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Evaluation of Yield Potential of Forage Maize (*Zea mays*) with Legumes in Inter-Cropping System under Organic Manure Nutrient Management

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Abstract

A field experiment was conducted during the rainy (Kharif) season of 2003 and 2004 to evaluate the production potential of maize (*Zea mays* L.) + legumes intercropping systems. The highest green forage (530.8 q/ha) and dry matter (59.2q/ha) yields were obtained when maize + cowpea [*Vigna unguiculata* (L.) walp.] was sown in planting pattern of 2 : 2 followed by 3:2 ratio maize + cowpea (527.3 q/ha) green and dry matter 55.7 q/ha) Maize + cowpea 2 : 2 ratio also gave maximum CEY 29.5q/ha in 2011-12. However, maize + cluster bean [*Gyamopsisteragonoloba* (L.) Taub.] in 3 : 3 row proportion recorded the second maximum land-equivalent ratio over all other treatments. The trial was repeated in 2011-12 for evaluation of seed yield and quality.

Key words : *Maize, intercropping, organic manure, seed yield, cowpea, cluster bean.*

Introduction

Quality forage production plays an important role in dairy industry. The area under fodder crops in India is about 4-5% of the cultivable area, as the feed and fodder crops hardly find any place in common cropping pattern. There is an urgent need to increase the productivity, production and quality of fodder crops in the country. Development of dual purpose (grain cum fodder) crop varieties is prime need to feed cattle as well as generate income to farmers. In this direction Meena *et al.,* reported sorghum hybrid cross combinations, ICSA 29011 x SPV 1822, ICSA 29006 x SPV 1822 and ICSA 29016 x SPV 1822 exhibited significant and positive heterobeltiosis for green fodder yield, dry fodder yield and some of the yield contributing traits.

Although, Cultivation of cereal forages along with leguminous crop either mixed or in an intercropping system appears to be a prospective method to produce more and nutritious fodder with an appreciable improvement in the enrichment of the soil. Present study was under taken to assess the forage productivity of maize along with cowpea and cluster bean intercropping system in Bareilly district of western Uttar Pradesh. Interestingly after rice and wheat, maize is one of the most important cereal crop in the world and has pivotal role in world's economy (1). Maize-legume systems come in three basic configuration. One is intercropping, in which maize and legumes are planted simultaneously in the same or alternating rows. Another approach is relay cropping, where maize and legumes are planted on different dates and grow together for at least a part of their life cycle. Maize and legumes may also be grown as monocultures in rotation, with maize being planted in the same field after the legume harvested. In developing countries of legumes include beans, pigionpeas, cowpeas, soybeans and groundnuts for food and non edible legmes like velvet beans and jock beans as a feed for livestock. The soybean shed 9-100% of its leaves at physiological maturity which resulted in about 110 kg/ha^{-1} N uptake. This source of nitrogen might be one of the factors responsible for the increase in maize yield that followed by soybean (20-40%) compared with maize yield plot. Nodule number did not differ significantly among genotypes, the weight was higher in soybean than cowpea.

Intercropping significantly improved photo-synthetically active radiation (PAR) to sole maize. LER indicates intercrops were relatively efficient and productive than sole crops. LER was higher in less fertility field than fields high in fertility. Within-row system significantly intercepted more PAR(mostly at mid to late pod filling stage of legumes), Higher MAI (Monitory Advantage Index) than 1:1 and 2:2 systems. Intercrop grain yielded followed similar trend as IPAR, LER, and MAI with highest yield (cowpea -20.6, Soybean – 17.9, ground nut-8.2, maize 30.7 q/ha^{-1}) achieved within row systems (2). In poor fertility fields, intercropping of maize into legumes is a safeguard household food and income security of resource poor small holders.

Materials and Methods

The trial was conducted on the farmers' field in Bithari Block of Bareilly district, during monsoon (Kharif) season

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Table : Effect of Intercropping forage and dry matter mean yield (q/ha) seed yield and protein content in seed.

Treatment	Forage mean yield (q/ha)		2011-2012 Seed yield (q/ha)				Protien %		
	Green	Dry	Maize	Cowpea	Cluster bean	CEY	Maize	Cowpea	Cluste rbean
Maize + Cowpea 2 : 2	530.8	59.2	18.3	5.6	-	29.5	11.3	22.8	-
Maize + Cowpea 3 : 2	527.3	55.7	19.2	4.1	-	27.4	11.9	22.4	-
Maize + Cowpea 3 : 3	515.1	53.1	18.3	4.3	-	26.9	11.2	23.1	-
Maize + Clusterbean 2 : 2	509.2	57.7	17.3	-	3.7	24.4	11.5	-	11.4
Maize + Clusterbean 3 : 3	511.1	56.3	19.3	-	4.5	28.3	11.1	-	10.9
Maize	505.2	53.9	24.7	-	-	24.7	11.1	-	-
Cowpea	375.3	38.3	-	12.2	-	24.4	-	24.1	-
Clusterbean	375.3	39.6	-	-	19.7	23.1	-	-	12.3
spalphaMean	481.2	51.7	14.6	3.3	3.5	26.1	8.5	11.6	4.3
CD 0.05	6.11	2.32	1.78	1.23	1.41	3.21	1.28	2.33	1.78

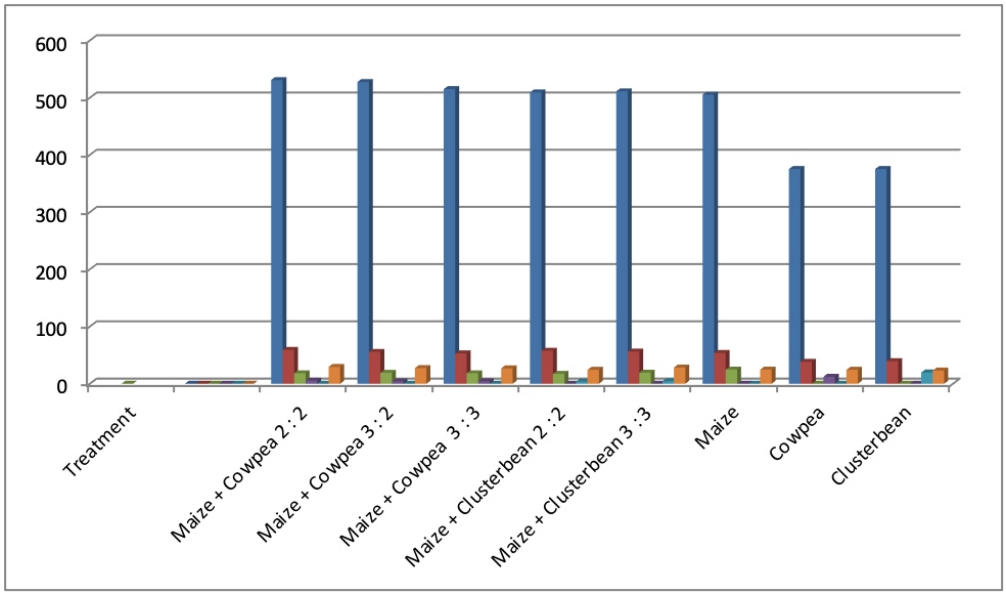

Fig.-1 : Effect of Intercropping forage and dry matter mean yield (q/ha) seed yield.

of 2003 and 2004. The sandy loam soil of the experimental plot had organic carbon 0.51%, available nitrogen 275 kg, available phosphorus 28 kg (P_2O_5) and available potassium 235 kg (K_2O)/ha with pH 7.4. Total treatments were replicated 3 times in randomized block design. The crops were sown at 25 cm spacing in row proportion as per treatments in the second week of July 2003 and 2004. Package of practices recommended for crops were followed as per fodder crop cultivation. Maize and legume crops were harvested at milk stage of maize for green forage yield. Plant nutrients as per recommended dose were applied through organic manures (50-55%) in form of vermi compost and FYM including bio-fertilizers.

Results and Discussion

Inter-cropping / LER / CEY : Inter-cropping improved resource use efficiency and productivity in relative to sole crops. Within-row system was more efficient and productive than distinct rows. With maize-legume intercropping, achieved higher LER. It might be due to higher resources use efficiency and grain productivity.

Protein content : Protein content was found little higher in maize seed received from intercropping system. It might be due to higher level of availability of nitrogen through biological fixations at seed filling stage by legumes.

Small holder farmers grow velvet beans in the maize 'Off season' – which leads to higher level of organic matter, nitrogen availability and upto 25 percent-increase in yields of the subsequent maize crop. Studies in Africa found that under conservation agriculture, the highest maize yield increases were achieved when the cereal was roted with legumes such as beans, cowpea and soybean. A highly productive maize-soybean rotation system, planted before maize, the soybean reduces triger infestations.

Maize-legume systems usually produce less maize than mono culture but provide higher income returns.

Fig.-2 : On farm trials in adopted villages.

Rotations provide better yields and higher profits than maize-legume systems especially suitable for small holders. One hectare of soybean fixes 22kg of nitrogen, produces 2.5 tonnes of forage and reduces striga infestations. Under conservation agriculture, the highest yields are achieved when maize is rotated with legumes.

Green forage and dry-matter yields were affected by various treatments. The total green forage and dry matter yields were highest under maize + cowpea in 2 : 2 ratio (530.8q/ha) which were at par with system of 3 : 2 row ratio of maize + cowpea intercrop (527.3q/ha). Combination in 2 : 2 proportion was 9.7% and 7.3% over yield of sole maize. Similarly, corresponding increase in dry forage yield was recorded 6.8% and 13.5% during respective years. The findings are in accordance to (1, 3). Intercropping planting pattern of maize + cowpea or maize + clusterbean in all row ratio produced significantly higher green and dry matter yield than sole crop of maize, cowpea and clusterbean. The increase in the overall yield of green and dry matter in the cropping system might be due to intercropping with leguminous crop because this might be nutrient sparing effect in root zone of cereal crop. Atmospheric nitrogen fixed by bacteria in root nodules of leguminous crops, enriched nitrogen supply to non leguminous fodder crops, sown in intercropping system of forage production under trial. Maize-legume rotations also help to maintain soil fertility in Mexico.

Conclusions

Maize + cowpea in 2 : 2 ratio produced highest yield of forage and dry matter over other intercropping system as to maize + clusterbean or sole crop of maize, clusterbean or cowpea under different treatments of the experiments. In farmers field maize protein content also improved in association with legumes crops. Economic crop equivalent yield was maximum yield was received from maize + cowpea (2 : 2 Ratio) followed by maize+cowpea (3 : 2 ratio), followed by maize + clusterbean (2 : 2 ratio).

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