Research Article

Production Efficiency of Maize with Legumes Intercropping and Weed Management Under Rainfed Condition

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Abstract

Three sets of field experiment was conducted during *kharif* seasons of 2006, 2007 and 2008 at Central Crop Research Farm, Sham Higginbottom University of Agriculture Technology and Sciences, Allahabad to assess the productivity of *kharif* maize (*Zea mays* L.) under legumes viz., black gram, greengram, cowpea and soybean intercropping system and its effect on weeds. The association of maize with blackgram, greengram and cowpea showed the highest land equivalent ratio (1.38) which were statistically at par. Maximum relative crowding coefficient values (10.79) was recorded in maize + greengram intercropping followed by inter cropping of maize + blackgram, aggressivity index (0.60) was statistically similar and significantly higher under intercropping of maize + soybean but it was statistically similar to intercropping of maize + blackgram, maize + greengram and maize + cowpea, respectively.

Keywords: LER; RCC; AI; Maize; legume; Intercropping.

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Introduction

Intercropping has been a popular farming practice from time immemorial which has received greater attention of the farming community because of its potential advantages, offers utilization of growth resources viz., land, water, nutrients and light by the crops and sustaining productivity [1]. One such system is intercropping of pulses with maize, which is one of the principal food crops of India has long been also a common practice in developing countries. Farmers are motivating to adopt intercropping primarily due to its economic gains [2], purpose of risk covering practice in tradition bound agriculture to make up a part of crop loss in rainfed and dryland tracts [3]. In intercropping systems when a legume is grown in association with cereals, the nitrogen of the associated crop may be improved by direct nitrogen transfer from legume to cereal. Legumes with their adaptability to different cropping patterns and their ability to fix nitrogen, may offer opportunities to sustain increased productivity. Productivity normally is enhanced by intercropping legumes in cropping systems. Legumes, both alone and as intercrop with cereals, have been advocated not only for yield augmentation but also for maintenance of soil health, particularly in degraded soil. The competitive behavior of component crops in different intercropping systems was determined in terms of land equivalent ratio, relative crowding coefficient and aggressivity index etc. In general intercropping is being looked as an efficient and most economical production system in India as it not only increases the production per unit area and time but also improves the resource-use efficiency and economic standard of the growers. The present study describes the production efficiency of maize based legume intercropping system and weed management under Allahabad condition.

Materials and Methods

Three sets of field experiment was conducted under rainfed condition during rainy season *(kharif)* of 2006, 2007 and 2008 at Crop Research Farm, Department of Agronomy, Sham Higginbottom University of Agriculture Technology and Sciences, Allahabad. The soil was sandy loam, neutral in reaction (pH 7.6), low in available nitrogen (196.3 kg/ha), medium in available phosphorus (17.21 kg/ha) and potassium (245.6 kg/ha) [4]. There were 25 treatment combinations of 5 intercropping systems viz., sole maize, maize + blackgram, maize + greengram, maize + cowpea

and maize + soybean and 5 weed control methods viz., control, hand weeding, pendimethalin 1 kg/ha, alachlor 2 kg/ha and metolachlor 1 kg/ha. The experiment was laid out in a factorial randomized block design with 3 replications. The recommended dose of fertilizers 120:60:60 NPK kg/ha. One-third of N, whole P_2O_5 and K_2O were applied at the time of sowing, while remaining two-third N was top dressed in 2 splits at knee height and tasseling stage and was planted in rows spacing 60 cm apart with a row of legume in between maize row as per treatment. Plant to plant spacing was kept as 25 cm and for legume as 10 cm. The herbicides were applied with the help of hand compression sprayer using of 650 L/ ha water as per treatment. Weeds were removed manually at 30 days after sowing as hand weeding plots.

The productivity functions were computed in the form of land equivalent ratio, relative crowding coefficient and aggressivity. Abbreviations used to calculate different productivity functions were Yaa pure stand yield of crop "a", Yab intercrop yield of crop "a", Ybb pure stand yield of crop "b", Yba intercrop yield of crop "b". The land equivalent ratio (LER) was worked out by using the formula of [5] as LER= (Yab/Yaa) + (Yba/Ybb). Relative crowding coefficient (K) as proposed by [6] as Kab=(Yab/Yaa–Yab). Where, Kab is relative crowding coefficient for the component crop "a". The aggressivity (A) shows the degree of dominance of one crop over other in an inter cropping or maized cropping system. Aggressivity value was calculated by the formula proposed by [7] as Aab=(Yab/Yaa) – (Yba/Ybb), where Aab is aggressivity value for the component crop "a". All the other abbreviations have been described above in this section.

Results and Discussion

Land equivalent ratio

Land equivalent ratio values are greater than one in all the intercropping systems indicating the yield advantage in intercropping over sole cropping of maize (**Table 1**). Intercropping of maize with blackgram, greengram and cowpea, respectively gave the maximum land equivalent ratio (1.38) were equivalent, while the minimum land equivalent ratio (1.29) was recorded for maize + soybean intercropping.

Table 1 Biological parameters of maize based legume intercropping system and weed control (average data of 3 years)

Treatments	Grain yield(q/ha)			Land equivalent ratio			Relative crowding coefficient (rcc)			Aggressivityindex		
	Maize	Legume	CEY	Aab	Aba	LER	Kab	Kba	K	Aab	Aba	AI
Intercropping systems												
Sole maize	59.07	--	59.07	--	--	--	--	--	--	--	--	--
Maize + blackgram	56.86	7.94	73.46	0.98	0.4	1.38	12.87	0.67	10.09	0.98	0.4	0.58
Maize + greengram	56.48	8.32	73.22	0.97	0.41	1.38	13.87	0.7	10.79	0.97	0.41	0.56
Maize + cowpea	55.55	11.68	73.35	0.96	0.42	1.38	7.69	0.73	6.62	0.96	0.42	0.54
Maize + soybean	54.82	12.18	73.56	0.95	0.34	1.29	6.3	0.5	3.55	0.95	0.34	0.6
SE(d)	0.6612	0.1867	0.7204	--	0.0212	0.0421	0.9798	0.049	0.7348	--	0.0212	0.0548
CD (P=0.05)	1.3293	0.3759	1.4485	--	0.0429	0.0852	1.9835	0.0992	1.4876	--	0.0429	0.1109
Weed control methods												
Control	49.72	6.21	60.59	1.07	0.3	1.37	-21.06	0.43	-9.27	1.07	0.3	0.76
Hand weeding at 30 DAS	62.26	8.59	77.5	0.92	0.43	1.35	10.23	0.74	7.82	0.92	0.43	0.48
Pendimethalin 1 kg/ha	53.5	7.34	66.49	0.98	0.37	1.34	37.97	0.57	22.04	0.98	0.37	0.61
Alachlor 2 kg/ha	57.28	8.08	71.6	0.92	0.4	1.33	12.44	0.67	8.47	0.92	0.4	0.52
Metolachlor 1 kg/ha	60.02	9.28	76.47	0.93	0.46	1.4	11.34	0.84	9.77	0.93	0.46	0.47
SE(d)	0.6612	0.2287	0.7204	0.0492	0.0237	0.047	1.0954	0.0548	0.8216	0.0492	0.0237	0.0612
CD (P=0.05)	1.3293	0.4604	1.4485	0.0996	0.048	0.0952	2.2176	0.1109	1.6632	0.0996	0.048	0.124

These LER value showed that to produce a yield combined mixture by growing sole stand would require 38% and 29% more land, respectively. This yield advantage owing to intercropping systems might be attributed to the combined effect of better utilization of natural (land, light) and added (fertilizer) resources than sole cropping of companion crops, resulting higher productivity per unit area. These results are reported by [8]. The maximum average land equivalent ratio (1.32) was recorded in application of metolachlor and the minimum land equivalent ratio (1.26) was recorded in application of alachlor indicating yield advantage of 32 and 26%, respectively. Similar findings are reported by [9].

Relative crowding coefficient (RCC)

In all the intercropping system included in this study maize appeared to be highly dominant as it had higher values of 'K' than the intercrops in different legumes as intercropping systems except maize + soybean intercropping, that soybean intercrops were utilized resources more competitively than blackgram, greengram, cowpea and soybean which was dominated. As the product of the coefficient of component crop was greater than one therefore all the intercropping systems had yield advantages (Table 1). Significantly maximum yield advantage was obtained from maize + greengram intercropping as indicated by its product of RCC value (10.79) followed by intercropping of maize + blackgram but it was statistically equivalent. The minimum product value of (3.55) was recorded under intercropping of maize + soybean. This might be owing to better utilization of land with the component crops, which recorded higher productivity. These results are reported by [10]. Across the weed control treatment, significantly higher yield advantage was obtained in application of pendimethalin, metolachlor, alachlor and hand weeding, over the control. Maximum product of RCC values (17.83) was recorded in application of pendimethalin than application of metolachlor; however, control treatment was indicated that value 'K' less than one had a yield disadvantage.

Aggressivity Index (AI)

Aggressivity value of zero indicates that component crops are equally competitive. For any other situation, both crops will have same numerical value, but the sign of the dominant species will be positive and that of dominated negative. The greater numerical value the bigger differences between actual and excepted yields. The aggressivity index indicating is competitive behaviour of different intercrops components (Table 1). Significantly maximum aggressivity index was obtained under intercropping of maize + soybean followed by intercropping of maize + blackgram, but it was statistically similar to intercropping of maize + greengram and maize + cowpea, respectively. These results are reported by [11]. Amongst various weed control, significantly maximum aggressivity values of (0.76) was obtained under control followed by application of pendimethalin which was statistically similar to application of alachlor. While the minimum AI was recorded in application of metolachlor and hand weeding were statistically on par.

Conclusion

It is concluded that maize appeared to be the dominant crop as indicated by its higher values of relative crowding coefficient, land equivalent ratio and positive sign of the aggressivity index indicating competitive behaviour of different intercrops. Maize grown in association with blackgram, greengram, cowpea and soybean utilized the resources more aggressively hence conferring their suitability as promising crops in maize based intercropping systems under Allahabad condition.

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