



Effect of row ratios and levels of nitrogen on growth and yield of maize (*Zea mays* L.) and clusterbean (*Cyamopsis tetragonoloba* L.) intercropping system

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Abstract: A field experiment was conducted during the *kharif* season 2014 at the Crop Research farm, Department of Agronomy, Allahabad School of Agriculture, SHIATS, Allahabad (U.P.) to find out the effect of row ratio and levels of nitrogen on growth and yield of maize (*Zea mays* L.) + clusterbean (*Cyamopsis tetragonoloba* L.) intercropping system, laid out in Randomized Block Design with twelve treatments, replicated thrice. The results revealed that sole maize + 100 % RDN produced significantly higher plant height (130.73 cm), dry weight (88.98 g), no. of cobs plant⁻¹ (1.14), seed index (18.3g) and grain yield (7.43 t ha⁻¹) and also the highest benefit cost ratio (2.25).

Key word : Intercropping, Maize, Clusterbean, Nitrogen levels, Row ratios

Introduction

Intercropping increases the efficiency with which scarce resources are used and reduces the failure risk of a single crop that is susceptible to environmental and economic fluctuation. Intercropping increase the cropping intensity, productivity and profitability though optimum utilization of soil, water, nutrient and sunlight in time and space. Intercropping has gained interest because of potential advantages it offers over yield, i.e. improved utilization of growth resources by the crops and improved reliability from season to season. When a legume is grown in association with another crop (intercropping), commonly a cereal, the nitrogen nutrition of the associated crop may be improved by direct nitrogen transfer from the legume to cereal (Giller and Wilson, 1991). Legumes, with their adaptability to different cropping patterns and their ability to fix nitrogen, may offer opportunities to sustain increased productivity (Jeyabal and Kuppaswamy, 2001). Therefore, productivity normally is potentially enhanced by the inclusion of a legume in a cropping system. Maize (*Zea mays* L.) is the third most important cereal crop in the world after wheat and rice and known as "Queen of cereals". Approximately 8 to 10% of the corn crop is used as food for human consumption. It is not only a source of food, fodder and feed, but also many by-products like glucose, starch and corn oil, etc are prepared from it. The Guar or cluster bean (*Cyamopsis tetragonoloba* L.) is an annual legume and the source of guar gum. This legume is a very valuable plant within a crop rotation cycle, as it lives in symbiosis with nitrogen-fixing bacteria. In fact, agriculturists in semi-arid regions of Rajasthan follow crop-rotation and use guar as a source to replenish the soil with essential fertilizers and nitrogen fixation, before the next crop. Guar as a plant has a multitude of different functions for human and animal nutrition but its gelling agent containing seeds (guar gum) are today the most important use. Demand is rising rapidly due to industrial use of guar gum in hydraulic fracturing (oil shale gas).

About 80% of world production occurs in India and Pakistan, but, due to strong demand, the plant is being introduced into new areas.

Nitrogen being an essential plant nutrient, has a direct bearing effect on the maize yield. Besides its role in protein synthesis and nucleic acid, it is a structural components of chlorophyll. A significant linear increase in yield of maize with increasing rate of N application has been reported by Gul *et al.*, 2015 and Imran *et al.*, 2015. Grain yield has been reported to show linear increase with increasing plant density until other production factors were not limiting (Anjum *et al.*, 1992). Keeping the above points in mind the present experiment was laid out to find out the compatibility of clusterbean as an intercropping with *kharif* maize and to find out the most suitable nitrogen recommendation for maize + clusterbean intercropping system.

Materials and Methods

This experiment was carried out during *Kharif* 2014 at Crop Research Farm, Department of Agronomy, SHIATS, Allahabad, UP. The climate of this region is typically sub-tropical and semi-arid with monsoon commencing by the third week of June and withdrawing by end of September. The temperature reaches up to 48°C during summer and in winter it goes down to as low as 2-3°C. During the summer hot scorching winds known as "Loo" and frost during winter months are common features. The soil was sandy loam in texture with a pH of 7.6, organic carbon content of 0.24% and EC of 0.27 dSm⁻¹, medium in available Nitrogen (237 kg ha⁻¹), and low in available Phosphorus (19.60 kg ha⁻¹) and available potash (95.0 kg ha⁻¹). Twelve treatment combinations comprising of two row ratios of intercropping maize with clusterbean in the ratio of 1:1 and 2:1 and three nitrogen levels for the intercropping system, viz. 100%, 75% and 50% of the recommended dose, compared with control under each nitrogen level tried, were laid out in a Randomized Block Design (RBD) and replicated thrice.

Table-1: Effect of row ratios and levels of nitrogen on growth of maize in maize + clusterbean intercropping system

Treatment	Plant height maize (cm)	Dry weight maize (g)	Crop growth rate (Maize) (g m ² day ⁻¹)	Relative growth rate (Maize) (g g ⁻¹ day ⁻¹)	Leaf area index
Sole Maize+50% RDN	119	88.27	14.71	0.0997	2.500
Sole Maize +75% RDN	123.53	87.24	14.81	0.0999	2.530
Sole Maize+ 100% RDN	130.73	88.98	14.50	0.0991	2.650
Maize+Clusterbean(1:1)+50% RDN	118.56	86.91	8.89	0.0999	2.480
Maize+Clusterbean(1:1)+75% RDN	120.86	87.80	8.87	0.0999	2.530
Maize+Clusterbean(1:1)+100% RDN	123.6	87.71	8.91	0.1000	2.600
Maize+Clusterbean(2:1)+50% RDN	117.8	86.17	11.42	0.0987	2.460
Maize+Clusterbean(2:1)+75% RDN	120.13	87.64	11.84	0.0999	2.493
Maize+Clusterbean(2:1)+100% RDN	122.13	87.22	11.80	0.3992	2.570
F-test	S	NS	NS	NS	S
S.E. (±)	1.9	53.19	9.08	0.14	0.007
CD.(P=0.05)	4.19	-	-	-	0.016

Table-2: Effect of row ratios and levels of nitrogen on yield of maize and economics of treatments in maize+ clusterbean intercropping system

Treatment details	Grain yield		LER	Maize equivalent yield (tha ⁻¹)	Net realization (Rs.)	BCR
	Maize (tha ⁻¹)	Cluster-bean (tha ⁻¹)				
Sole Maize+50% RDN	4.66	-	-	4.66	19119	1.45
Sole Maize +75% RDN	4.92	-	-	4.92	22025	1.51
Sole Maize+ 100% RDN	7.43	-	-	7.43	54075	2.25
SoleClusterben+50% RDN	-	0.877	-	2.32	1225	1.03
Sole Cluster bean+75% RDN	-	0.769	-	2.02	-2925	0.91
SoleClusterbean+100% RDN	-	0.677	-	1.79	-6718	0.80
Maize+Clusterbean(1:1)+50% RDN	3.91	0.267	1.14	0.70	15985	1.34
Maize+Clusterbean(1:1)+75% RDN	3.60	0.281	1.08	0.73	12564	1.27
Maize+Clusterbean(1:1)+100% RDN	4.13	0.308	1.01	0.81	18694	1.39
Maize+Clusterbean(2:1)+50% RDN	4.60	0.125	1.26	0.30	13284	1.28
Maize+Clusterbean(2:1)+75% RDN	4.70	0.133	1.11	0.34	20071	1.42
Maize+Clusterbean(2:1)+100% RDN	6.69	0.154	1.12	0.40	46067	1.96
F-test	S	S	-	S	-	-
S.E. (±)	0.06	0.027	-	0.10	-	-
CD.(P=0.05)	0.14	0.057	-	0.20	-	-

Maize grain sale at ₹ 13100/t and clusterbean at ₹ 40000 /t (According to Commission For Agricultural Costs and Prices)

Results and Discussion

Growth parameters of maize: A perusal of the table 1 on the growth parameters of maize recorded at 90 DAS clearly shows that the significantly higher plant height and Leaf Area Index was recorded in treatment T₃ (Maize + 100% RDN), while the dry matter production, crop growth rate and relative growth rate did not differ significantly among the treatments. Among the intercropping treatments, the highest plant height and leaf area index was recorded under the treatment Maize + Clusterbean (1:1) + 100% RDN. The dry matter production, crop growth rate and relative growth rate did not differ significantly among the treatments. It is evident that crop responded to higher doses of nitrogen and accordingly the growth parameters were recorded to be maximum with 100% recommended dose of nitrogen as compared to those for fertilized with 75% recommended dose of nitrogen and sole crop of maize showed better growth, probably due to facing no competition of intercrop. These findings are in corroboration with the observations of Jadhav and Shelke, 2012.

Grain yield: The observations on the grain yield (t/ha) of maize was statistically analyzed and is being presented in table 2. A perusal of the table clearly shows that highest grain yield (7.43 t/ha) was recorded under treatment Sole Maize + 100% RDN. Similar finding have been reported by Kumar et al., 2009.

LER and maize equivalent yield: The observations on LER and Maize Equivalent Yield presented in table 2 depicts the highest LER (1.26) under treatment Maize + clusterbean (2:1) + 50% RDN. The highest Maize Equivalent Yield (7.43 t/ha) was recorded in Sole maize +100 % RDN. The experimental results depict that the crop responded better when sown alone and provided with 100% RDN, probably due to the competition faced by maize intersown with clusterbean for sunlight, space and nutrients, which reduced the grain yield under intercropping, resulting into lower yield and lesser profit as compared to sole cropping.

Economics of treatments: The highest benefit cost ratio (2.25:1) was recorded under the treatment Sole maize+100%RDN because of higher gross return (₹ 97333) with lesser cost of cultivation (₹ 43258). From the above finding, it may be concluded that clusterbean does not have synergetic interaction with maize in intercropping system tried and hence growing sole maize, fertilized with 100% recommended dose of nitrogen alongwith full doses of phosphorus and potassium can be recommended for obtaining higher profits.

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