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Performance of maize (*Zea mays*) as affected by nutrient management and intercropping with clusterbean (*Cyamopsis tetragonoloba*)

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Maize (*Zea mays* L.) is one of the principal crop grown for food and fodder. It has very high yield potential so it is called as 'Queen of cereals'. Intercropping has been a popular farming practice from the time immemorial. In the early years of agriculture development, farmers adopted it mainly as a risk covering practice. In the recent years, increasing population pressure has necessitated enhancement in crop productivity to achieve food and nutritional security thus the concept of intercropping has assumed considerable significance specially under rainfed areas of India. Scientifically this practice envisages simultaneous growing of two or more crops differing in height, canopy development, growth rate and nutrient requirement in such a way that they experience least competition and efficiently utilize environmental factors, thereby utilization of available resources to utmost level. Advantages of intercropping of legumes with cereals has been highlighted by several authors (Aiyer 1949, Willey 1979). Nutrient requirement of maize intercropped with a legume may also be different than that of sole maize. In intercropping system involving legume and non-legume, legume may provide nitrogen benefiting non-legume component growing in association with it (Waghmare *et al*. 1982, Sharma and Choubey 1991). Keeping these in view, an experiment was undertaken to improve the productivity and profitability of maize and clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] intercropping system with optimum row ratio and balanced fertilization under arid region.

A field experiment was conducted during *kharif* 2011 at the Instructional Farm, Department of Agronomy, Rajasthan College of Agriculture, Udaipur to assess feasibility of maize + clusterbean intercropping system under varying row arrangement to standardize nutrient application for maize crop in maize + clusterbean intercropping system. The experimental site is situated at 24°35' N latitude and 74°42' E longitude an altitude of 579.5 m above mean sea level. It falls under agroclimatic zone IV a (Sub-Humid Southern Plain and Aravalli Hill) of Rajasthan. The soil of the experimental field was sandy clay-loam in texture with bulk density of 1.40 Mg/m^3, slightly alkaline in reaction and calcareous in nature, low in available nitrogen (268.38 kg/ha), medium in phosphorus (21.46 kg/ha) and high in potassium status (280.5 kg/ha). The experiment consisted of 16 treatment combinations comprising five intercropping and row arrangements [maize sole (60 cm × 25 cm), maize (75 cm × 20 cm) + clusterbean (1:2), maize (60 cm × 25 cm) + clusterbean (1:1), maize (50 cm × 30 cm) + clusterbean (1:1) maize (30 cm × 25 cm) + clusterbean (2:2)], three fertility levels applied to maize crop (100, 75 and 50 per cent recommended dose of fertilizer) and absolute control, i e clusterbean sole (30 cm × 10 cm). The recommended dose of fertilizer consisted of 90 kg N and 30 kg P_2O_5/ha. These treatments were replicated thrice in factorial randomized block design. The seed of maize variety PHEM 2 and clusterbean variety RGC 936 were sown on 14 July 2011 in furrow opened at a row spacing as per treatments and seed were placed at a depth of 4-5cm and 3-4cm, respectively.

Data (Table 1) show that compared to sole maize, maize intercropped with clusterbean under varying row arrangements significantly reduced weight/cob. The extent of reduction was to the tune of 3.79, 5.96, 10.41 and 13.87 per cent under maize (75 cm × 20 cm) + clusterbean (1:2), maize (30 cm × 25 cm) + clusterbean (2:2), maize (60 cm × 25 cm) and (50 cm × 30 cm) + clusterbean (1:1), respectively. Data further show that cob weight was significantly affected by application of fertility levels to maize crop. The highest cob weight/plant was recorded under 100% RDF which was at par with 75% RDF, both these levels significantly enhanced cob weight/plant by 3.95 and 2.62%, respectively over 50% RDF. The highest grains/cob (257.89) under maize sole, the intercropping systems, viz. maize (30 cm × 25 cm) + clusterbean (2:2), maize (75 cm × 20 cm) + clusterbean (1:2), maize (60 cm × 25 cm) and (50 cm × 30 cm) + clusterbean (1:1) recorded reduction by 4.91, 5.17, 7.76 and 9.43%, respectively. The number of grains/cob were

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Table 1 Effect of intercropping system and fertility levels on yield attributes and yield of maize

Treatment	Weight/cob (g)	Grain/cob	Grain weight/cob (g)	Grain yield (q/ha)	Stover yield (q/ha)
Intercropping system					
Sole maize (60 cm × 25 cm)	70.44	257.89	49.04	26.14	59.24
Maize (75 cm × 20 cm) + clusterbean (1:2)	67.77	244.56	45.40	23.03	54.48
Maize (60 cm × 25 cm) + clusterbean (1:1)	63.11	237.89	40.33	22.09	50.63
Maize (50 cm × 30 cm) + clusterbean (1:1)	60.67	233.56	37.44	20.98	47.96
Maize (30 cm × 25 cm) + clusterbean (2:2)	66.24	245.22	43.46	22.65	52.67
SEm ±	0.746	4.02	1.01	0.697	1.62
CD (P=0.05)	2.15	11.62	2.92	2.01	4.68
Fertility levels (Maize)					
100% RDF	66.78	250.00	45.80	24.70	55.64
75% RDF	65.92	245.93	43.60	23.43	53.20
50% RDF	64.24	235.53	40.00	20.80	50.15
SEm ±	0.578	3.12	0.783	0.540	1.25
CD (P=0.05)	1.67	9.00	2.26	1.56	3.62

significantly affected by various fertility levels applied to maize crop. The number of grains/cob under 100% RDF remains at par with 75% RDF, however both these levels significantly increased grains/cob by 6.14 and 4.42% respectively over 50% RDF. grain weight/cob under sole maize was significantly higher by 8.02, 12.84, 21.60 and 30.98% over that recorded under maize (75 cm × 20 cm) + clusterbean (1:2), maize (30 cm × 25 cm) + clusterbean (2:2), maize (60 cm × 25 cm), (50 cm × 30 cm) + clusterbean (1:1) systems, respectively. Among intercropping systems, maize sown at 75 cm × 20 cm spacing intercropped with clusterbean in row ratio 1:2 produced highest grain weight/cob (45.4 g) which was found at par with maize (30 cm × 25 cm) intercropped with clusterbean in 2:2 row ratio however both these intercropping system significantly improved grain weight/cob by 12.57, 7.76% over maize (60 cm × 25 cm) + clusterbean (1:1) and 21.26, 16.08% over maize (50 cm × 30 cm) + clusterbean (1:1), respectively. The magnitude of difference in grain weight/cob between maize sown at (50 cm × 30 cm) and (60 cm × 25 cm) intercropped with clusterbean in 1:1 row ratio was not significant. The application of 100% RDF to maize recorded highest grain weight/cob (45.80g) which was at par with 75% RDF (43.6g) and both these levels significantly improved grain weight/cob by 14.50 and 9.00% respectively over 50% RDF.

A perusal of data (Table 1) reveals that maize sown alone produced highest grain yield of 26.14 q/ha which was significantly higher by 13.50, 15.41, 18.33 and 24.59% over different intercropping systems, viz. maize (75 cm × 20 cm) + clusterbean (1:2), maize (30 cm × 25 cm) + clusterbean (2:2), maize (60 cm × 25 cm) and (50 cm × 30 cm) + clusterbean (1:1), respectively. Among intercropping systems, maize (75 cm × 20 cm) + clusterbean in 1:2 row arrangement recorded highest grain yield of maize which was at par with maize (30 cm × 25 cm) + clusterbean (2:2) and maize (60 cm × 25 cm) + clusterbean (1:1) but registered significant increase by 9.77% over maize (50 cm × 30 cm) + clusterbean (1:1). Further the magnitude of difference in grain yield between maize sown at (60 cm × 25 cm) and (50 cm × 30 cm) spacing intercropped with clusterbean in 1:1 row ratio was not significant.

The fertility levels had significant effect on grain yield of maize. When compared to application of 50% RDF, application of 100 and 75% RDF to maize significantly improved grain yield by 18.75 and 12.64%, respectively. Further the difference in grain yield produced under 100 and 75% RDF was not significant. It is explicit from data (Table 1) that intercropping system under varying row arrangement had significant influence on stover yield. The crop sown alone produced the highest stover yield (59.24 q/ha) registering significant increases of 8.74, 12.47, 17.01 and 23.52% over maize (75 cm × 20 cm) + clusterbean (1:2), maize (30 cm × 25 cm) + clusterbean (2:2), maize (60 cm × 25 cm) and (50 cm × 30 cm) + clusterbean (1:1) systems, respectively. Among varying row arrangements, maize (75 cm × 20 cm) intercropped with clusterbean (1:2) recorded highest stover yield (54.48 q/ha) which was significantly higher by 13.59% over maize (50 cm × 30 cm) + clusterbean (1:1) but found at par with maize (30 cm × 25 cm) + clusterbean (2:2) and maize (60 cm × 25 cm) + clusterbean (1:1). Further difference in stover yield produced under maize (60 cm × 25 cm) and (50 cm × 30 cm) spacing intercropped with clusterbean in 1:1 row ratio was not significant. The application of 100 and 75% RDF to maize significantly enhanced stover yield by 10.95 and 6.08%, respectively over 50% RDF. Further the difference in stover yield produced under 100 and 75% RDF application was not significant.

Since yield of the crop is artifact of several yield

components, which are dependent on vegetative and reproductive growth of crop. Thus enhanced vegetative and reproductive growth of maize under their sole stand ultimately reflected in higher productivity of these crops. A unit increase in weight/cob, grains/cob and grain weight/cob increased maize grain yield by 38.17, 146.54, 2.59 and 101.57 q/ha. Such effect of spatial arrangement on yield of base and component crop were also reported by Shekhawat (1997), Marer *et al.* (2007) and Latha *et al.* (2008).

SUMMARY

In intercropping system involving legume and non-legume, legume may provide nitrogen benefiting non-legume component growing in association with it. Keeping this in view a field experiment was conducted during *kharif* 2011 to assess feasibility of maize (*Zea mays* L.) + clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] intercropping system under varying row arrangement to standardize nutrient application for maize crop in maize + clusterbean intercropping system.

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