

Pigeonpea (*Cajanus cajan*) intercropping with legumes in Bihar plateau at different levels of phosphate and cropping patterns

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ABSTRACT

An experiment was conducted during the rainy season of 1991 and 1992 at Giridih, eastern fringe of Bihar Plateau under rainfed condition, to study the intercropping effect of pigeonpea [*Cajanus cajan* (L.) Millsp.] with 2 legumes, viz. greengram (*Phaseolus radiatus* L.) and groundnut (*Arachis hypogaea* L.), under different levels of phosphate fertilizer and cropping patterns in the upland plot and succeeding crop of Indian mustard [*Brassica juncea* (L.) Czernj. & Cosson] was sown under residual fertility. Pigeonpea + groundnut paired row system at 60 kg P₂O₅/ha resulted the highest pigeonpea seed yield (17.55 q/ha) and it was 1.6% and 5.3% significantly higher than that of 0 and 30 kg P₂O₅/ha. Pigeonpea, groundnut and greengram yields increased significantly with the increasing levels of P₂O₅. Relative yield loss due to intercropping was noted maximum (8.53%) in pigeonpea + groundnut alternate row system and minimum (6.1%) in pigeonpea + groundnut paired row system. Highest monetary advantage of Rs 6670/ha was also obtained in pigeonpea + groundnut paired row systems. Levels of phosphate differed significantly and 6.0 to 6.4 q/ha mustard grain were obtained as follow up crop.

Key words : Pigeonpea intercropping, Succeeding crop, Phosphate levels, Cropping Patterns

Bihar plateau is mainly characterized by monocropping. The average annual rainfall is about 1,200 mm with 80–85% of the total rainfall received between mid-June and early October. Pigeonpea is the dominant pulse crop grown during the rainy (*khari*) season. Intercropping of pigeonpea with short-duration pulses (Sharma and Rajput, 1996) and groundnut is the most popular

combination (Singh and Singh, 1994; Dwivedi and Bajpai, 1997). The present study was conducted to evaluate the phosphate requirement, establish an ideal planting method and find out the intercropping effect on succeeding crop.

MATERIALS AND METHODS

A field experiment was conducted

during the rainy (*kharif*) season of 1991 and 1992 at the Experimental Farm, Indian Statistical Institute, Giridh, the eastern fringe of Bihar plateau. 'T 21' pigeonpea was intercropped with 'K 3' and 'Pusa Baisakhi' greengram with 3 levels of phosphate, i.e. 0, 30 and 60 kg P_2O_5 . Besides sole cropping, alternate row and paired row systems were the planting methods in split-plot design with 3 replications. The main plot included levels of phosphates along with a common dose of N and K each @ 20 kg/ha and the sub-plots included planting methods. Pigeonpea, groundnut and greengram in sole treatments were spaced at 60, 30 and 20 cm respectively. In alternate row planting method, 1 row of groundnut and 2 rows of greengram respectively were sown between 2 rows of pigeonpea. However, in paired rows treatments, spacing between rows and between paired rows was 30 and

90 cm respectively. Individual plot sizes were 16.2, 19.2 and 22.95 m² in sole, alternate and paired row plots respectively. Sowing was done on 18 June 1991 and 24 June 1992. Soil at the experimental site had pH 6.4, organic carbon 0.29%, low available P (6.2 kg/ha) and medium available K (235.2 kg/ha) status. Soon after harvest of the *kharif* crops, a succeeding crop of Indian mustard (cv. 'TM 17') was sown, grown entirely on the residual fertility with minimal life-saving irrigation.

RESULT AND DISCUSSION

Seed yield performance

Seed yield of pigeonpea in the first year (Table 1) increased significantly with the increasing levels of P fertilizer. The highest yield was recorded with 60 kg P_2O_5 /ha, being 5.81% and 19.89% higher than that recorded with that 30 kg and 0 kg P_2O_5 /ha respectively. Intercrops, groundnut and

Table 1. Seed yield (q/ha) of sole and intercrops as affected by different cropping systems and phosphate levels

Treatment	First year			Second year			Pooled		
	P.P.	G.N.	G.G.	P.P.	G.N.	G.G.	P.P.	G.N.	G.G.
<i>Cropping system</i>									
Sole P.P.	17.55			17.51			17.53		
Sole G.N.		15.28			15.36			15.32	
Sole G.G.			5.82			5.36			5.69
P.P. + G.N. (alternate)	17.70	8.77		16.37	8.01		16.03	8.39	
P.P. + G.N. (paired)	16.33	9.62		16.59	8.13		16.46	8.87	
P.P. + G.G. (alternate)	15.49		3.80	16.26		3.76	15.88		3.78
P.P. + G.G. (paired)	15.90		3.39	16.47		3.90	16.19		3.64
CD (P = 0.05)	0.47	0.57	0.28	0.73	0.29	0.27	0.35	0.30	0.18
<i>P₂O₅ (kg/ha)</i>									
0	14.58	9.99	3.71	15.86	9.99	4.06	15.22	9.99	3.88
30	16.52	11.53	4.48	16.84	10.60	4.47	16.68	11.07	4.48
60	17.48	12.15	4.81	17.22	10.91	4.69	17.35	11.53	4.75
CD (P=0.05)	0.77	0.33	0.09	NS	0.38	0.21	0.56	0.21	0.10

P.P., Pigeonpea; G.N., groundnut; G.G., greengram

greengram, also showed significant increases in yield with increasing levels of P_2O_5 . An increase of 21.62% and 15.4% in groundnut yield under 60 kg and 30 kg P_2O_5 /ha respectively was recorded over the control. In case of greengram, it showed 29.6% and 20.7% yield increases at 60 kg and 30 kg P_2O_5 /ha respectively over the control. In the second year, seed yield of pigeonpea was not increased significantly due to the increasing level of P_2O_5 . However, a similar yield trend was observed as that of the first year. Intercrops, groundnut and greengram, also showed significant increase with the increasing levels of P_2O_5 . An increase in yield of groundnut was 9.21% and 6.11% in and greengram was 15.51% and 10.10% was at 60 kg and 30 kg P_2O_5 /ha respectively over the control. Highly positive relationship between seed yield of pigeonpea and P levels was also recorded by Mahapatra *et al.* (1991).

Cropping systems effect

Pigeonpea yield was reduced significantly due to intercropping. Sole crop of pigeonpea had the highest yield. Yield reduction than sole pigeonpea due to

intercropping of pigeonpea was also reported by Singh and Singh (1994). Among the intercropping systems, pigeonpea + groundnut paired row system gave the highest yield in both the years. In case of intercrops, groundnut and greengram had shown significant yield differences among the cropping systems. In the first year, paired row system gave significantly higher yields than alternate row system. In the second year alternate row and paired rows were at par for both the crops, groundnut and greengram. Higher seed yields of crops associated with pigeonpea in paired row planting were also obtained by Srinivasan and Ahlawat (1984).

Intercropping indices

Values of land-equivalent ratio (LER) (Table 2) clearly indicated the yield advantages owing to intercropping. Advantage of 52% and 57% was recorded for groundnut and greengram respectively. Alternate row system and paired row system did not show any differences. Higher LER due to intercropping of pigeonpea with groundnut was recorded by Shinde *et al.* (1989). Regarding pigeonpea

Table 2. Competition functions to measure intercropping effect on pigeonpea-based intercropping

Treatment	Land-equivalent ratio		Monetary advantage (Rs/ha)		P.P. equivalence yield		Relative yield loss (%)	
	1991	1992	1991	1992	1991	1992	1991	1992
Sole P. P.	1.00	1.00			17.55	17.51		
P.P. + G.N. (alternate)	1.58	1.45	6,038	5,937	26.97	26.71	10.54	6.51
P.P. + G.N. (paired)	1.56	1.48	7,228	6,112	28.70	27.09	6.95	5.25
P.P. + G.G. (alternate)	1.53	1.61	4,910	5,488	19.94	20.70	4.73	7.14
P.P. + G.G. (paired)	1.49	1.60	4,606	5,794	19.87	21.07	9.40	5.94

P.P., Pigeonpea; G.N., groundnut; G.G., greengram

equivalence, highest mean value of 27.89 q/ha was noted in the pigeonpea+groundnut paired row system, followed by pigeonpea + groundnut alternate row system, pigeonpea + greengram paired row and pigeonpea + greengram alternate row system. However, the corresponding figure in sole cropping of pigeonpea was found to be 17.53 q/ha only.

Monetary advantage was also highest in pigeonpea + groundnut paired row system. The rank is similar to pigeonpea equivalence. Relative yield loss was lowest (6.1%) in pigeonpea + groundnut paired row and it was 8.52% in pigeonpea + groundnut alternate row system. Yield loss was same (7.67%) in both the cropping systems of pigeonpea + greengram combination.

Succeeding crop yield

Grain yield of Indian mustard grown as

succeeding crop indicated (Table 3) that this crop can produce 6.0 to 6.4 q/ha grain and 16.3 to 17.5 q/ha biomass. In the first year, there was no significant difference in grain yield of Indian mustard among the P_2O_5 levels. Also no significant differences were found among the plots of different cropping systems. However, highest grain yield was obtained after sole groundnut. In the second year 30 and 60 kg level plots had significantly higher grain yield than the control. Grain yield of Indian mustard after all the treatments was significantly higher over that after pigeonpea sole crop. Similar trend of results was noted in dry vegetative yield in both the years. Singh *et al.* (1967) reported useful effect of phosphorus on legumes and its favourable residual effect on following crop of maize. Maize grown after legumes receiving 40 kg P_2O_5 /ha gave significantly higher yield than that grown after unfertilized legumes. Adhikary *et al.*

Table 3. Grain and stalk yields (q/ha) of Indian mustard grown as succeeding crop after *kharif* crops

Treatment	Grain yield			Stalk yield		
	1991	1992	Pooled	1991	1992	Pooled
<i>Cropping system</i>						
Sole P.P.	6.18	5.84	5.99	17.31	15.37	16.34
Sole G.N.	6.53	6.29	6.41	18.58	16.37	17.47
Sole G.G.	6.39	6.20	6.29	18.14	16.21	17.17
P.P. + G.N. (alternate)	6.40	6.28	6.34	18.03	16.44	17.24
P.P. + G.N. (paired)	6.39	6.25	6.32	18.00	16.40	17.20
P.P. + G.G. (alternate)	6.34	6.24	6.29	17.79	16.44	17.12
P.P. + G.G. (paired)	6.39	6.28	6.33	17.92	16.49	17.20
CD (P=0.05)	NS	0.24	0.18	NS	0.62	0.51
<i>P₂O₅ (kg/ha)</i>						
0	6.26	6.09	6.17	17.56	15.94	16.77
30	6.42	6.26	6.34	18.17	16.44	17.31
60	6.43	6.24	6.33	18.17	16.26	17.27
CD (P = 0.05)	NS	0.05	0.08	NS	0.30	0.38

(1991) also reported the beneficial effect on succeeding crop of wheat after legumes. Pigeonpea intercropped with blackgram, crowpea and groundnut improved the fertility status of soil and effected an economy of 38, 56 and 77 kg/ha respectively in succeeding wheat as compared with sole pigeonpea (Patel, 1980).

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