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Growth and Yield of Pigeonpea as Influenced by Association of Soybean and Phosphorus Application*

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ABSTRACT

Experiment on growth and yield of pigeonpea as influenced by association of soybean and phosphorus fertilization revealed that grain yield of pigeonpea in replacement system (14.07 q/ha or 83.89%) and in additive system (13.96 q/ha or 83.24%) being at par was about 17.5 per cent less than sole pigeonpea (16.77 a/ha or 100%). Harvest index of pigeonpea was increased in replacement system (17.66%) than sole pigeonpea (16.70%). Superior yield attributes and growth character were observed in replacement series of soybean intercropping than sole cropping. Growth and yield of pigeonpea was found significant upto 60 kg P_2O_5 / ha. X optima for pigeonpea crop was computed as 68.82 kg P_2O_5/ha however yield was maximized by 86.5 kg P_2O_5/ha.

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INTRODUCTION

Intercropping of early maturing pigeonpea and soybean has become popular in soybean growing tract of Madhya Pradesh which is also gaining popularity in Uttar Pradesh both as in sole and in intercropping systems. Saxena and Yadav (1976) first time made an attempt to evaluate optimum row proportion of soybean cultivars in intercropping with short duration pigeonpea at Pantnagar in additive series. In intercropping of soyabean with pigeonpea, most of the research worker have considered pigeonpea as main crop and soybean as an intercrop (Ahlawat *et al.*, 1982).

Phosphorus is one of the most limiting plant nutrients which is essential for good growth of crop. The beneficial role of phosphorus in improving physical conditions of soil well realised when fertilizer is applied to leguminous crop. But the recommendations are not available on phosphorus requirement of pigeonpea in intercropping with soybean.

MATERIALS AND METHODS

The present field investigation was made at Student's Intructional Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur in Central U. P. during 1995-96 and 1996-97 in which 4 cropping systems (sole soybean, sole pigeonpea, two rows of soybean in between 2 rows of pigeonpea in additive and 4 rows of soybean followed by 2 rows of pigeonpea in replacement series) was tried

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under increasing doses of phosphorus (@ 0, 30, 60 and 90 kg P_2O_5/ha) in a 4 replicated randomized block design. The sowing was done on June 25th during both the years with uniform application of 20 kg N + 20 kg K_2O/ha. Phosphorus application was done through single superphosphate in rows 40 cm apart using 100 kg seed of JS-72-44 and 16 kg seed of UPAS 120 per hectare in pure cropping of soybean and pigeonpea, respectively. While in case of intercropping, the seed rate per row was used on the basis of seed rate used in sole cropping. The experimental field was sandy loam in texture, low in organic carbon and nitrogen, medium in available P and potash with slightly alkaline in reaction. The error variances for the two years for the yield of pigeonpea were subjected to homogeneity test which was found to be non significant, hence, the results were pooled.

RESULTS AND DISCUSSION

Growth and yield of pigeonpea in association of soybean

Pigeonpea was grown in association of soybean with 100% rows in additive series and 66.6% rows in replacement series in comparison to pure soybean. Perusal of the results in Table 1 revealed that initial stand of the crop was as per treatment but number of plants of pigeonpea in additive series was reduced by 11.58 per cent without any reduction in replacement series. This is attributed to higher mortaility of the plants (15.6%) in additive series. This indicated the teletoxic association of soybean with pigeonpea which was more pronounced in additive than replacement system. This was reflected by height of the crop, leaf area index, branches per plant and other yield attributes. The increase in the extent of adverse effect of soybean on growth of pigeonpea plants was observed upto 90 day stage with a slight recovery thereafter.

Consequently the grain and stick yield of pigeonpea was found to be reduced in intercropping in additive system by a margin of 16.7% and 14.63% respectively. The reduction in grain and straw yield of pigeonpea particularly in additive series is attributed to the combine effect of harvested plants and seed yield per plant which was due to reduction in number of seeds per plant. The adverse effect of soybean on pigeonpea in additive series of intercropping was also reported by Saxena and Yadav (1976). @ 17.6% and Tomar *et al.* (1987), @ 6.25%.

But in case of replacement series, a different trend was noticed in the growth and yield of pigeonpea, growth of pigeonpea measured in terms of LAI, development of pods, grain and productive branches per plant were found to be increased over pure as well as in intercropping of pigeonpea (additive). This resulted into 32.20% increase in the seed yield per plant in comparision to pure pigeonpea. It is because of this fact that the grain yield of pigeonpea in replacement series with soybean was 83.89% with 65.14% plant population showing an increase of 18.25%. Similarly sticks and straw yield of pigeonpea in replacement series was 74.07% and 92.37% with 65.14% plant population. This showed a positive effect of soybean on growth and yield of peigonpea. Similar results have also been reported by Tomar *et al.* (1997) and Billore *et al.* (1993) in 4:2 row system.

TABLE 1

Growth and yield of pigeonpea as influenced by association of soybean and phosphorus application.

Treatment	Plant population oooha Initial	at harvest	Morta-lity %	Number of pods/ plant	Pod yield plant (g)	Number of seeds/ plant	Seed yield plant (g)
Cropping System							
Sole pigeonpea	91.57	88.07	3.68	124.19	30.12	277.40	19.58
Soybean + pigeonpea (2 : 1) additive	91.57	77.88	15.16	120.71	28.23	260.96	17.64
Soybean + pigeonpea (4:2) replacement	60.71	57.37	5.55	156.40	41.66	370.93	25.85
SE (diff.)	0.363	0.404	0.498	3.499	0.909	7.89	0.525
CD at 5%	0.725	0.807	0.994	6.985	1.815	15.76	1.048
Doses of P_2O_5 kg/ha							
0	80.88	74.51	7.49	99.25	24.11	216.27	14.94
30	81.26	74.86	7.98	132.45	33.01	298.20	21.07
60	81.65	74.33	8.44	152.40	37.92	347.75	24.05
90	81.34	74.25	8.60	150.42	38.28	350.13	24.51
SE (diff.)	0.419	0.467	0.575	4.039	1.049	9.12	0.606
CD at 5%	NS	NS	NS	08.066	2.066	18.20	1.211

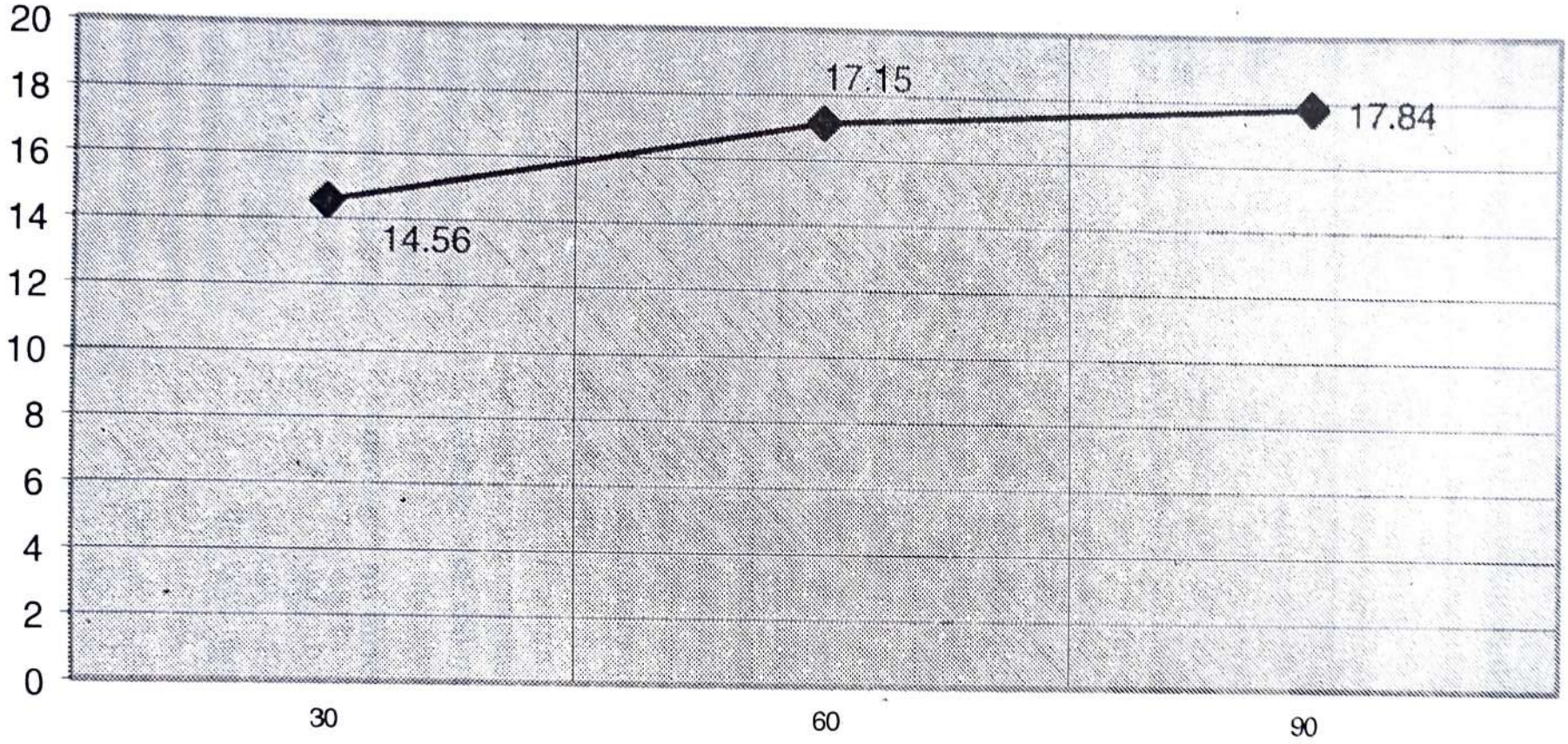
The total P uptake was 12.6 kg/ha in additive system and 12.17 kg/ha in replacement system which was comparatively lower than its sole cropping (12.27 kg/ha). Phosphorus use efficiency was significantly higher in replacement system and P use efficiency was highest in replacement system (25.36%) and lower in sole pigeonpea (17.82%).

Effect of Phosphorus on Pigeonpea

Data presented in Table-1 & 2 revealed that the grain, sticks and straw yield of pigeonpea was maximized with 60 kg P_2O_5/ ha. All the growth parameters like plant height, productive and total branches, number of pods and seed and its yield per plant showed tendency of maximizing their values with the application of 60 kg P_2O_5/ ha in pure and in intercropping systems. These results find the support of Nimje (1995) and Billore *et al.* (1993). The results on phosphorus use efficiency of pigeonpea crop showed that it was maximum at 30 kg P_2O_5/ha (17.14 kg grain per kg of P_2O_5) and was decreased to 13.59 kg grain per kg of P_2O_5 at 60 kg P_2O_5/ha and 10.02 kg grain per kg of P_2O_5 at 90 kg P_2O_5/ha. Phosphorus recovery was estimated @ 33.69%, 25.36% and 20.09% with the application of 30, 60 and 90 kg P_2O_5/ha, respectively.

Phosphorus requirements of pigeonpea

In view of the hand of the response to phosphorus rates, single degree feedom analysis was carried out in respect to grain yield data of pigeonpea and Quadratic regression equation $y = 10.17 + 5.34\ x - 0.93x^2$ was calculated and depicted in Fig-1.



Quadratic Response Curve of Grain Yield of Pigeonpea (q/ha) on Phosphorus Doses

TABLE 2

Yield and phosphorus uptake of pigeonpea under the influence of soybean intercropping and phosphorus application.

(2 years pooled data)

Treatment	Biomass q/ha	Straw yield q/ha.	Sticks yield q/ha.	Grain yield q/ha.	HI%	Phosphorus uptake kg/ha			P use efficiency kg grain per kg of P_2O_5	P utilization efficiency %
						Sticks +straw	Grain	Total		
Cropping System										
Sole pigeonpea	95.55	13.11	69.56	16.77	16.70	8.99	6.29	15.27	8.422	17.82
Soybean + pigeonpea (2:1) additive	85.47	11.80	59.39	13.96	15.63	7.68	4.92	12.60	8.77	16.16
Soybean + pigeonpea (4:2) replacement	77.72	12.11	51.53	14.07	17.66	6.88	5.29	12.17	13.37	25.36
SE (diff.)	2.149	0.315	1.773	0.339	0.195	0.218	0.159	0.344	–	–
CD at 5%	4.292	0.628	3.540	0.678	0.391	0.436	0.318	0.713	–	–
Doses of P_2O_5 kg/ha										
0	70.55	8.94	51.44	10.17	14.78	5.98	3.28	9.25	0.00	0.00
30	86.04	12.432	59.05	14.56	16.57	7.72	5.31	13.02	17.14	33.69
60	94.13	13.89	63.07	17.15	18.22	8.52	6.47	14.99	13.59	25.36
90	99.32	14.38	67.10	17.84	17.96	9.08	6.94	16.01	10.02	20.09
SE (diff.)	2.482	0.383	2.047	0.392	0.226	0.252	0.184	0.397	–	–
CD at 5%	4.596	0.726	4.088	0.783	0.451	0.503	0.367	0.823	–	–

On this equation x maxima, yield at x maxima and response to P application was computed. Results showed that maximum grain yield of pigeonpea (17.85 q/ha) was obtained with the application of 86.5 kg P_2O_5/ha @ 33.08 kg grain per kg of P_2O_5 or Rs. 30.30 per one rupee spent on phosphorus. Optimum yield for pigeonpea was 20.23 q/ha 'however' obtained with 68.82 kg P_2O_5/ha.

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