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Higher Levels of Phosphorus Affects Production and Productivity of Pigeonpea (*Cajanus cajan*) under Rainfed Condition

Bhushan Prasad Singh[1], Anjani Kumar[2], Gopal Krishna [3], G Mardi[4], Sanjeev Kumar[5], Ranjay Kumar Singh [6]

Krishi Vigyan Kendra, DEE Birsa Agricultural University, Ranchi.

ABSTRACT

A field experiment was carried out during rainy (kharif) season of 2015-16 and 2016-17 to study the effect of levels of phosphorus on production, productivity and profitability of pigeonpea under rainfed condition. Plant height (215.87 cm), branches per plant (17.06), pods length (5.41cm), pods/plant (188), grains/pod (4.33), 100 seed weight (11.37g), grain yield (12.20q/ha), stalk yield (45.6q/ha), harvest index (21.07%), net return (Rs70312.50) and benefit: cost ratio (3.51) were significantly higher at 60 kg P_2O_5/ha. Result revealed that P level 60kg/ha gave 58.44 , 31.18 and 4.27 per cent higher grain yield and 68.91, 35.93 and 3.70 per cent higher net return, respectively as compared to application of phosphorus levels 28 kg/ha, 40 kg /ha and 50 kg/ha. The trend of phosphorus levels to pigeonpea showed that higher dose of phosphorus gave maximum production and profitability as compared to lower dose of phosphorus application (Singh et al 2012).

Key Words: Pigeonpea, Phosphorus, Growth, Yield, Profitability, Production, Economics, Rainfed.

INTRODUCTION

Pigeonpea (*Cajanus cajan* L.) is one of the major pulse crops of India. At present long and medium duration pigeonpea is cultivated mostly on marginal land as mono/mixed crop either with imbalance fertilizer dose or without fertilizer under rainfed condition of Jharkhand. The evolution of new varieties of pigeonpea have provided the opportunity for multiple cropping in irrigated as well as rainfed areas. During the past the prices of phosphorus are increasing due to decrease in government subsidy on fertilizer, especially of phosphorus (P) and potassium (K). It has created imbalance of P nutrition and soil P reserve. Therefore, it is necessary to apply P in balanced amount for improving the productivity and profitability of pigeonpea. The organic based resources, farmyard manure is important source of organic manure, which not only provides balanced nutrition to the plants but also sustains crop productivity provides good substrate for growth of microorganisms, maintain favourable nutritional balance and soil physical properties Mahetele and Kushwaha (2011) but their availability is seriously constrained due to its alternative use as fuel.

Inoculation of pulses with PGPR and rhizobium causes growth stimulation of plant and enhances crop yields. The synergism has also been reported between rhizobium species and PSB in urdbean (Prasad *et al*, 2002) . The productivity of pigeon can be increased by inoculation of bioculture prepared from rhizobium, phosphate solubilizing organism (Govindan and Thirumurugan, 2005). Under present scenario where food and nutritional security are under threat, it has become imperative to ameliorate the soil plant-atmosphere as a whole rather than feeding the crop alone. The present investigation was undertaken to achieve maximum productivity without deteriorating the soil fertility with the optimum use of inorganic fertilizer in medium duration pigeonpea.

Corresponding Author's Email: bhushanbbau@gmail.com

Scientist Agronomy[1], Director ATARI, Patna[2], Scientist Extension[3], Scientist Plant Protection[4], Scientist Agronomy[5], Scientist Plant Protection[6],

Table 1. Effect of levels of phosphorus on plant height, branches/plant, pods length, pods/plant, grain/ pod and 100 grain weight of pigeonpea.

Treatment	Plant height (cm)	Branches / plant	Pod length (cm)	Pods / plant	Grain/pod	100 grain weight (g)
P_2O_5 (kg/ha)						
28	203.37	10.03	4.65	157.56	3.71	9.96
40	205.80	11.31	4.92	168.57	3.88	10.31
50	215.00	16.62	5.35	184.50	4.31	11.35
60	215.87	17.06	5.41	188.00	4.33	11.37
CD(P=0.05)	3.31	2.316	0.188	10.784	0.252	0.474
SEM $\pm$	1.12	0.782	0.064	3.642	0.085	0.160
CV%	1.50	16.061	3.530	5.897	5.933	4.215

MATERIALS AND METHODS

The field experiment was conducted during the *Kharif* season of 2015-16 and 2016-17 at farmers' field. The soils were sandy loam with PH 5.3 to 6.5, organic carbon 2.2 to 5.3 g/ kg, available N 122.3 to 147.6 kg/ha, available P 3.4 to 6.2 Kg/ha and available K 58.1 to 312.4 Kg/ha. The treatment consisted of four levels of Phosphorus (28,40,50 and 60 kg P_20_5/ha). In all four treatments with eight replications were tested in randomized block design. All the doses of phosphorus treatments and recommended doses of nitrogen (25 Kg/ha) and potassium (25kg/ha) were applied as basal dose. The pigeonpea cultivar ICPL 87119 (Asha) was shown on 28th July 2015 and harvested on 5th February 2016. Harvest index (%) was calculated based on the formula.

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

Net return were calculated by subtracting cost of cultivation from gross return.

Benefit: cost ratio was calculated by dividing the gross return with cost of cultivation. For economic analysis the prevailing prices of the input and produce during the period of the experiment were considered.

RESULTS AND DISCUSSION

Growth and yield attributes

Phosphorus levels exerted significant effect on plant height and yield indices of pigeonpea. Application of 60 kg P_20_5/ha significantly enhanced plant height and yield indices *viz.,* plant height (215.87 cm), branches/plant (17.06), pod length (5.41cm), pods/plant(188) and grain/pod (4.33) and found superior as compared to application of P_20_5 28,40 and 50 Kg/ha. P_20_5 60kg/ha followed by P_20_5 50 kg/ha viz plant height (215 cm), branches/ plant (16.62), pods length (5.35 cm), pods/plant (184.5) and grain/pod (4.31). Singh *et al* (1994) has reported superiority of SSP to DAP.

Grain yield, stalk yield, 100 seed weight and harvest index (%)

Application of P_20_5 60 Kg/ha significantly increased the grain and stalk yields, 100 seed weight and harvest index % over application of P_20_5 28,40 and 50 kg/ha. This might be owing to supply of adequate quantities and balanced proportion of plant nutrients to the crop as per need which increased availability of these nutrients to plant resulting in favorable increase in plant height, yield attributing characters and finally grain and stalk yield. It is reported that higher grain yield of pigeonpea at 18:46:20:20 kg N, P, K and S/ha (Goud and kale, 2010) . Result revealed that the grain yield (12.2 q/

Table 2. Effect of levels of phosphorus on grain yield, stalk yield, harvest index, net return and benefit: cost ratio of pigeonpea.

Treatment	Grain yield (q/ ha)	Stalk yield (q/ ha)	Harvest index (%)	Net return (Rs/ ha)	Benefit: cost ratio
P_2O_5 (kg/ha)					
28	7.70	33.70	18.62	41625	2.59
40	9.30	41.00	18.44	51725	2.86
50	11.70	45.50	20.40	67800	3.56
60	12.20	45.60	21.07	70312.50	3.51
CD(P=0.05)	0.178	0.44	1.293	12896.75	0.696
SEM±	0.060	0.15	0.437	4355.79	0.235
CV%	16.56	10.22	6.28	21.20	21.207

ha) stalk yield (45.6 q/ha) 100 seed weight (11.37g) and harvest index (21.07%) found maximum when P_20_5 applied as 60 kg/ha as compared to application of P_20_5 28,40,50 kg/ha. Result showed that P level 60 kg/ha gave 58.44, 31.18 and 4.27 per cent higher grain yield over P level 28,40 and 50 kg/ha. It was reported that grain yield and phosphorus status in pigeonpea- wheat system influenced by phosphorus levels (Katyal *et al,* 1999). The stalk yield (45.6 q/ ha) and 45.5 q/ha found at par when P_20_5 applied as 60 and 50 Kg/ha respectively and it was 35.31 per cent higher as compared to lower dose of P_20_5 application (28 kg/ha) (Kumar and Rana, 2007. It was reported that the greater value of stalk yield at higher dose of P owing to significantly higher value of dry matter /plant besides the other growth and yield parameters of pigeonpea under rainfed condition (Sarkar *et al* ,1997).

Economics

Application of phosphorus level 60 Kg/ha fetched higher net return (Rs. 68500/ha) and benefit: cost ratio (3.42) as compared to phosphorus level 28, 40 and 50 kg/ha. The net return was 68.91%, 35.93% and 3.70% higher at P level 60 kg/ha as compared to P level 28,40 and 60 kg/ha, respectively. It was reported that higher monetary returns at higher fertility level in pigeonpea + greengram intercropping system[8]. It was also reported that the maximum net return and benefit: cost ratio under combined inoculation of rhizobium + PSB together with 60 kg P_2O_5 application (Singh and Yadav, 2008).

CONCLUSION

The investigation results conclude that the application of higher dose of phosphorus level (60 kg/ha) gave maximum grain yield (12.20 q/ha) as compared to lower dose of phosphorus levels (28 kg/ha) gave lowest grain yield (7.70 q/ha). The yield gap between higher and lower levels of phosphorus found 58.44% which influence the net return gap by 68.91%. It was reported that the improvement in nutrient status of the soil may be ascribed to more biomass (leaves, root, etc) added by pigeonpea and improvement in fertility status of the soil through addition of fertilizers (Sarkar et al 1997).

REFERENCES

Mahetele D and Kushwaha H S (2011). Productivity and profitability of pigeonpea as influenced by FYM, PSB and phosphorus fertilization under rainfed condition. *J Food Legumes* 24 (1): 72-74.

Govindan K and Thirumurugan V (2005). Synergistic association of rhizobium with phosphate solublizing bacteria under different sources of nutrient supply on productivity and soil fertility in soyoabean (Glycine max). *Indian J Agron* **50** (3) 2014 – 2017.

Goud V V and Kale H B (2010). Productivity and profitability of pigonpea under different sources of nutrients in rainfed condition of central India. *J Food Legumes* **23** (3 and 4): 212-17.

Katyal V, Gangwar K S and Sharma S K (1999). Grain yield and phosphorus status in pigenapea (Cajanus Cajan). Wheat (*Triticum aestivum*) system influence by levels and frequency of P application. *Indian J Agri Sci* **69**(2); 84-85.

Kumar A and Rana K S (2007). Performance of pigeonpea (Cajanus Cajan) + greengram (Phaseolus radiatus) inter cropping system as influenced by moisture conservation practices and fertility level under rainfed conditions *Indian J Agron* **52**(1); 31-35

Prasad H, Chandra R, Pareek R P and Kumar N (2002). Synergism among phosphate solublizing bacteria, rhizobacteria and rhizobium with Urdbean. *Indian J Pulses Res* **15**(2):131-135.

Sarkar R K, Shit D and Chakaraborty A (1997). Effects of level and sources of phosphorus with and without farmyard manure on pigeanpea (*Cajanus cajan*), under rainfed condition. *Indian J Agron* **42** (1): 120-123.

Singh R S and Yadav M K (2008). Effect of Phosphorus and biofertilizers on growth, yield and nutrient uptake of long duration pigeonpea under rainfed condition. *J Food Legumes* **21** (1): 46 - 48.

Singh A K and Singh R S (2012). Effect of phosphorus levels and bio - inoculants on growth and yield of long duration piegenpea (*Cajanus cajan* L. Millsp). *J Food Legumes* **25** (1); 73-75.

Singh P, Verma B S and Sahu M P (1994). Effect of level and sources of phosphorus and bio regulators on groundnut (Arachis hypogea). *Indian J Agron* **39**(1): 66-70.

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