basis, there is need to improve the soil fertility. Since forages are heavy feeders and greatly deplete the soil of its nutrients particularly under fodder-fodder cropping system. It is, therefore, important to manage the soil and fertilizer nutrients in such a manner that could increase the forage productivity. Continuous use of chemical fertilizers under intensive cropping system apart from causing environmental pollution has become costly enough for the farmers to afford their purchase. On the other hand, use of organic manures alone cannot satisfy the crop requirement. So the integrated nutrient management involving use of organic manures, bio-fertilizer and

Table-1: Plant height and dry matter production at flowering and maturity of oats as affected by different levels of organic and inorganic fertilizers.

Treatment	Plant height (cm)		Dry matter production (q/ha)			
			Flowering		Maturity	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Organic fertilizer level (t/ha)						
O_1 (10 t FYM/ha)	123.5	123.6	104.5	102.7	111.8	112.6
O_2 (5 t FYM/ha + 1 t Vermicompost/ha)	125.4	125.5	105.8	104.1	114.9	114.6
O_3 (5 t FYM/ha + 1 t Poultry manure/ha)	127.6	127.7	108.3	107.0	116.1	116.4
O_4 (5 t FYM/ha + 2.5 t Sheep manure/ha)	123.8	123.9	106.1	104.4	115.0	115.0
O_5 (5 t FYM/ha + 0.5 kg Azospirillum/ha)	120.7	120.8	101.3	99.7	109.4	110.0
SE m±	1.93	1.79	2.40	2.32	1.84	1.91
CD (p = 0.05)	5.52	5.13	6.89	6.64	5.29	5.46
Inorganic fertilizer level (kg/ha)						
F_1 (50% RFD)	119.2	121.1	89.4	87.8	98.4	97.5
F_2 (75% RFD)	125.1	124.6	110.8	109.1	119.5	120.2
F_3 (100% RFD)	128.4	127.8	115.3	113.8	122.4	123.4
SE m±	1.49	1.39	1.86	1.79	1.42	1.48
CD (p = 0.05)	4.28	3.98	5.34	5.15	4.10	4.25

* RFD = 80, 40 and 20 kg N, P_2O_5 and K_2O/ha, respectively.

Table-2 : Yield contributing characters of oats as affected by different levels of organic and inorganic fertilizers.

Treatment	Panicles/m^2		Spikelets/panicle		Grains/panicle		1000-grain weight (g)	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Organic fertilizer level (t/ha)								
O_1 (10 t FYM/ha)	329	321	38.5	38.0	38.1	37.8	34.5	34.6
O_2 (5 t FYM/ha + 1 t Vermicompost/ha)	334	326	41.7	42.2	40.8	40.9	34.6	34.6
O_3 (5 t FYM/ha + 1 t Poultry manure/ha)	339	331	44.6	44.8	41.5	41.9	34.7	34.6
O_4 (5 t FYM/ha + 2.5 t Sheep manure/ha)	331	321	38.8	39.1	38.1	38.6	34.5	34.6
O_5 (5 t FYM/ha + 0.5 kg Azospirillum/ha)	326	314	36.9	36.7	36.4	36.1	34.6	34.5
SE m±	4.05	3.60	0.35	0.38	0.37	0.86	0.28	0.25
CD (p = 0.05)	11.61	10.31	1.01	1.08	1.06	2.47	NS	NS
Inorganic fertilizer level (kg/ha)								
F_1 (50% RFD)	289	279	36.2	35.9	35.2	34.8	34.3	34.3
F_2 (75% RFD)	350	342	42.0	42.3	40.9	41.0	34.5	34.4
F_3 (100% RFD)	354	345	42.2	42.4	41.0	41.2	35.0	35.0
SE m±	3.15	2.79	0.27	0.29	0.29	0.67	0.22	0.19
CD (p = 0.05)	9.00	8.0	0.79	0.84	0.83	1.92	0.64	0.55

* RFD = 80, 40 and 20 kg N, P_2O_5 and K_2O/ha, respectively.

chemical fertilizers seeks to maintain the soil fertility for sustaining desired levels of fodder production and productivity through optimization of all benefits from all possible sources of plant nutrients in an integrated manner.

MATERIALS AND METHODS

Field experiments were conducted at SKUAST-Kashmir, Shalimar campus, India to study theresidual effect of integrated nutrient management applied to fodder maize in summer 2007-08 and2008-09 on the succeeding oats growth and yield. The soilof the experimental field was silty clay loam in texture. The nutrient status of soil atthe start of experiment was low in available nitrogen (270.3kg ha^{-1}), medium in available phosphorus (14.3kg ha^{-1}) and available potassium (160kg ha^{-1}) with the pH of 6.6. The organic carbon were analysed and depicts low rating (0.37 %). The field experiment were laid out in randomized block design with two factors (organic and inorganic fertilizers) and three replications. The first factor comprised of five organic treatments in fodder maize viz. FYM @ 10 t/ha (O_1);FYM @ 5 t/ha + Vermicompost @ 1 t/ha (O_2); FYM @ 5 t/ha + Poultry manure @ 1 t/ha (O_3); FYM @ 5 t/ha + Sheep manure @ 2.5 t/ha (O_4);

Table-3 : Grain yield, straw yield and harvest index of oats as affected by different levels of organic and inorganic fertilizers.

Treatment	Grain yield (q/ha)		Straw yield (q/ha)		Harvest index (%)	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Organic fertilizer level (t/ha)						
O_1 (10 t FYM/ha)	41.3	41.2	87.1	84.5	32.1	32.8
O_2 (5 t FYM/ha + 1 t Vermicompost/ha)	41.9	42.0	88.1	85.3	32.2	33.0
O_3 (5 t FYM/ha + 1 t Poultry manure/ha)	42.5	42.3	89.5	86.6	32.2	32.8
O_4 (5 t FYM/ha + 2.5 t Sheep manure/ha)	41.3	41.2	88.3	85.4	31.9	32.5
O_5 (5 t FYM/ha + 0.5 kg Azospirillum/ha)	39.4	39.5	85.8	82.6	31.5	32.3
SE m±	0.72	0.81	1.35	2.03	0.64	0.65
CD (p = 0.05)	2.06	2.32	NS	NS	NS	NS
Inorganic fertilizer level (kg/ha)						
F_1 (50% RFD)	35.4	34.6	72.7	73.4	32.0	32.0
F_2 (75% RFD)	43.8	42.9	89.0	87.2	33.0	33.1
F_3 (100% RFD)	44.6	43.4	101.7	93.7	30.5	31.5
SE m±	0.56	0.63	1.05	1.57	0.50	0.51
CD (p = 0.05)	1.60	1.80	3.00	4.50	1.43	1.45

* RFD = 80, 40 and 20 kg N, P_2O_5 and K_2O/ha, respectively.

Fig.1: Yield contributing characters of oats as affected by organic fertilizer levels (2007-08)

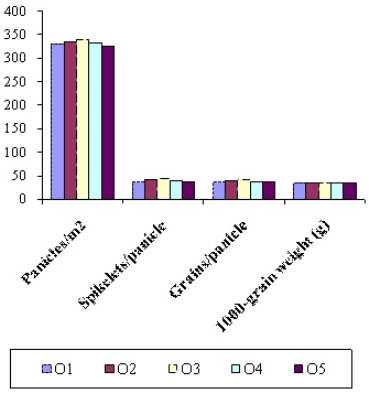
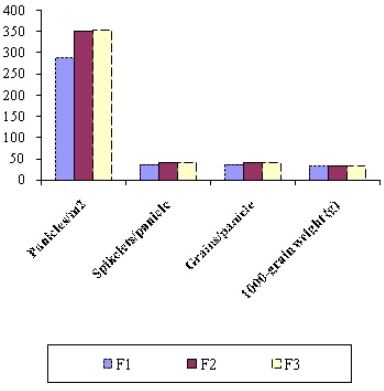


Fig.2: Yield contributing characters of oats as affected by inorganic fertilizer levels (2008-09)



FYM @ 5 t/ha + Azospirillum @ 0.5 kg/ha (O_5) and the second factor comprised of three fertilizer levels in fodder maize viz. 50% Recommended dose of NPK (F_1); 75% Recommended dose of NPK (F_2); 100% Recommended dose of NPK (F_3). The recommended dose of fertilizer (RDF) adopted for Fodder maize was 80:40:20 kg N, P_2O_5 and K_2O ha^{-1}. The seeds of oats were dibbled on both sides of the preceding maize crop ridge spaced 60 cm apart with a plant to plant spacing of 22 cm within the row. The fodder maize crop was harvested on 10.09.2007 and 12.09.2008,respectively during the two years of study. The oats crop was sown on 17.10.2007 and 17.10.2008 and harvested on29.05.2007 and 29.05.2008. The following growth parameters were recorded at 30, 45, 60, 75 and 90 DAS *viz.,* plant height, dry matter production (DMP), Number of panicles/m^2, Number of spikelets/panicle and Number of grains/panicle. The Grain yield (kg ha^{-1}), Biological yield(kg ha^{-1}), Straw yield(kg ha^{-1}), Harvest index (%) was recorded at harvest. The data obtained in respect of various observations were statistically analyzed by the method described by Cochran and Cox (1963). The significance of "F" and "t" was tested at 5 per cent level of significance. The critical difference value was determined when "F" test was significant.

RESULTS AND DISCUSSION

Residual effect on oats : Residual effect on any nutrient depends on the several factors viz., amount and kind of fertilizer applied, soil condition, yield of crop

and efficiency of succeeding crop. In the present study, the experiment included application of recommended dose of nitrogen, phosphorus and potassium to oats crop given after fodder maize with cowpea intercrop (80, 40 and 20 kg N, P_2O_5 and K_2O/ha, respectively).

Effect of organic fertilizers : Organic manures, besides supplying nutrients to the crop often leave substantial residual effect on the succeeding crops in the system (Shivanand, 2004). Residual organic matter added to the soil by the manure refers to the carryover benefit of the application. Nutrient present in the organic matter are not fully available to the crops in the seasonal application. Amongst different organic fertilizers, O_3 (5 t FYM + 1 t poultry manure /ha) produced significantly taller plants and more dry matter production than rest of the treatments during both years of experimentation (Table-1). The Number of panicles/m^2, spikelets/panicle and Grains/panicle recorded with O_3 (5 t FYM + 1 t poultry manure/ha) was significantly more compared to other organic fertilizer combinations during both years of study (Table-2). The improvement of above growth parameters in oat crop is associated with increase in NPK in the soil due to residual effect of FYM and poultry manure application. Better crop growth recorded might be the result of adequate nutrition released by organics as earlier reported by Babaji *et al.* (2011). The present study also revealed that organic fertilizer combination O_3 (5 t FYM/ha + 1 t Poultry manure/ha) at par with O_1 (10 t FYM/ha), O_2 (5 t FYM/ha + 1 t Vermicompost/ha) and O_4 (5 t FYM/ha + 2.5 t Sheep manure/ha) applied to fodder maize significantly increased grain yield of succeeding oats crop during both years of experimentation compared to O_5 (5 t FYM/ha + 0.5 kg Azospirillum/ha). However, straw yield was not affected by organic fertilizer combinations (Table 3). The significant increase in the grain yield could be attributed to the absorption of nutrients which is associated to manure quality, mineralization intensity and utilization by a given crop. Similar findings have also been reported earlier by Silva *et al.* (2009) working under Brasilia conditions. The study further revealed that the growth characters viz., plant height, dry matter accumulation at flowering and maturity, yield attributes viz., panicles/m^2 and grains/panicle and nitrogen, phosphorus and potassium uptake in grain and straw improved significantly with O_3 (5 t FYM/ha + 1 t Poultry manure /ha) applied to the fodder maize compared to O_5 (5 t FYM/ha + 0.5 kg Azospirillum/ha). All the organic manure combinations remained statistically at par with one another except for grains/panicle. Earlier Bharambe *et al.* (2002) studied soybean-sorghum cropping sequence and reported that application of 5 Mg/ha sugarcane trash + 80, 40 and 49 kg N, P and K/ha to soybean recorded the highest fodder and grain yield of sorghum as well as growth and yield contributing characters. The residual nutrients especially N, P and K released from organic fertilizer combinations especially O_3 (5 t FYM/ha + 1 t Poultry manure /ha) may have helped in improvement of growth and yield contributing characters. Similar findings have also been reported earlier by Singh *et al.* (1996).

Effect of inorganic fertilizers : On an average a crop removes ½ to ¾ of applied nitrogen (Tisdale and Nelson, 1975). What is left, however, is not all carried over because of various losses. The nitrogen salts move up and down in the soil solution depending upon direction of water movement. Of the two nitrogen salts, nitrates move readily while ammoniacal nitrogen is adsorbed by soil colloids. Phosphorus is reported to be retained in soil not only for a season or so but for longer periods. In addition, phosphorus is responsible for better root development which helps in more foraging capacity of plant roots and better utilization from soil. Potassium ion is positively charged and tends to attach itself to the colloidal complex and is restricted in movement. Hence, the amount and type of clay and the amount of organic matter present in the soil invariably influences its movement and as such is reported to be retained in the soil for longer periods. The results infer that amongst different inorganic fertilizer levels, F_3 (100% RFD) produced significantly taller plants, DMP and other yield attributes than F_1 (50% RFD) and F_2 (75% RFD) during 2007-08 and 2008-09. The present study also revealed that fertility level F_2(75% RFD) significantly increased grain yield of oats over F_1 (50 % RFD) with a yield superiority of 23.72 and 23.99 per cent during 2007-08 and 2008-09, respectively, whereas straw yield showed significant and consistent increase up to F_3 (100% RFD) fertility level (Table 3). Munir and Ranjha (2004) also reported that increasing dose of phosphorus applied to wheat significantly increased fresh and dry fodder yield of succeeding fodder sorghum. The increase due to the residual NPK could be the result of favourable effect on growth characters. The plots supplied with higher doses of NPK in fodder maize with cowpea intercrop produced

vigorous oats plants. The study also revealed that the plant height, dry matter accumulation at flowering and maturity and various yield attributes viz., panicle/m^2, grains and spikelets/panicle of oats showed significant improvement with increase in the fertility level from F_1 (50% RFD) to F_2 (75% RFD). Increase in the availability of nutrients and enhanced meristematic activity may have contributed in the improvement of yield attributes. Karezmarczyk *et al*. (1996) observed similar results.

CONCLUSION

Application of 5t FYM + 1t poultry manure/ha (O_3) significantly increased the plant height, dry matter production, number of panicles/m^2, grains and spikelets/panicle of oats over 5t FYM/ha + 0.5 kg Azospirillum /ha (O_5). Organic fertilizer combination O_3 (5t FYM + 1t poultry manure/ha) significantly improved grain yield of oats over O_5 (5t FYM/ha + 0.5 kg Azospirillum /ha), however straw yield remained unaffected with different organic fertilizer combinations. The plant height, dry matter production, number of panicles/m^2, grains and spikelets/panicle improved significantly with increase in fertility levels from F_1 (50% RFD) to F_2 (75% RFD) beyond which level the difference remained statistically unmarked. The grain yield of oats improved significantly with increase in fertility level from F_1 (50% RFD) to F_2 (75% RFD), whereas straw yield showed significant and consistent increase with increase in the fertility level from F_1 (50% RFD) to F_3 (100% RFD). Thus, the result of the study lead to the conclusion that for realizing higher yields in oats crop under temperate environment of Kashmir Valley, the integrated nutrient management must centre around 5t FYM + 1 t poultry manure + 75 % recommended NPK/ha in preceding fodder maize along with recommended package for succeeding oats crop i.e. 80 – 40 – 20 kg N, P_2O_5 and K_2O/ha, respectively. However, such nutrient studies require more critical testing at various locations over a longer period before final recommendations are made.

REFERENCES

1. Anonymous (2005). *Digest of Statistics*. Directorate of Economics and Statistics, Planning and Development Department, Government of Jammu and Kashmir, Srinagar.
2. Babaji, B.A.,Yahaya, R. A. and Mahadi, M.A. (2011). Growth attributes and pod yield of four cowpea [*Vignaunguiculata*(L.) Walp.] varieties as influenced by residual effect of different application rates of farm yard manure. *J. Agric. Sci., 3(2):* 165-171.
3. Bharambe, P.R; Tajuddin, A.H; Oza, S.R. and Shelke, D.K. (2002). Effect of irrigation and crop residue management on crop and soil productivity under soybean-sorghum cropping system. *Journal of the Indian Society of Soil Science*, *50(3):* 233-236.
4. Cochran, G. C. and Cox, M. M. (1963). Experimental Designs. *Asia Publishing House*, Bombay, pp. 293-316.
5. Hussain, A., Khan, S., Mufti, M.U. and Bakhsh, A. (2002). Introduction and use of oats cultivars in Pakistan. Proceedings of "5th TAPAFON (Temperate Asia Pasture and Fodder Network) meeting/conference held at Renewable Natural Resources Research Center, Bajo (Wangdue-Bhutan). pp. 159-166.
6. Karczmarczyk, S; Koszanshi, Z; Friedrich, S. and Kowalski, W. (1996). Comparisions of the reaction of two oat cultivars to sprinkle irrigation and mineral fertilizer application on growth, development and yield. *ZeszytyProblemowePosterpowNaukRoliniezych*, 438: 219-226.
7. Munir, I. and Ranjha, A.M. 2004. Effect of residual phosphorus on sorghum fodder in two different textured soils. *International Journal of Agriculture and Biology, 6(6):* 967-969.
8. PanunziEleonora. 2008. *Brief analysis of FAO Statistical Data on Pasture and Fodder Crops.*
9. Shivanand, T. (2004). *Practical Soil Science and Agricultural Chemistry*. Published by International Book Distribution Co., Lucknow, UP, India.
10. Silva-Le-Sergio, Paulo; Silva-de-Jaeveson, Oliveira-de-T, Henrique. Fabio, Ana Karenina Sousa and Gustavo, P. Duda (2009). Residual effect of cattle manure application a green ear yield and grain yield. *Hortic. Bras., 24(2):* 1-6.
11. Singh, J; Pathak, H; Debnath, G. and Bajaj, J. C. (1996). Productivity of maize-chickpea-sorghum (fodder) cropping system with integrated use of biogas slurry and fertilizer. *Fertilizer News*, *41(7):* 43-46.
12. Tisdale, S. L. and Nelson. W. L. (1975). *Soil fertility and fertilizers*. Macmillan Publication Co. New York, pp. 556-574.
13. Tripathi, S. B. (2003). Nutrient management in forage based cropping system. *Fertilizer News*, *48(10):* 41-45 & 47-48.