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Yield, quality and soil fertility of cluster bean (*Cyamopsis tetragonoloba* L.) as influenced by various row spacing and levels of phosphorus

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ABSTRACT : A field experiment was conducted at Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *Kharif* season of 2010 on loamy sand soil. The treatments comprised of three levels of row spacing (S_1 = 30 cm × 15 cm, S_2 = 45 cm × 15 cm and S_3 = 60 cm × 15 cm) and four levels of phosphorus (P_1 = 0 kg P_2O_5/ha, P_2 = 20 kg P_2O_5/ha, P_3 = 40 kg P_2O_5/ha and P_4 = 60 kg P_2O_5/ha). The results under the study showed that the row spacing significantly influenced and wider spacing (60 cm × 15 cm) produced maximum available nitrogen and available phosphorus in the soil after harvest whereas, maximum green pod yield and dry fodder yield was recorded in narrowest row spacing (30 cm × 15 cm). The application of phosphorus significantly influenced the various yield and quality parameters and higher dose of phosphorus (60 kg P_2O_5/ha) was found superior in yield and quality characters under study. The 60 kg P_2O_5/ha recorded maximum pod yield and dry fodder yield.

Key **W**ords : Spacing, Phosphorus, Soil fertility, Cluster bean

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Cluster bean popularly known as guar belongs to the family Leguminosae. It's an important seed as well as vegetable crop. In India, green and tender pods of cluster bean are used as vegetable. Green plant of cluster bean is rich in protein and, therefore, used as green forage. Spacing related to plant density and is generally dependent upon crop variety, climate, soil fertility status and management. Phosphorus is the second important plant nutrient after nitrogen. Phosphorus is known to activate microbes, influencing plant growth and involved in energy transformation in plants. Phosphorus fertilizers are more essential for better root development, growth and yield of leguminous crops. Application of phosphorus, influences symbiotic nitrogen fixation and increase yield and quality of green pods of cluster bean. Therefore, proper nutrient management is of prime importance. Optimum levels of phosphorus and row spacing result in better yield, quality and soil fertility. Thus, the productivity of cluster bean can be increased by proper phosphorus management and maintaining optimum row spacing.

RESEARCH PROCEDURE

A field experiment was conducted during *Kharif* season of 2010 at the Horticulture Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat). The soil was loamy sand in texture having available nitrogen 160 kg/ha from 30 cm depth (Jackson, 1978 method) and available phosphorus 26.31 kg/ha from 30 cm depth (Olsen method, Jackson, 1978). The soil was slightly saline in reaction (ph 7.2-7.7). The treatments comprised of three levels of row spacing (S_1 = 30 cm × 15 cm, S_2 = 45 cm × 15 cm and S_3 = 60 cm × 15 cm) and four levels of phosphorus (P_1 = 0 kg P_2O_5/ha, P_2 = 20 kg P_2O_5/ha, P_3 = 40 kg P_2O_5/ha and P_4 = 60 kg P_2O_5/ha). The

experiment was conducted in Factorial Randomized Block Design with three replications. Pusa Navbahar variety of cluster bean was used in experiment. Phosphorus was applied 5-6 cm deep in rows in the form of di-ammonium phosphate as per treatments at the time of sowing. Half dose of nitrogen in the form of urea and full dose of potash in the form of MOP were applied as basal as per recommendation. Remaining half dose of nitrogen was applied in the form of urea at flowering stage of the crop.

RESEARCH ANALYSIS AND REASONING

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Effect of different treatments on yield :

Effect of row spacing :

The mean data on green pod yield in (Table 1) revealed that the different treatments of row spacing has marked have influence on the green pod yield. Maximum green pod yield (94.48 q/ha) was recorded under the closer row spacing S_1. Here, it appears that though the number of plant attributes have been found to be influenced beneficially by wider row spacing, but ultimate green pod yield per hectare has been higher under closer row spacing. It also appears that the yield potential of the individual plant might have not been able to perform better, but due to more number of individuals per unit area and their cumulative effect on yield resulted in higher yield. Therefore, higher yield potential of plants under wider row spacing could not compensate the total yield obtained from closer row spacing. Similar results were also reported by Naik (1989) and Uddin *et al*. (2001). The data on dry fodder yield (Table 1) revealed that the different treatments of row spacing markedly influenced the dry fodder yield. Maximum dry fodder yield (40.23 q/ha) was recorded under the closer row spacing S_1. It also appears that the yield potential of the individual plant might have not been able to perform better, but due to more number of individuals per unit area and their cumulative effect on yield resulted in higher dry fodder yield. Therefore,

Table : 1 Yield, quality and soil fertility as influenced by various row spacings and levels of phosphorus

Treatments	Green pod yield (q/ha)	Yield of dry fodder (q/ha)	Protein content of green pod (%)	Soil fertility status after harvest crop		
				N	P	K
Initial	-	-	-	160.00	26.31	277.50
Row spacings (cm)						
S_1 (30cm x15cm)	94.48	40.23	19.21	159.72	25.13	263.63
S_2 (45cm x 15cm)	79.59	26.44	19.53	148.70	27.39	270.49
S_3 (60cm x 15cm)	66.74	21.40	19.94	141.40	29.30	273.88
S.E. ±	2.32	0.80	0.35	3.66	0.62	4.02
C.D. (P=0.05)	6.81	2.36	NS	10.74	1.82	NS
Phosphorus levels (P_2O_5 kg /ha)						
P_1 (0)	68.88	27.02	18.71	139.47	23.11	259.38
P_2 (20)	76.66	29.08	19.28	149.53	25.55	265.83
P_3 (40)	85.30	29.90	19.77	153.73	29.48	273.03
P_4 (60)	90.23	31.41	20.49	157.14	30.94	279.09
S.E. ±	2.68	0.93	0.40	4.23	0.71	4.64
C.D. (P=0.05)	7.86	2.72	1.17	12.40	2.10	13.62
Interaction (S x P)						
S.E. ±	4.64	1.61	0.69	7.32	1.32	8.04
C.D. (P=0.05)	NS	NS	NS	NS	3.63	NS

NS=Non–significant

Table 2 : Interaction effect of row spacings and levels of phosphorus after harvest on available phosphorus

Treatments	S × P			
	P_1	P_2	P_3	P_4
S_1	22.73	24.91	26.42	26.44
S_2	23.13	25.48	30.30	30.63
S_3	23.46	26.27	31.73	35.75
S.E. ±		1.24		
C.D. (P=0.05)		3.63		

higher fodder yield was obtained in closer row spacing.

Effect of phosphorus levels :

It is obvious from the data (Table 1) that maximum green pod yield (90.23 q/ha) of cluster bean was recorded with the application of phosphorus @ 60 kg/ha regardless of varying row spacings (Table 1). This was mainly due to production of more number of green pods, more weight of green pods per plant and length of green pod. Higher green pod yield in cluster bean due to higher doses of phosphorus nutrient were also reported by Mishra (1999) and Baboo and Mishra (2004). In the present study, maximum dry fodder yield (31.41 q/ha) of cluster bean was recorded with the application of phosphorus @ 60 kg/ha. This might to be due to the efficient use of phosphorus. Higher dry fodder yield was also reported due to higher doses of phosphorus nutrition by Meena *et al.* (2003).

Effect of interaction :

The interaction effect of row spacing and phosphorus levels on green pod yield and dry fodder yield was found non-significant.

Effect on quality parameters :

Effect of row spacing :

The mean data on protein content of green pod (Table 1) revealed that protein content per cent in green pod was not affected significantly due to various row spacing.

Effect of phosphorus levels :

The mean data on protein content in green pod (Table 1) revealed that protein content of green pod was found significant. Phosphorus at P_4 level recorded significantly higher protein (20.49 %) content than P_3, P_2 and P_1 levels of phosphorus. This might be due to the increase in N content in green pod on account of phosphorus application. Similar trend was observed by Singh and Rajput (1985) and Singh *et al.* (1987).

Effect of interaction :

The interaction effect of row spacing and phosphorus levels on protein content (%) in green pod was found non-significant.

Effect on soil status :

Effect of row spacing :

The higher available nitrogen, phosphorus and potassium were observed in different row spacings treatments. Treatment S_1 (30 cm × 15 cm) established its superiority by recording more available nitrogen. However, it was closely followed by treatments S_2 (45 cm × 15 cm). This might be due to the increase in N content in soil because cluster bean is a legume crop. The treatment S_3 (60 cm × 15 cm) recorded the highest phosphorus. However, it was closely recorded under treatment S_2 (45 cm × 15 cm) after harvest (Table 1). Effect of row spacing on available potash was found non-significant. It may be due to presence of higher available potash in the experimental area.

Effect of phosphorus levels :

The higher available nitrogen, phosphorus and potassium were observed in different levels of phosphorus treatments. Treatment P_4 (60 kg P_2O_5/ha) established its superiority by recording more available nitrogen, phosphorus and potassium. However, it was closely followed by treatments P_3 (40 kg P_2O_5/ha). This might be due to the increase in soil status after harvest of the crop, because cluster bean is legume crop and phosphorus application increase activity of soil micro-organisms, more efficiency of nitrogen fixation. The lowest available nitrogen, phosphorus and potassium was recorded under treatment P_1 (0 kg P_2O_5/ha) after harvest (Table 1).

Effect of interaction :

The interaction effect of row spacing and phosphorus levels on soil fertility status was found to be non-significant in case of nitrogen and potassium (Table 2). But, it was found to be significantly influenced on available phosphorus. The maximum dose of phosphorus (60 kg P_2O_5/ha) with widest spacing (60 cm×15 cm) recorded significantly higher phosphorus (35.75 kg/ha). It is because of phosphorus application increases the activity of soil microorganisms, more efficiency of nitrogen fixation and plants required more nutrient root development, growth. Similar work related to the present work was aslo done by Khandelwal *et al.* (2012) and Kumar *et al.* (2001) on cowpea and Ramana *et al.* (2010) on french bean.

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