The Bioscan 11(1): 327-330, 2016 (Supplement on Agronomy)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

PERFORMANCE OF HYBRID PIGEONPEA (*CAJANUS CAJAN* L.) AS INFLUENCED BY NUTRIENT AND LIME LEVELS UNDER RAINFED CONDITION OF JHARKHAND

S. K. SINGH*, N. KUMARI, C. S. SINGH, S. KARMAKAR AND A. N. PURAN
Department of Agronomy, Birsa Agricultural University, Kanke, Ranchi - 834 006, Jharkhand, INDIA
e-mail: sksinghbau@gmail.com

KEYWORDS
Economics
Hybrid pigeonpea
Lime
Nodulation
Nutrient levels

Received on :
10.11.2015

Accepted on :
20.02.2016

***Corresponding author**

ABSTRACT

A field experiment was conducted during *kharif* season of 2009-10 at Birsa Agricultural University, Ranchi, to find out the effect of varying levels of nutrient and lime application on the performance hybrid pigeonpea. The experiment was laid out in randomized block design (factorial) with three replication keeping three nutrient levels (100% RDF, 150% RDF and 200% RDF) and three lime levels (control, 200 and 400 kg/ha). Application of 150% recommended dose of fertilizer (30:60:30:30 kg NPKS/ha) gave significantly higher plant height, leaf area index, number of primary branches/plant, number of secondary branches/plant, number of pods/plant, number of seeds/pod, 100 seed weight, grain yield (16.63 q/ha) and stover yield (49.99 q/ha) which ultimately resulted in significantly higher net return (Rs. 34573/ha) hybrid pigeonpea. However, it was statistically at par with 200% RDF (40:80:40:40 kg NPKS). The nutrient level failed to cause significant variation in harvest index and B: C ratio. Application of lime upto 200 kg/ha significantly improved the plant height, leaf area index, number of primary and secondary branches/plant, number of nodules/plant, dry weight of nodules/plant, number of pods/plant, number of seed/pods, 100 seed weight, grain yield (17.40 q/ha), stover yield (51.62 q/ha), net return (Rs. 51242/ha) and B:C Ratio (2.53) of hybrid pigeonpea

INTRODUCTION

Pigeon pea (*Cajanus cajan* L.) is one of the most important pulse crop in India. It is cultivated mostly on marginal land in mono/mixed cropping system without any fertilizers under rainfed conditions of Jharkhand. Nitrogen and phosphorus are most important plant nutrients for crop production. Nitrogen constituent of chlorophyll, harnesses solar energy and fixes atmospheric CO_2 as carbohydrates. Phosphorus plays important role in root development, nodulation, flowering, fruiting and is usually a constituent of phospholipids, nucleic acid, protein, coenzyme, NAD, NADP, and ATP. (Yugandhar and Savithramma, 2013). Being a pulse crop, it utilizes the atmospheric nitrogen through symbiotic association. Yet for obtaining better yield a starter dose of nitrogen and adequate phosphorus are considered essential (Katiyar, 1985). So, fertilizer plays a key component of management that influences the growth, development and yield of hybrid pigeonpea as full plant expression in hybrid pigeonpea can be achieved only with a proper and well defined fertilizer schedule. In upland soil of Jharkhand, the development of roots and formation of nodule with effective rhizo bacteria is highly affected due to acidity of the soil and ultimately the plant performance. The application of lime reduces the soil acidity (pH increases) as it reduces the soluble aluminum and manganese to nontoxic levels and creates a suitable environment for rhizobium bacteria. Saini and Thakur (1996) stated that moderate doses of nitrogen and phosphorus (30:60 kg N:P per hectare) significantly increased the plant height, branches/plant and leaf area index of grain legumes compared to no N and P. The higher grain yield of blackgram is associated with significantly superior yield attributes e.g. effective number of pods per plant and 1000 seed weight (Singh *et al.*, 1993). For obtaining maximum yield from hybrid pigeonpea the recommended dose of fertilizer and lime levels is yet to be decided. Keeping all the views in mind an experiment was conducted to study the performance of hybrid pigeonpea as influenced by nutrient and lime levels under rainfed condition of Jharkhand.

MATERIALS AND METHODS

The field experiment was conducted during *kharif* season of 2009-10 at the Birsa Agricultural University farm, Ranchi, Jharkhand. The soil was sandy loam in texture, acidic in reaction (pH 5.8), low in organic carbon (0.35%) and available nitrogen (232 kg/ha), medium in available phosphorus (19.7 kg/ha), potassium (186.4 kg/ha) and sulphur (12.6 kg/ha). The experiment was laid out in a Randomized Block Design with nine treatments replicated thrice. The treatment consisted of three nutrient levels viz., 100% RDF, 150% RDF and 200% RDF and three lime levels viz., 0, 200 and 400 kg/ha. The recommended dose of fertilizer was 20 kg N, 40 kg P_20_5, 20 kg K_2O and 20 kg S/ha. Full dose of fertilizer and lime were applied as basal. Plant sampling ware made at 30, 60, 90 days after sowing and at maturity to recorded the growth parameters such as plant height, number of primary and secondary branches, leaf area index, number and dry weight of nodules while, the yield attributes, grain and stover yield were recorded at harvest. Hybrid pigeonpea "ICPH-2671" was sown on 08 July 2009 at spacing of 90 cm x 25 cm with seed rate of 20 kg/ha.

The crop was harvested in the first week of February, 2010. Total rainfall recorded during crop period was 1013.7 mm. Data were analyzed statistically for test of significance following the fishers method of "Analysis of Variance" by Panse and Sukhatme (1989). Critical differences were worked out wherever necessary at five percent probability level.

RESULTS AND DISCUSSION

Plant height

The results of the growth parameters revealed that there was a gradual increase in the plant height of hybrid pigeonpea till maturity of the crop. Irrespective of the growth stages, application of recommended dose of fertilizer manifested marked variation in plant height at all the growth stages and were significantly higher under 150% recommended dose of fertilizer (Table 1). Further, increase in nutrient levels failed to cause significant variation in plant height. Similar result was found by Shivran *et al.,* (2000). Significant enhancement in plant height was also recorded with increasing lime application upto 200 kg/ha at all the growth stages.

Leaf area index

The leaf area index increased successively as the growth progressed upto 120 days after sowing and thereafter it declined at harvest due to drying of leaves. The leaf area index of hybrid pigeonpea increased with each increment in nutrient level (Table 1). However, significant improvement in leaf area index was recorded upto 150% recommended dose of fertilizer at all growth stages. Similar result was noted by Singh *et al.,* (2011). Among the lime levels, application of 200 kg lime/ha registered significantly higher leaf area index than those of control at all stages. Further increase in lime levels increased the leaf area index but, the magnitude of variation in leaf area index was statistically not significant.

Branches per plant

The number of primary and secondary branches of pigeonpea increased as the growth progressed value being maximum at harvest (Table 2). There was significant increase in number of primary and secondary branches/plant with increase in nutrient levels upto 150% RDF at all the growth stages. Increasing lime levels tended to increase the number of primary and secondary branches per plant upto the higher lime levels i.e. 200 kg /ha. However, significant variation in number of primary and secondary branches were recorded only up to 200 kg lime/ha at all the growth stages. The mineral nutrient are directly involved in the synthesis of protein, chloroplast pigments and electron transfer, thus increasing nutrient levels increased the photosynthetic activity of pigeonpea plant which naturally accounts for higher number of primary and secondary branches per plant. Similar results were finding in Amruta *et al.* (2015), Srinivas and Srinivas (1997).

Nodules per plant

The number of nodules per plant and dry weight of nodules per plant increased sharply up to 90 days after sowing and thereafter declined at maturity due to degeneration of root nodules (Table 2). The development of lateral buds and seed development during reproductive stage required more energy resulting in degeneration of nodules at maturity. The nutrient levels manifested marked variation in number of nodules per plant and dry weight of nodules/plant and were significantly higher under 150% recommended dose of fertilizer at all the growth stages. Further increase in nutrient level increase the number of nodules per plant and dry weight of nodules per plant but failed to cause significant variation. Marked improvement in number of nodules per plant and dry weight of nodules per plant were also noticed with the application of 200 kg lime/ha which produced significantly higher number of nodule per plant and dry weight nodule per plant at all the growth stages. These results are related to results of Patel *et al.* (2013).

Yield attributes

The yield attributing characters of pigeonpea viz., number of pods per plant, number of seeds per pod and 100 seed weight increased significantly with each increment in fertilizer level up to 150% recommended dose of fertilizer (Table 3). Further increase in nutrient levels though increased the number of pods per plant, number of seeds per pod and 100 seed weight, failed to record statistical significance. Application of varying lime levels also significantly influenced the number of pods per plant, number of seeds per pod and 100 seed weight of pigeonpea and application of 200 kg lime/ha was found to be the most effective in augmenting the yield attributing characters of pigeonpea. This might be attributed to better growth and enhanced photosynthesis in the presence of required nutrients

Table 1: Effect of nutrient and lime levels on plant height and leaf area index of hybrid pigeonpea

Treatments	Plant height (cm)				Leaf area index			
	30 DAT	60 DAT	90 DAT	At maturity	30 DAT	60 DAT	90 DAT	At maturity
Nutrient levels								
100% RDF	32.94	80.94	140.12	169.32	1.85	4.59	6.20	4.71
150% RDF	38.00	87.76	147.51	175.83	2.62	5.87	7.45	6.61
200% RDF	41.36	91.16	148.80	178.13	2.98	6.89	8.26	7.04
SEm±	1.29	2.07	2.11	0.90	0.13	0.35	0.30	0.34
CD (P=0.05)	3.87	6.21	6.34	2.71	0.39	1.06	0.90	1.01
Lime levels								
0 kg/ha	29.51	78.94	137.62	163.31	1.5	3.93	5.62	4.63
200 kg/ha	39.79	88.44	147.67	179.78	2.82	6.21	7.79	6.41
400 kg/ha	43.00	92.47	151.14	180.20	3.12	7.21	8.50	7.39
SEm±	1.29	2.07	2.11	0.90	0.13	0.35	0.30	0.34
CD (P=0.05)	3.87	6.21	6.34	2.71	0.39	1.06	0.90	1.01

Table 2: Effect of nutrient and lime levels on primary and secondary branches/plant, number of nodules /plant and dry weight of nodules of hybrid pigeonpea

Treatments	Number of primary branches/plant				Number of secondary branches/plant		
	30 DAT	60 DAT	90 DAT	At maturity	60 DAT	90 DAT	At maturity
Nutrient levels							
100% RDF	4.97	6.49	15.92	19.64	10.41	20.27	24.70
150% RDF	5.84	7.32	17.69	20.80	11.69	22.69	27.80
200% RDF	6.37	7.86	18.87	21.84	12.63	24.10	29.40
SEm±	0.22	0.19	0.44	0.36	0.36	0.68	0.77
CD (P=0.05)	0.65	0.58	1.30	1.07	1.08	2.04	2.29
Lime levels							
0 kg/ha	4.60	6.00	15.71	19.02	10.01	19.07	23.26
200 kg/ha	6.01	7.64	17.77	21.30	11.93	23.13	28.60
400 kg/ha	6.57	8.02	19.00	21.97	12.79	24.86	30.04
SEm±	0.22	0.19	0.44	0.36	0.36	0.68	0.77
CD (P=0.05)	0.65	0.58	1.30	1.07	1.08	2.04	2.29

Treatments	Number of nodules/plant				Dry weight of nodules (mg/plant)		
	30 DAT	60 DAT	90 DAT	At maturity	30 DAT	60 DAT	90 DAT
Nutrient levels							
100% RDF	8.93	17.03	27.02	9.86	49.33	58.74	74.46
150% RDF	10.56	21.26	30.09	11.66	58.44	65.26	79.41
200% RDF	11.91	23.08	31.60	12.54	62.00	70.22	82.80
SEm±	0.52	0.89	0.78	0.54	1.51	1.76	1.38
CD (P=0.05)	1.55	2.68	2.33	1.63	4.53	5.27	4.12
Lime levels							
0 kg/ha	8.63	16.22	26.69	9.37	50.00	54.33	71.96
200 kg/ha	10.9	22.03	30.13	11.78	58.11	68.06	81.07
400 kg/ha	11.87	23.11	31.89	12.91	61.67	71.83	83.64
SEm±	0.52	0.89	0.78	0.54	1.51	1.76	1.38
CD (P=0.05)	1.55	2.68	2.33	1.63	4.53	5.27	4.12

Table 3: Effect of nutrient and lime levels on yield attributes, yield an economics of hybrid pigeonpea

Treatments	Number of Pods/ plant	Number of Seed/pod	100-seed weight (g)	Grain yield (q/ha)	Stover yield (q/ha)	Harvest index (%)	Gross return (Rs./ha)	Net return (Rs./ha)	Benefit: cost ratio
Nutrient levels									
100% RDF	156.63	2.99	9.07	14.39	45.49	23.77	42,801	29,446	2.20
150% RDF	183.21	3.84	9.42	16.63	49.99	25.00	49,081	34,573	2.38
200% RDF	194.30	4.03	9.53	17.90	51.45	25.69	52,477	36,816	2.35
SEm±	6.50	0.19	0.08	0.51	1.42	0.70	1351	1351	0.09
CD (P=0.05)	19.48	0.56	0.25	1.53	4.26	N.S	4050	4050	N.S
Lime levels									
0 kg/ha	142.32	2.81	8.97	13.25	43.17	23.23	39,595	25,687	1.84
200 kg/ha	187.40	3.99	9.43	17.40	51.62	25.21	51,242	36,734	2.53
400 kg/ha	204.42	4.07	9.63	18.28	52.15	26.02	53,522	38,414	2.54
SEm±	6.50	0.19	0.08	0.51	1.42	0.70	1351	1351	0.09
CD (P=0.05)	19.48	0.56	0.25	1.53	4.26	N.S	4050	4050	0.28

in sufficient amount and also due to better translocation of photosynthates to sink due to balanced fertilization. Similar results were noted by Singh *et al*. (2010).

Grain and stover yield

Yield is the sum total effect of different growth and yield attributes. There was significant increase in grain and stover yield of pigeonpea with the increasing nutrient level up to 150% of recommended dose of nutrient (Table 3). Further increase in nutrient level, through increased the grain and stover yield but failed to record statistical significance. Increasing nutrient levels delays senescence and increases the life cycle of the plant resulting the higher economic yield. Similar results were observed by Kantwa *et al.,* (2005). Increase in lime levels also increased the grain and stover yield of pigeonpea. However, the magnitude of increase was significantly higher with lime application of 200 kg/ha. Similar results was found Singh *et al.,* (2006). The varying level of nutrient and lime application failed to cause significant variation in harvest index although the harvest index increased with each increment in nutrient and lime application upto the highest level.

Economics

Economic advantage is key factor for viability of any technology and will not be accepted to farming community until it is not economically viable. Among the different nutrient levels, application of 150% recommended dose of fertilizer resulted in significantly higher gross return, net return and B:C ratio over 100% RDF (Table 3). This might be due to higher grain and stover yield of crop at higher nutrient levels. Lime level also significantly influenced the economics of pigeonpea and application of 200 kg lime/ha was found to be the most effective in augmenting the gross return, net return and B: C ratio of hybrid pigeonpea. Similar results were obtained by Sarkar *et al.* (2004).

REFERENCES

Amruta, N., Maruthi, J. B., Sarika, G. and Deepika, C. 2015. Effect of integrated nutrient management and spacing on growth and yield parameters of black gram cv. LBG-625 (Rashmi). *The Bioscan*. **10(1):** 193-198.

Kantwa, S. R., Ahlawat, I. P. S. and Gangaiah, B. 2005. Effect of land configuration, post monsoon irrigation and phosphorus on performance of sole and intercropped pigeonpea (*Cajanua cajan*). *Indian J. Agronomy*. **50(4):** 278-280.

Katiyar, R. P. 1985. Production technology for gram in Himachal Pradesh. *Indian Farming*. **35:** 11- 13.

Panse, V. G. and Sukhatme, P. 1989. Statistical methods for Agricultural workers, 3rd edn. *Indian Council of Agricultural Research*, New Delhi.

Patel, H. R., Patel, H. F., Maheriya, V. D. and Dodia, I. N. 2013. Response of *kharif* greengram to sulphur and phosphorous fertilization with and without biofertilizer application. *The Bioscan*. **8(1):** 149-152.

Saini, J. P. and Thakur, S. R. 1996. Effect of nitrogen and phosphorus on vegetable pea (Pisum sativum) in cold desert area. *Indian J. Agricultural Sciences*. **66:** 514-517.

Sarkar, A. K., Singh, Surendra, Singh, R. N. and Saha, P. B. 2004. Integrated nutrient management practices for crops. Soil Science and *Agricultural Chemistry* (Birsa Agricultural University). Tech. Bull: 01/2004.

Shivran, P. L., Ahlawet, I. P. S. and Shivran, P. R. 2000. Effect of phosphorus and sulphur on pigeonpea (*Cajanus cajan*) and succeeding wheat (*Triticum aestivum*) in pigeonpea-wheat cropping system. *Indian J. Agronomy*. **45(1):** 25-30.

Singh, A. K., Choudhary, R. K. and Roy Sharma, R. P. 1993. Effect of inoculation and fertilizer levels on yield, yield attributes and nutrient uptake of greengram (*Phaseolus radiatus*) and blackgram (*P. mungo*). *Indian J. Agronomy*. **38:** 663-665.

Singh, C. S., Singh, Ashok Kumar and Singh, Arvind Kumar 2010. Effect of levels and sources of nutrient application growth, yield and economics of babycorn (*Zea mays*) and their residual effect on succeeding wheat (*Triticuna aestivum*). *Environment and Ecology*. **28(2):** 919-922.

Singh, C. S., Singh, Ashok Kumar and Singh, Arvind Kumar 2011. Growth and yield response of rice to various levels of fertility, sulfur and zinc under transplanted condition. *Environment and Ecology*. **29(3):** 978-984.

Singh, R. S., Srivastava, G. P. and Kumar Sanjay 2006. Fertilizer management in pigeonpea based intercropping systems. II. Nutrient removal and net change in soil fertility. *J. Research* (BAU). **18(1):** 39-43.

Srinivas, A. and Raju, M. and Srinivas 1997. Phosphorus fertilization of short duration pigeonpea varieties in alfisols under rainfed conditions. *Legume Research*. **20(2):** 104-108.

Yugandhar, P. and Savithramma, N. 2013. Green synthesis of calcium carbonate nanoparticles and their effects on seed germination and seedling growth of *Vigna Mungo*. *International J. Advanced Research*. **1(8):** 89-103.