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Original Research Article

Phosphorus Requirement in Chickpea (*Cicer arietinum*) + Indian mustard (*Brassica juncea*) Intercropping System under Rain Fed Condition of Bundelkhnd (U.P.)

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A B S T R A C T

A field experiment was conducted during rabi 2007-08 and 2008-09 at Research Farm of Brahmanand Post Graduate College, Rath, Hamirpur (U.P.). The treatments comprised 20 combinations of 5 cropping systems (Soile chickpea, Sole Indian mustard, 2:1, 4:2 and 6:3 row ratios of CP+M intercropping) in main plots and 4 Phosphorus levels (0.30, 60 and 90 kg P/ha) in sub-plots of a split plot design. Sole crops of chickpea and mustard gave highest see yield. Among intercropping, 6:34 row ratio of CP+M produced significantly highest seed yield of chickpea (10.96q/ha) under 4:2 row ratio of CP+M (9.93 q/ha). Mustard seed yield was highest (6.15 q/ha) under 4:2 row ratio 09f CP+M intercropping which was at per with the seed yield under 6:3 row ratio (5.89 q/89 q/ha but significantly highest then 2:1 row ratio (5.37 q/ha) of intercropping Chickpea equivalent yield was recorded significantly highest of 15.50 q/ha) under 6:3 row ratio of CP+M followed by 4:2 row ratio of 14.66 q/ha CEY yield. LER was worked out highest of 1.32 under 6:3 row ratio of CP+M followed by 1.26 under 4:2 row ration. Seed yield of chickpea mustard and CEY increased with increasing levels of phosphorus up to 60 kg p/ha where yields were obtained 11.87, 7.93 and 14.37 q/ha respectively. Thus, these results prove that intercropping of CP+M in 6:3 row ratio with 60 Kg. is a better combination for higher productivity of the intercropping system.

Keywords

Chickpea Indian mustard intercropping. Phosphorus. Seed yield Land equivalent ratio

Introduction

Putses and oilseeds are more remunerative than cereals under rainfed condition. Chickpea is an important crop of rainfed areas in Bundelkhnad zone of Uttar Pradesh. Indian mustard is also grown on sizeable area, but in stand with chickpea, lentil and/or linseed crop, where yields are very poor because of improper plant stand of component crops and fertilizer nutrition. *Prasad et al.,* (1997) observed higher productivity of chickpea when intercropped with Indian mustard. This system not only stabilized chickpea production but also increased the cropping intensity and land utilization efficiency. The success of intercropping system depends mainly on suitable population of component crops in proper row adjustment so that competition between them may be minimized Proper fertilization of component crops is also essential to exploit their yield potential. Research informations on those to important

aspects of chickpea + Indian mustard intercropping are lacking particularly for silty loam *(Parwa)* soil of Bundelkhand zone in Uttar Pradesh. Therefore, the present study was undertaken on row proportions and phosphorus requirement of chickpea Indian+ mustard intercropping system.

Materials and Methods

The field experiment was conducted during rabi seasons of 2007-08 and 2008-09 at Research Farm Brahmanand post Graduate college, Rath, Hamirpur (U.P.). the soil of experimental site was silty loam in texture, slightly alkaline in nature (pH 7.8) having 4.2% O.C., 25.27 kg/ha available p and 202 kg/ha available k. the reinfall was received only 9.6 and 16.0 mm during crop seasons of 2007-08 and 2008-09, respectively. The experiment was laid out in split plot design with 20 treatment combinations having 5 cropping systems (sole chickpea. Sole Indian mustered, CP+M in 2.1, 4.2 and 6.3 row proportions) in plots and 4 phosphorus levels (0.30 60. 90 kg. p/ha) in sub-plots replicated thrice. Intercropping was done in replacement series. The variety of chickpea and Indian mustard was Radhey and Vardan, respectively.

The recommended seed rate of each crop was used in sole cropping. Whereas the seed quantity varied according to the sarea occupied by the crops in intercropping system. An uniform dose of 18 kg. N.ha in chickpea and 60 kg N/ha in Indian mustared was applied at the time of sowing on the basis of actual area occupied by each crop. Sowing was done in rows 40-cm apart in each case on 3.11.2007 and 12.11.2008 in two years. The observations were recorded on growth and yield attributes, actual yield of component crops. Chickpea equivalent yield (CEY) and land equivalent ratio (LER). The CEY was worked out by converting the yield of mustared into the yield of chickpea on the basis of prevailing market price of the crops. LER of the system was calculated by using the formula given by Willey (1979).

Results and Discussion

Growth characters

In chickpea number of branches/plant and dry matter/plant were recorded significantly higher in sole stand then intercropping treatments However, dry weight of root nodules/plant was highest in 6:3 row ratio of CP+M intercropping and lowest in sole chickpea. In mustard, number of branches and dry matter/plant were recorded highest in 4:2 row ratio of CP+M intercropping followed by 6:3 row ratio of intercropping. Sole mustard rop registered significantly lowest branches and dry matter/plant. Plant height of chickpea or mustard could not be influenced by cropping systems significantly However, mustared plant height showed increase in intercropping treatments over sole stand numerically (Table 1). Reduction in branches and dry matter/plant of chickpea in intercropping system might be due to shading effect of mustard on chickpea. Better growth on mlustard in intercropping might be due to reduced plant competition within the community. Rana *et al.,* (1996) also observed similar results

Increasing levels of phosphorus increased plant height, number of branches/plant and dry matter/plant of chickpea and mustard both significantly up to 60 kg p/ha (Table 1). Dry weight of root nodules in chickpea also increased significantly up to 60 kg. p/ha. It might be due to increased availability of phosphorus to plants at higher rate of application. Which improved the call division and development through proper carbohydrate metabolism and respiration

resulting better growth of chickpea and mustard. These results corroborate to the findings of Tripat *et al.,* (2005.)

Yield attributes

In chickpea, number of pods/plant, seed weight/plant and harvest index were recorded significantly highest values in sole, cropping while seeds/pod and 1000-seed weight were not influenced significantly by cropping systems (Table 1). Among intercropping no significant weight/plant and harvest attributes, but intercropping reduced pods/plant. Seed index significantly compared with sole chickpea. These reductions might be due to intensified interspecific competition for light offered by mustard plants (Kushwaha, 1983). In mustard crop number of siliquae/plant, seeds/siliqua. 1000-seed weight and seed weight/plant recorded highest values in intercropping of CP+M in 4:2 row ratio. The intercropping in 6:3 and 2:1 row ratios of CP+M also recorded significantly higher values of yield attributes over sole mustard. The higher values of yield attribuites in intercropping systems may be ascribed to the low inter and intra-specific competition as compared to sole mustard where each plant faced more competition particularly for upper ground growth resources (Kushwaha, 1983). Almost similar results have been reported by Tripathi *et al.,* (2005) and Kumar and sing (2006). The yield attributes of chickpea (Pods/plant, seeds/plant and seed weight/plant) and mustard siliquae/plant, seeds/siliqua. 1000-seed weight and seed weight/plant) increased with increasing levels of phosphorus significantly up to 60 kg P/ha. These improvements in yield attributes of chickpea and mustard owing to P fertilization may be accounted for favourable influence of P mutrition on promotion of source capacity in legumes and oilseeds (Sarkar *et al.,* 1995). These results are in accordance to the findings of Tripathi *et al.,* (2005) and Kumar and Singh (2006).

Productivity

Undoughtily the seed yield of chickpea and mustard was produced significantly highest in their sole stands (Table 2). It was associated with thigher plant population p0er unit area in sole stand of both crops. Chickpea produced significantly highest seed yield under 6:3 row ratio of CP+M intercropping. While significantly lowest seed yield was recorded in 2:1 now ratio of CP+M intercropping. These seed yields might be attributed to various yield attributes of chickpea which also behaved in similar manner. In case of mustard. 4:2 row ratio being at par with row ratio of 6:3 of CP+M intercropping produced significantly higher seed yield than 2:1 row ratio of CP+M intercropping. Such yields are attributed to yield attributes of mustard. These results confirm the findings of Tripathi *et al.,* (2005) and Kumar and Singh (2006).

Further, analysis of seed yield showed that in intercropping systems. Plant stand chickpea was 66.7 per cent of sole chickpea, but seed yield of produced 61.5, 72.3 and 79.8 per cent in 2:1, 4:2 and 6:3 ratios of CP+M intercropping on the basis of proled data. These fingers show that chickpen had the yield advantage of 5.6% in 4:2 and 13.1% in 6:3 row ratio of intercropping while 2:1 row ratio gave a yield loss of 5.2 per cent. Similarly in mustard where 33 per cent plant stand of sole mustard was maintained in intercropping system, seed yield advantage were worked out as 14:1, 21.0 and 18.7 per cent in 2:1, 4:2 and 6.3 row ratios of CP intercropping. Results clearly indicate that mustard crop was more benefited in CP+M intercropping

Table.1 Growth character and yield attributes of chickpea and Indian mustard in intercropping systems as influenced by different phosphorus levels (Poled data of 2 years)

Treatments	Chickpea characters									Indian mustard characters							
	Plant Height (cm)	Num-ber of branch es per plant	Dry Wt. of Nodu-les/plan t (mg)	Dry wt. per plant (g)	Pods per plant	Seeds Per pod	1000 seed wt. (g)	Seed wt. per plant (g)	Harve-st Index (%)	Plant Height (cm)	Branc hes per plant	Dry wt./Pla nt	Silliq-uae per Plant	Seeds per siliqua	1000 seed Wt. (g)	Seed wt. Per Plant (g)	Harv-est Index (%)
Intercropping systems																	
Sole chickoea	76.75	28.09	195.87	34.90	26.98	1.78	182.25	8.48	39.92	-	-	-	-	-	-	-	-
Sole mustard	-	-	-	-	-	-	-	-	-	137.65	23.98	47.65	322.01	12.19	4.19	7.71	21.81
CP+M (2:1)	77.15	23.25	202.66	30.13	24.80	1.79	186.97	7.45	32.21	139.33	32.23	67.98	446.80	14.10	4.33	10.81	23.08
CP+M(4:2)	77.40	23.53	210.20	30.15	25.15	1.79	186.55	7.59	35.29	140.73	35.52	75.09	505.83	14.23	4.43	12.27	22.72
CP+M (6:3)	77.42	23.93	222.11	30.68	25.71	1.78	186.04	7.66	36.69	142.18	34.11	72.26	475.00	14.16	4.39	11.47	22.54
S.Ed. ±	1.93	0.62	5.45	0.71	0.58	0.01	0.97	0.23	0.28	0.78	0.89	1.86	13.05	0.10	0.03	0.25	0.17
C.D. at 5%	NS	1.35	11.88	1.55	1.26	NS	NS	0.50	0.61	NS	1.94	4.05	28.44	0.22	0.07	0.54	0.37
Phosphorus (kg/ha)																	
0	73.62	19.17	162.41	26.02	21.67	1.77	183.15	6.33	35.07	130.86	27.85	56.75	362.64	12.78	4.03	8.35	21.87
30	77.02	23.95	206.16	30.69	25.27	1.78	185.44	7.57	37.08	138.05	30.64	63.75	425.61	13.71	4.29	10.14	22.43
60	79.94	27.75	228.98	34.40	27.89	1.88	187.44	8.62	36.98	143.58	32.87	69.57	465.70	14.02	4.48	11.43	22.83
90	78.13	27.94	233.29	34.74	27.81	1.79	188.83	8.66	35.95	147.41	34.48	72.93	495.72	14.27	4.55	12.34	23.03
S.Ed. ±	2.10	0.89	8.12	0.96	0.85	0.02	1.31	0.35	0.38	4.04	1.15	2.30	15.62	0.13	0.04	0.36	0.24
C.D. at 5%	4.12	1.74	15.92	1.88	1.67	NS	2.57	0.69	0.74	7.92	2.25	4.51	30.62	0.25	0.08	0.74	0.47

Table.2 Seed yield (q/ha) of chickpea, Indian mustard. Chickpea equivalent and land equivalent ratio as influenced by intercropping systems and phosphorus

Treatments	Seeds yield of chickpea (q/ha)			Seed yield of mustard (q/ha)			Chickpea equivalent seed yield (q/ha)			Land equivalent ratio		
	2007-08	2008-09	Pooled	2007-08	2008-09	Pooled	2007-08	2008-09	Pooled	2007-08	2008-09	Pooled
Intercropping systems												
Sole chickpea	**14.01**	**13.44**	**13.73**	-	-	-	**14.01**	**13.44**	**13.73**	**1.00**	**1.00**	**1.00**
Sole mustard	-	-	-	**11.64**	**11.02**	**11.33**	**8.95**	**8.47**	**8.71**	**1.00**	**1.00**	**1.00**
CP+M (2:1)	**8.69**	**8.21**	**8.45**	**5.48**	**5.25**	**5.37**	**12.91**	**12.25**	**12.58**	**1.08**	**1.09**	**1.09**
CP+M (4:2)	**10.23**	**9.63**	**9.93**	**6.28**	**6.01**	**6.15**	**15.06**	**14.25**	**14.56**	**1.27**	**1.26**	**1.27**
CP+M (6:3)	**11.19**	**10.72**	**10.96**	**6.02**	**5.76**	**5.89**	**15.82**	**15.18**	**15.50**	**1.32**	**1.32**	**1.32**
S.Ed ±	**0.39**	**0.43**	**0.31**	**0.22**	**0.32**	**0.19**	**0.51**	**0.44**	**0.36**	-	-	-
CD at 5%	**0.95**	**1.06**	**0.68**	**0.55**	**0.78**	**0.41**	**1.18**	**1.02**	**0.78**	-	-	-
Phosphorus (kg/ha)												
0	**9.00**	**8.73**	**8.87**	**5.61**	**5.37**	**5.49**	**10.65**	**10.29**	**10.47**	**1.19**	**1.19**	**1.19**
30	**11.14**	**10.61**	**10.88**	**7.00**	**6.68**	**6.84**	**13.22**	**12.60**	**12.91**	**1.23**	**1.22**	**1.23**
60	**12.20**	**11.53**	**11.87**	**8.12**	**7.73**	**7.93**	**14.76**	**13.98**	**14.37**	**1.23**	**1.23**	**1.23**
90	**11.78**	**11.20**	**11.49**	**8.70**	**8.25**	**8.48**	**14.78**	**14.00**	**14.39**	**1.25**	**1.24**	**1.25**
S. Ed. ±	**0.54**	**0.63**	**0.45**	**0.34**	**0.46**	**0.30**	**0.61**	**0.53**	**0.42**	-	-	-
C.D. at 5%	**1.12**	**1.29**	**0.88**	**0.71**	**0.96**	**0.59**	**1.25**	**1.09**	**0.82**	-	-	-

Total productivity of intercropping system inform of chickpea equivalent yield was recorded significantly highest in 6:3 row ratio of CP+M closely followed by 4:2 row ratio of CP+M, while lowest in sole mustard (Table 2). It might be attributed to higher seed yield of chickpea in 6:3 row ratio and that of mustard m 4:2 row ratio of CP. M interecropping. The intercropping of CP+M in 2:1 row ratio could not produce even at par with sole chickpea, thus proved to be non-advantageous Kumar and Singh (2006) also observed similar results.

The seed yield of both chickpea and mustard increased signfieantly due to phosphorus application up to 60 kg P/ha. It might be attributed to various yield attributes of both component crops. It may be ascribed to assimilation and translocation of more pohotosynthates towards sink at higher level of phosphorus application. These results may be supported by findings of *Tripathi et al., (2005) and Kumar and Singh (2006).*

Land equivalent ratio (LER)

It was computed much higher in 6:3 and 4:2 row ratios of CP+M intercropping as compared to 2:1 row ratio which attain LER just above sole cropping (Table 2).

The reason may be explained that in 6:3 or 4:2 row ratios of CP+M intercropping component crops particularly mustard utilized intercropping environmental resources more efficiently and increased proportionate yield by larger margin than the area allotted. LER was increased slightly with P application over control, but increased P rates had not remarkable effect on LER. It might be associated with more efficient utilization of P by component crops in intercropping system. These results confirm the findings of *Tripathi et al*., (2005).

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