International Journal of Research in Agronomy 2024; 7(3): 613-616

E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(3): 613-616
Received: 01-01-2024
Accepted: 05-02-2024

IB Pandey
Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

RS Singh
Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Sunil Kumar
Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Rajendra Prasad
Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Rabindra Prasad
Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Amrendra Kumar
Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Corresponding Author:
IB Pandey
Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Response of long duration pigeonpea (*Cajanus Cajan* L .) to foliar application of nutrients and insecticides under rainfed condition of Bihar

IB Pandey, RS Singh, Sunil Kumar, Rajendra Prasad, Rabindra Prasad and Amrendra Kumar

DOI: https://doi.org/10.33545/2618060X.2024.v7.i3h.560

Abstract
A field experiment was conducted for three consecutive years during *Kharif* seasons of 2016-17 to 2018-19 at Tirhut College of Agriculture, Dholi a campus of Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur to study the response of long duration pigeonpea [(*Cajanus cajan*) (L.) Millsp] to foliar application of nutrients and insecticides under rainfed condition. Foliar application of multi-micronutrient 2 ml/litre + indoxacarb 1 ml/litre at 50% flowering fb profenofos 1 ml/litre 15 days later together with based application of RDF recorded higher number of pods/plant, pod length (5.6 cm), number of grains/pod (212), fruiting efficiency (16.8%) water-use-efficiency (3.5 kg/ha/mm), production efficiency in term of ₹/ha/day (366.7) and kg/ha/day (8.61), grain yield (2286.5 kg/ha), and NPK-uptake by crop and net return (96.83×10^3₹/ha) but was found at par with foliar application of 1% urea+ 0.25% borax and $ZnSO_4$ at 50% flowering together with basal application of RDF and significantly higher than foliar application of 2% urea, 0.5% borax and 0.5% $ZnSO_4$ at 50% flowering individually together with basal application of RDF and RDF alone. However, significantly higher B:C ratio (3.15) was registered under foliar application of 1% urea + 0.25% borax and $ZnSO_4$ together with RDF. Foliar application of indoxacarb 1ml/litre at 50% flowering fb profenofos 1 ml/litre 15 days later with RDF and foliar application of these insecticides with multi-micronutrient at 50% flowering with RDF significantly reduced the incidence of pod borer and pod fly than other treatments. Plant height, branches/ plant, 100-grain weight, and protein content in grain were unaffected by foliar application of nutrients and insecticides.

Keywords: Branches, economics, fruiting efficiency, pigeonpea, production efficiency, water-use efficiency

Introduction
Pigeonpea is grown throughout the tropical and sub-tropical regions of the world, between 30^0N and 35^0S latitudes. However, in India major area is lying between 14^0S and 28^0N latitudes. In India pigeonpea is grown in an area of about 4.50 mha and produce 3.66 mt of grain with productivity of 824 kg/ha. However, in Bihar it is grown in an area of 24.11 thousand hectares and produce 39.32 thousand tons of grain with productivity of 1631 kg/ha (Anonymous, 2023) [1]. Long duration pigeonpea is widely cultivated in Bihar mostly on marginal and sub-marginal land under rainfall condition without any fertilizers. The yield of pigeonpea is limited by several factors such as agronomic, pathogenic, entomological, genetic and their interaction with environment. Among the nutrients, N, P, K are most important nutrients which contribute to proper growth and yield of crop plant and it also has direct effect on plant metabolism. In turn, the nutrients are known to alter the various physiological and biochemical functions which finally influences the yield of crop. Sometime soil applied nutrients are not sufficient for crop to meet out their nutrient requirement and it may be due to non-availability of nutrients because of abrupt soil condition, exhausted soil condition or nutrient losses through leaching and many more things which can hinder the availability of nutrients to plants and cease the plant growth, which ultimately affect the yield and quality of the crop produce. So, the foliar application of nutrients at critical crop growth stages is appropriate and accurate method of correcting the nutrient deficiencies (Thakur *et al.* 2017) [7].

In almost all the pulses, flower drop determines the yield and yield attributing characters. Retention of flowers produced by the plant helps to get more yield than expected. Another major constraint in pigeonpea production is incidence of pod borer and pod fly. In India, nearly three hundred species of insects are known to infest pigeonpea at its various growth stages, of these pod borer and pod fly are important feeder of pigeonpea, which are collectively referred to as the pod borer complex. Pod fly is a hidden pest of pigeonpea inflicted 21.0 to 38.5% pod damage and 12.3 to 19.9% grain damage (Patra *et al.* 2016) [5]. Keeping these facts in view the present study was carried out to find out the response of long duration pigeonpea to foliar application of nutrients and insecticides under rainfed condition of Bihar.

Materials and Methods

The field experiment was conducted at research farm of Tirhut College of Agriculture, Dholi (25^0 98′ N 85^0 76′ E and an altitude of 51.3 m above sea-level) a campus of Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar during *Kharif* season for three consecutive years 2016-17 to 2018-19. The soil of the experimental plot was sandy loam in texture, low in organic carbon (0.34%), low in available nitrogen (145.6 kg/ha^{-1}), low in available phosphorus (12.6 kg/ha), medium in available potassium (151.4 kg/ha), low in Zinc (0.6 ppm) and low in boron (0.4 ppm) with pH 8.1. The treatment comprised, T_1 – RDF (20:40:20:20 kg NPKS/ha), T_2 – RDF + 2% urea spray at 50% flowering, T_3 – RDF + 0.5% borax spray at 50% flowering, T_4 - RDF + 0.5% $ZnSO_4$ spray at 50% flowering, T_5 – RDF + 0.1% urea + 0.25% borax + 0.25% $ZnSO_4$ spray at 50% flowering, T_6 – RDF + multi-micronutrient 2 ml/litre of water at 50% flowering, T_7 – RDF + indoxacarb 1 ml/litre of water at 50% flowering fb. profenofos 1 ml/litre of water 15 days later and T_8 – T_6 + indoxacarb 1 ml/litre of water at 50% flowering fb profenofos 1 ml/litre of water 15 days later. The experiment was laid out in randomized block design and replicated thrice. The pigeonpea variety “Pusa-9” was sown in 4th week of July and was harvested in 3rd week of April in all the experimental years. Pigeonpea was sown in rows 60 cm apart and plant to plant distance of 20 cm was maintained by thinning three weeks after sowing. Full dose of nitrogen, phosphorus, potassium, and sulphur were applied at the time of sowing. The crop received 646.8 mm mean rainfall during the crop growth period. The initial pH, organic carbon, N, P and K-content of soil were analyzed by glass electrode pH meter, Walkley Alkaline permagnate, Olsen’s and flame photometric method respectively. Fruiting efficiency was worked out by dividing the flower bearing pods by total number of flowers multiplied by 100. Economics was worked out on prevailing market price of input and output. Net return was calculated by subtracting cost of cultivation from gross return. Benefit: Cost ratio was calculated by dividing the net returns by cost of cultivation. Production efficiency in term of kg/ha/day and ₹/ha/day were obtained by yield and net return of pigeonpea divided by the duration of crop in that treatment respectively. Data pertaining to each character were analyzed statistically by applying the standard procedure of randomized block design (Cochran and cox, 1977) [3].

Results and Discussion

Growth and yield attributes

Plant height, branches/plant, and 100-grain weight of pigeonpea were not significantly influenced by foliar application of either nutrient or insecticides (Table 1). However, number of pods/plants, pod length and grains/pod were significantly higher in these treatments than the basal application of recommended dose of fertilizers alone. Foliar application of indoxacarb at 50% flowering fb profenofos 15 days later together with foliar application of multi-micronutrient at 50% flowering and RDF recorded significantly higher pods/plant than the foliar application of borax and $ZnSo_4$ but was found at par with foliar application of indoxacarb fb profenofos 15 days later with RDF. Foliar application of these nutrients and insecticides at 50% flowering and 15 days later would have helped for reducing flower drop and contributed more for reproductive parts resulting in an increase in number of pods/plants, pod length and grains/pod. Similar results have also been reported by Avinash *et al.* (2020) [8].

Incidence of insect pest

Foliar application of indoxacarb 1 ml/litre of water at 50% flowering fb profenofos 1ml/litre of water 15 days later together with basal application of RDF and application of these insecticides with RDF + foliar application of multi-micronutrient significantly reduced the incidence of pod borer and pod fly than the basal application of RDF and foliar application of borax and $ZnSo_4$ together with RDF (Table 2). Meena *et al.* (2020) [4] also reported minimum damage by pod borers and pod fly under RDF + foliar application multi-micronutrient 2 ml/litre + indoxacarb 375 ml/ha at 50% flowering fb dimethoate 1.0 litre/ha 15 days later.

Fruiting efficiency

Foliar application of multi-micronutrient at 50% flowering fb indoxacarb 1 ml/litre of water at 50% flowering and profenofos 1 ml/litre of water 15 days later together with RDF recorded significantly higher fruiting efficiency than foliar application of nutrients but was found at par with foliar application of 1% urea, + 0.25% borax and ZnSo4 at 50% flowering and foliar application of these insecticides together with RDF (Table 1). Higher fruiting efficiency in these treatments might be due to providing adequate quantity of nutrients and water to the crop plant leading to reduce flower dropping and increased pod bearing capacity of the plant.

Grain and stalk yields

Foliar application of multi-micronutrient 2ml/litre + indoxacarb 1 ml/litre at 50% flowering fb profenofos 1 ml/litre 15 days later together with RDF although produced higher grain and stalk yields but was found at par with foliar application of 1% urea + 0.25% borax and $ZnSo_4$ at 50% flowering together with RDF and foliar application of these insecticides at 50% flowering together with RDF and significantly higher over foliar application of 2% urea, 0.5% borax and 0.5% $ZnSO_4$ separately together with RDF and RDF alone (Table 1). This might be due to absorption of adequate quantity of nutrients through plant foliage which increased availability of these nutrients to the plant resulting in reduced flower dropping and favorable increase in yield attributing character *viz*, number of pods/plant pod length and grains/pod and finally the grain and stall yields. The reduction in the incidence of pod borers and pod fly might be another reason for higher grain yield in treatment. The results are in accordance with the results obtained by Priyanka (2019) [6]. Simitar trend has also been recorded in harvest index also.

Production and water-use efficiency

The production and water-use efficiency were also significantly higher when 1% urea + 0.25% borax and $ZnSO_4$ were sprayed at 50% flowering together with basal application RDF and foliar application of multi-micronutrient 2 ml/litre + indoxacarb 1 ml/litre at 50% flowering and profenofos 1 ml/litre 15 days later together with basal application of RDF than the foliar application of other nutrients with based application of RDF and RDF done (Table 2). The increase in production efficiency in term of ₹/ha/day and kg/ha/day might be due to increase in grain yield in these treatments. However, increase in water-use-efficiency in these treatments was achieved owing to increase in grain yield per unit of water used.

Protein content

Protein content in grain slightly increased under foliar application of nutrients and multi-micronutrient than the basal application of RDF but could not reach to the level of significance (Table 2).

NPK- uptake

NPK – uptake by crop were significantly influenced by foliar application of nutrients and insecticides (Table 2). Foliar application of multi-micronutrient 2 ml/litre + indoxacarb 1 ml/litre at 50% flowering *fb* profenofos 1 ml/litre 15 days later together with based application of RDF recorded highest NPK – uptake by crop which was found at par with foliar application of 1% urea + 0.25% borax and $ZnSO_4$ at 50% flowering together with basal application of RDF and significantly higher over foliar application of higher dose of those nutrients individually and insecticides with basal application of RDF and RDF alone. The higher NPK-uptake in these treatments might be due to enhanced biomass production of pigeonpea.

Economics

Foliar application of multi-micronutrient 2 ml/litre + indoxacarb 1 ml/litre at 50% flowering fb profenofos 1 ml/litre 15 days later although recorded higher net return but being at par with foliar application of 1% urea + 0.25% borax and $ZnSO_4$ at 50% flowering and significantly higher than foliar application of higher dose of nutrients separately and insecticides together with RDF (Table 2). However, significantly higher B:C ratio was registered under foliar application 1% urea + 0.25% borax + $ZnSO_4$ at 50% flowering. The lower net return per rupees investment under foliar application of multi-micronutrient + indoxacarb fb profenofop was obviously due to increase in input cost with no commensurate increase in grain yield of pigeonpea. The lower net return per investment under foliar application of multi-micronutrient + Indoxacarb fb profenofos was obviously due to increase in input cost with no commensurate increase in grain yield of pigeonpea.

Table 1: Effect of foliar application of nutrients and insecticides on growth, yield indices, fruiting efficiency and grain yield of pigeonpea.

Treatments	Plant height (cm)	Branches/ plant	Grains/ pod	Pods/ plant	Length of pod (cm)	100-grain wt. (g)	Fruiting efficiency (%)	Grain yield (kg/ha)	Stalk yield (kg/ha)	Harvest Index (%)
RDF (20:40:20:20 NPKS kg/ha)	222.4	19.3	4.1	187	4.9	11.3	12.2	1882.7	8359.1	18.38
RDF + 2% urea spray at 50% flowering	223.8	18.4	4.5	196	5.8	11.8	14.2	2059.5	8979.4	18.66
RDF + 0.5% Borax spray at 50% flowering	221.8	17.9	4.4	190	5.4	12.0	13.5	1967.8	8618.9	18.59
RDF + 0.5% $ZnSO_4$ spray at 50% flowering	223.0	18.0	4.3	192	5.5	11.6	13.8	1991.3	8701.9	18.62
RDF + 1% urea +0.25% Borax + 0.25% $ZnSO_4$ spray at 50% flowering	221.2	19.8	4.5	201	5.6	12.2	16.2	2176.6	9359.3	18.87
RDF + multi-micronutrient 2 ml/litre at 50% flowering	223.6	18.5	4.4	199	5.8	10.9	14.1	2107.5	9116.5	18.78
RDF + Indoxacarb (1.0 ml/litre) at 50% flowering + profenofos (1ml/litre) at 15 days later	222.5	19.2	4.3	205	5.5	11.9	15.9	2113.7	9132.3	18.80
RDF + multi-micronutrient (2 ml/l) + Indoxacarb (1.0 ml/litre) at 50% flowering + profenofos (1ml/litre) at 15 days later.	221.6	18.8	4.6	212	5.6	12.1	16.8	2286.5	9800.4	18.92
SEm±	2.20	1.3	0.1	3.5	0.1	0.4	0.71	48.7	136.3	0.10
CD(P=0.05)	NS	NS	0.3	12.0	0.4	NS	2.4	167.6	467.9	0.34

Table 2: Effect of foliar application of nutrients and insecticides on incidence of pod borer, pod fly, water use efficiency, production efficiency, NPK uptake by crops and economics

Treatments	Water use efficiency (kg/ha/mm)	Production efficiency (kg/ha/day)	Productivity (Rs/ha/day)	Protein content in grain (%)	Pod borer (%)	Pod fly (%)	N-uptake (kg/ha)	P-uptake (kg/ha)	K-uptake (kg/ha)	Net Return (x 10^3 Rs/ha)	B:C ratio
RDF (20:40:20:20 NPKS kg/ha)	2.7	6.62	302.1	20.38	13.8	15.1	133.7	37.1	100.7	79.77	3.09
RDF + 2% urea spray at 50% flowering	3.0	7.37	333.2	20.73	14.3	16.0	146.5	39.7	107.0	87.97	3.21
RDF + 0.5% Borax spray at 50% flowering	2.3	7.05	312.4	20.40	13.9	15.2	138.9	38.3	103.9	82.48	2.97
RDF + 0.5% $ZnSO_4$ spray at 50% flowering	2.9	7.08	316.5	20.37	12.9	15.8	140.2	38.9	104.6	83.56	3.01
RDF + 1% urea +0.25% Borax + 0.25% $ZnSO_4$ spray at 50% flowering	3.1	8.24	355.3	20.60	13.4	16.3	153.0	41.5	110.9	93.82	3.37
RDF + multi-micronutrient 2 ml/litre at 50% flowering	3.1	7.37	340.6	20.34	13.8	15.9	147.3	40.1	108.1	89.94	3.25
RDF + Indoxacarb (1.0 ml/litre) at 50% flowering + profenofos (1 ml/litre) at 15 days later	3.3	8.01	332.9	20.32	4.8	3.4	147.9	40.4	109.2	87.91	2.90
RDF + multi-micronutrient (2 ml/l) + Indoxacarb (1.0 ml/litre) at 50% flowering + profenofos (1 ml/litre) at 15 days later.	3.5	8.61	366.7	20.39	5.1	3.8	159.3	43.2	115.0	96.83	3.15
S Em±	0.12	0.33	2.1	0.2	0.6	0.5	2.8	0.8	1.3	1.81	0.05
CD(P=0.05)	0.4	1.12	7.2	NS	2.2	1.8	9.6	2.6	4.5	6.18	0.18

Conclusion

Foliar application of multi-micronutrients 2 ml/litre + indoxacarb 1 ml/litre at 50% flowering fb profenofos 1 ml/litre 15 days later together with RDF reduced incidence of pod borers and pod fly and enhanced fruiting efficiency, production efficiency, water-use efficiency, grain yield and net return but was at par with foliar application of 1% urea + 0.25% borax + $ZnSO_4$ at 50% flowering together with basal application of RDF. However, higher B:C ratio was associated foliar application of 1% urae + .25% borax and $ZnSO_4$ at 50% flowering together RDF. Hence, for enhancing the productivity and profitability of long duration pigeonpea these package of practices to be adopted.

References

1. Anonymous. Project Coordinators Report of All India Coordinator Research Project on kharif pulses (2022-23); 2023. p. 46-48.
2. Patil AJR, Patil RP, Rathod SP. Influence of foliar application of nutrients and plant growth regulators on yield and yield components in pigeonpea (*Cajanus cajan*). Int J Chem Stud. 2020;8(5):2341-2343.
3. Cochran, WG, Cox, GM. Experimental Design. Asia Publishing House, Calcutta. 1977; p. 95-132 and 145-181.
4. Meena SN, Patidar BK, Jadon C, Meena HP, Meena BS, Yadav RK, *et al*. Response of pigeonpea [(*Cajanus cajan* (L)] to foliar application of nutrient and pest management at flowering stage. Int J Bio-Resource Stress Manag. 2020;11(5):432-436.
5. Patra, S, Firakel, DM, Azad Thakur, NS, Roy A. Insect pest complex and crop losses in pigeonpea in medium altitude of hill of Meghalaya. Ecoscan. 2016;11(1):297-300.
6. Priyanka, E, Shrirame, MD, Dabade, GA. Study of foliar nutrient management on growth and yield of pigeonpea (*Cajanus cajan*). J Pharm Cogn Phytochem. 2019;8(4):2497-2499.
7. Thakur V, Teggelli RG, Meena MK. Influence of Foliar Nutrition on Growth and Yield of Pulses Grown under North Eastern Dry Zone of Karnataka: A Review. Int J Pure App Biosci. 2017;5(5):787-795.
8. Rashmi BN, Harlapur SF, Avinash B, Ravikumar CR, Nagaswarupa HP, Kumar MA, *et al*. Facile green synthesis of silver oxide nanoparticles and their electrochemical, photocatalytic and biological studies. Inorganic Chemistry Communications. 2020 Jan 1;111:107580.