The Journal of Rural and Agricultural Research Vol. 13 No. 2, 90-93 (2013)
Received June 2013; Acceptance Septmber 2013

Studies on planting densities and nutrient management of component crop in maize (*Zea mays* l.) and local field bean (D*olichus lablab* l.) intercropping system

R. MOHAN KUMAR, G. K. GIRIJESH, K. MANJUNATHA CHARI[1] AND MUNNALAL[2]
Department of Agronomy, University of Agricultural Sciences, Banagalore-65,

Abstract

A field experiment was carried out in 2010 to determine the appropriate spatial arrangement of component crops in the maize-field bean intercropping system for optimum grain yield and production efficiency. The experimental design was a randomized complete block design with three replications. Treatments consisted of combinations of three relative row proportions of maize and field bean and two nutrient management practices. One sole crop each of maize and field bean was added for comparison along with farmers practice. The results indicated that the spatial arrangement and nutrient management practices are important factors determining the productivity of the maize + field bean intercropping system. The spatial arrangement to adopt in order to obtain high yields for the component crops differed significantly. For spatial arrangement of four rows of maize alternating with two rows of field bean gave the best maize equivalent yields (4888.65 kg ha^{-1}). System harvest index (0.37), B:C (3.24) were significantly higher over other and LER (1.37) and ATER (1.68) values recorded were in general greater than unity, implying that it will be more productive to intercrop maize and field bean than grow them in monoculture.

Keywords: maize, field bean, intercropping, equivalent yield, LER, ATER spatial arrangement, B:C, System Harvest index

Introduction

Maximum production can be obtained by adjusting the best planting pattern which maintains the population (Nawab *et al*., 1999). The intercropping is one such opportunity to get economically viable farming practices has long been recognized in India. For many centuries, the Indian farmer has practiced this system in some form or the other. The main concept of intercropping is to get increased productivity per unit land area and time and also equitable and judicious utilization of land resources and farming inputs including labour. The magnitude of the agro-economic advantages depends upon the type of intercrop (Rao, 1991). Due to ever increasing pressure on cultivated land for food and commercial crops, it may not be possible to increase the arable area under forage and green manuring crops. One of the potential opportunities to meet this demand is by inclusion of dual purpose leguminous crops in intercropping systems like field bean local

Materials and Methods

A field experiment was conducted during *kharif* 2010 at Zonal agricultural Research station, Navile, Shimoga. The soil was sandy loam in texture having low organic carbon (0.39 %) and available nitrogen (229 kg ha^{-1}), phosphorus (139 kg ha^{-1}) and potassium (174 kg ha^{-1}) were low, high and medium, respectively with pH 5.7. a set of nine treatments comprising of maize + field bean 4:1 with 100 NPK to only main crop, maize + field bean 4:2 with 100 NPK to only main crop, maize + field bean 8:2 with 100 NPK to only main crop, maize + field bean 4:1 with 100 NPK to both the crop, maize + field bean 4:2 with 100 NPK to both the crop, maize + field bean 8:2 with 100 NPK to both the crop, farmers practice (8:2 row proportion with 200 kg DAP + 50 kg urea ha^{-1}), sole maize and sole field bean. Crops were planted in line at the spacing of 45 cm x 20 cm in case of maize and 45 cm x 15 cm in case of field bean as per the treatment details. Seeds of maize (NAH 2049) and field bean (var. local) were used, planting were done on 15th June 2010). A common dose of fertilizerat100:50:25 and 25:50:25 kg NPK per hectare respectively was applied to sole crop of maize and field bean. To the intercropping system a fertilizer dose proportionate to the area occupied by intercrop population was applied in addition to the fertilizer dose given to the base crop. For assessing the biological feasibility and economic viability of the

[1]Department of Soil Science, University of Agricultural Sciences, Dharwad-05
[2]Central Research Institute for Dryland Agriculture, Hyderabad - 59

system, land use and production efficiency were computed as suggested by Willey (1979) and Heibseh (1978) and other different functions were calculated by the following formulae.

$$\textbf{MEY} = \text{Maize yield (kg ha}^{-1}) + \frac{\text{Intercrop yield (kg ha}^{-1}) \times \text{price (Rs kg}^{-1})}{\text{Maize price (Rs. kg}^{-1})}$$

$$\textbf{LER} = \frac{Yab}{Yaa} + \frac{Yba}{Ybb}$$

$$\textbf{ATER} = \frac{(Rya \times ta) + (Ryb \times tb)}{T}$$

Where,

Ry = Relative yield of species a and b

$$i.e., = \frac{\text{Yield of component crop under intercropping per hectare}}{\text{Yield of component crop under sole cropping per hectare}}$$

$$\textbf{SHI} = \frac{\text{Economic yield of main crop + Economic yield of component crop}}{\text{Biological yield of main crop + Biological yield of component crop}}$$

$$\textbf{Benefit: cost} = \frac{\text{Gross returns } (Rs.\ ha^{-1})}{\text{Cost of cultivation } (Rs.\ ha^{-1})}$$

Where, Y_{ab} and Y_{ba} are the yields as intercrop of a and b

Y_{aa} and Y_{bb} are the yield of a and b in sole cropping

t = Duration (days) for species a and b

T = Total duration (days) of the inter cropping system.

Results and Discussion

Plant density:

The intercropping of field bean in maize followed for the study is replacement series. While introducing field bean with varied row proportion as intercrop in maize, maize population was reduced by field bean to an extent of 20 per cent in case of (4:1) and (8:2) and 33 per cent in case of (4:2) row proportion. field bean crop intercropped in maize planted at different planting patterns produced different number of plants unit area. A slight higher plant population was observed in case of field bean intercropped in row proportion of 4:1 and 8:2 which produced 88,888 plants ha^{-1}. While minimum were recorded in 4:2 row proportion 66,666 plants ha^{-1}. Sahi (1988) and Saleem (1991) also reported that plant population m-2 of lentil was reduced significantly by the associated wheat crop as compared to its sole planting.

Maize Seed yield:

Sole maize showed higher growth and yield attributes over intercropped maize (Table 1) plant height, leaf area index, dry matter production, grains per cob and 100 grain weight of maize decreased significantly in intercropping depend on the row proportion. Maize in association with field bean in 4:2 row proportion with 100 per cent NPK to both the crop has recorded taller plants, higher LAI, more dry matter production, grains per cob and test weight compare to other treatments. Maximum reductions in growth and yield attributes were recorded in farmers practice due to lack of recommended dose of fertilizer and also luxuriant growth and establishments of field bean exerted more competition.

Sole crop resulted in higher grain and Stover yield in comparison to their intercrop due to less interspaces competition and increased habitat population. Significantly higher grain yield of maize was recorded under sole stand. Among different intercrop combination significantly higher grain and Stover yield were recorded under the maize + field bean 8:2 with 100 per cent NPK to both the crops (Table 1). This was recorded on account of improvement in the yield attributes and the higher plant population per unit area. These results are in consonance with Ullah *et al.* (2007) and Akman & Sencar (1999) reported significant results.

Field bean Seed yield:

Significantly higher grain yield were registered in sole maize, a considerable decrease of grain yield was observed by intercropping field bean in various planting patterns of maize. In various planting patterns intercropping of field bean produced a grain yield ranging from 88 to 110 kg ha-1 where field bean was not fertilized with recommended dose of fertilizers. Among intercropping treatments higher seed yield was recorded when field bean was intercropped in maize + field bean 4:2 with 100 per cent recommended dose of NPK applied to both the crops. The lowest yield was recorded when mash was planted in 4:1 with 100 per cent NPK only to maize. The resulting lower yield due to intercropping is ascribed to a lower plant population and fewer number of seeds plant-1in unfertilized rows of field bean (Table 1). A higher yield in the maize + field bean 4:2 with 100 per cent NPK to both the crop was attributed to a greater number of seeds plant-1 as well as a higher 100- seed weight due to more and longer pods plant-1 in contrast unfertilized field bean. This difference in yield might be due to the availability of more space for light interception and air circulation and less shading of associated maize crop. Several authors (Rao & Sadaphal 1993, Rao 1982) have also reported reduction in yield of legumes when intercropped in maize.

System harvest index, Maize equivalent yield, Land Equivalent Ratio and Area Time Equivalent Ratio:

System harvest index Maize equivalent yield, Land Equivalent Ratio and Area Time Equivalent Ratio

Table 1: Grain yield and maize grain (kg ha^{-1}) equivalent yield of maize and field bean intercropping system as

Treatments	Plant population (%)		Nutrient management		Grain yield (kg ha^{-1})		MEY
	Maize	Field bean	Maize	Field bean	Maize	Field bean	(kg ha^{-1})
T_1 M+FB 4:1	80	20	100 % RDF	-	3646	88	3846.52
T_2 M+FB 4:2	66	33	100 % RDF	-	3588	136	3897.85
T_3 M+FB 8:2	80	20	100 % RDF	-	3932	110	4182.14
T_4 M+FB 4:1	80	20	100 % RDF	100 % RDF	4027	280	4664.31
T_5 M+FB 4:2	66	33	100 % RDF	100 % RDF	3836	463	4888.65
T_6 M+FB 8:2	80	20	100 % RDF	100 % RDF	4054	300	4736.50
T_7 M+FB 8:2	80	20	200 kg DAP + 50 kg urea as top dress ha^{-1}		3143	258	3729.94
T_8 Sole maize	100	0	100 % RDF		4361	-	4361.00
T_9 Sole field bean	0	100		100 % RDF	-	934	2122.73
S. Em±					210.16	12.84	199.90
CD (P=0.05 %)					647.62	39.56	599.40
C.V. %					9.52	6.92	8.55
Mean					3823.88	321.13	4048.00

Influenced by per cent plant population and nutrient management

M: maize F: field bean RDF: recommended dose of fertilizer DAP: di-ammonium phosphate

Table 2: LER, ATER, Net returns, B:C of maize and field bean intercropping system as influenced by per cent plant population and nutrient management

Treatments	Plant population (%)		Nutrient management		Harvest index		SHI	LER	ATER	B:C
	Maize	Field bean	Maize	Field bean	Maize	Field bean				
T_1 M+FB 4:1	80	20	100 % RDF	-	0.35	0.28	0.35	0.928	1.039	2.32
T_2 M+FB 4:2	66	33	100 % RDF	-	0.35	0.30	0.35	0.945	1.036	2.47
T_3 M+FB 8:2	80	20	100 % RDF	-	0.37	0.27	0.37	1.018	1.092	2.51
T_4 M+FB 4:1	80	20	100% RDF	100% RDF	0.38	0.32	0.37	1.226	1.415	2.80
T_5 M+FB 4:2	66	33	100% RDF	100% RDF	0.37	0.34	0.37	1.376	1.685	3.24
T_6 M+FB 8:2	80	20	100% RDF	100% RDF	0.37	0.34	0.37	1.252	1.452	2.84
T_7 M+FB 8:2	80	20	200 kg DAP + 50 kg urea as top dress ha^{-1}		0.36	0.30	0.35	0.99	1.171	2.66
T_8 Sole M	100	0	100 % RDF		0.33	-	0.33	1.00	1.00	2.74
T_9 Sole FB	0	100		100 % RDF	-	0.28	0.28	1.00	1.00	2.20
S. Em±CD (P=0.05 %)C.V. %Mean0.04NS12.140.36					0.030.0911.170.30			0.140.439.402.64		

M: maize F: field bean RDF: recommended dose of fertilizer DAP: di-ammonium phosphate SHI: System harvest index LER: land equivalent ratio ATER: area time equivalent ratio B:C: benefit cost ratio

calculated from intercrop yield were 0.37, 4888.65 kg ha^{-1}, 1.37 and 1.68 respectively in maize + field bean intercropping system which were higher over other intercropping treatments and sole cropping (Table 2) the LER and ATER values more than unity indicates the higher yield advantages over sole cropping. It might be due to better growth and establishment of both the component crops at 4:2 row proportions with 100 per cent NPK to both the crops. Aal (1991) and Raghuwanshi *et al.* (1994) also reported a higher LER in intercropping as compared to Sole crops.

Conclusions

Intercropping system reduced the grain yield to a significant extent. However, additional production from intercrop obtained from maize + field bean compensated more than the losses in maize production. Planting pattern had significant effect on grain yield and 1000 grain weight. Maximum maize equivalent weight was recorded in maize + field bean 4:2. Further, maximum LER, ATER, B:C, system harvest index was recorded in same treatment which clearly shows efficient system productivity.

References

Aal, S. M. 1991. Studies on the response of some soybean varieties to intercropping with cotton, *Ann. Agric. Sci*. Moshtohor, 29(1): 37-50

Akman, Z. and Sencar. 1999. Effect of various sowing patterns on grain yield and agronomic characters of intercropped maize and legumes (bean and cowpea). *Turk. J. Agri. Forst*. 23(5): 1139-1148. (CAB Absts., 1998-2000).

Hiebsch, C. K., and Macollam, R. E., 1980, Area time equivalent ratio. A method of evaluating productivity of intercrops. *Agron. J.,* 75: 15-22.

Nawab, K., M. Hatman, B.A. Khan, K. Rasul and M. Mansoor. 1999. Study of some morphological characters in maize as affected by time of weeding and plant spacing. *Sarhad J. Agric*. 154(1): 21-24.

Raghuwanshi, R. K. S., R. Umat, A. K. Gupta, and Gurjar, N.S., 1994. Performance of soybean-based intercropping systems in black cotton soils under different fertility levels, *Crop Res*. Hisar, 8(2): 233-238.

Rao, B. R. R., M. N. Sadaphal. 1993. Intercropping cotton with green gram and cowpeas and its residual effect on succeeding wheat crop. Zeitchrift fur Acker-und pflamzembau, 152(3): 199-207.

Rao, M. H. 1982. Intercropping in cotton. Cotton Dev., 12(1/2): 33-34.

Sahi, F.H. 1988. Studies on wheat-lentil intercropping system under irrigated conditions, *M.Sc. (Hons.) Agric. Thesis, Uni. Agri*. Faisalabad, Pakistan.

Saleem, K. 1991. Effect of some legume and non-legume associated cultures on growth and yield of lentil, *M.Sc. (Hons) Agric. Thesis, Uni. Agri*., Faisalabad, Pakistan.

Ullah, A., M.A. Bhatti, Z.A. Gurmani and M. Imran. 2007. Studies on planting patterns of maize (*Zea mays* L.) facilitating legumes intercropping. *J. Agri. Res.* 45: 113-117.

Willey, R. W., 1979, Intercropping its importance and research needs, Part-I, competition and yield advantageous. *Field Crop Abstracts,* 32: 1-10.