Article AR2126b DOI: HTTPS://DOI.ORG/10.23910/1.2020.2126b

International Journal of Bio-resource and Stress Management

October 2020

Crossref

Print ISSN 0976-3988
Online ISSN 0976-4038

IJBSM 2020, 11(5):432-436

Research Article *Stress Management*

Response of Pigeonpea [*Cajanus cajan* (L.)] to Foliar Application of Nutrient and Pest Management at Flowering Stage

S. N. Meena*, B. K. Patidar, Chaman Jadon, H. P. Meena, B. S. Meena, R. K. Yadav, S. L. Yadav, N. L. Meena, Pratap Singh and M. L. Jat

Agricultural Research Station, Kota (AU, Kota) Rajasthan (324 001), India

Open Access

Corresponding Author

S. N. Meena
e-mail: satyanarayan.ars08@gmail.com

Citation: Meena et al., 2020. Response of Pigeonpea [(*Cajanus cajan* (L.)] to Foliar Application of Nutrient and Pest Management at Flowering Stage. International Journal of Bio-resource and Stress Management 2020, 11(5), 432-436. HTTPS://DOI.ORG/10.23910/1.2020.2126b.

Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

Conflict of interests: The authors have declared that no conflict of interest exists.

Acknowledgement: The authors are highly thankful to All India Coordinated Research Project on Pigeonpea and Zonal Director Research, ARS, Kota for providing all facilities to conduct the research work..

Article History

RECEIVED in 19th June 2020 RECEIVED in revised form 26th August 2020 ACCEPTED in final form 27th September 2020

Abstract

A field experiment was conducted at Agricultural Research Station, Kota during two consecutive *kharif* seasons (June to January) of each 2017-18 and 2018-19) to find out suitable combination compatibility between insecticides and foliar nutrients for enhancing productivity and profitability of pigeon pea. The experiment was laid out in RBD design comprising eight treatments with three replication and the variety was ICPL 88039. The soil of experimental field was clay loam in texture, alkaline in reaction, medium in organic carbon, available nitrogen, phosphorus and high in potash. On the basis of pooled analysis, the results revealed that application of RDF+multi-micronutrient (Zn 5.0%, Mn 2.0%, Fe 2.0%, Bo 0.5%, Cu 0.5% and Mo 0.05%) spray @ 2 ml l^{-1} at 50% flowering+Indoxacarb 15.8 EC @ 375 ml ha^{-1} at flowering+Dimethoate 30 EC @ 1.0 l ha^{-1} at 15 days after first spray recorded maximum and significantly higher pods $plant^{-1}$ (179.0), grain yield (1767 kg ha^{-1}), net return (₹ 70729 ha^{-1}), B:C ratio (2.96) and minimum pod damage by pod borer (5.25%) and pod fly (5.39%). The treatment RDF+multi-micronutrient spray @ 2 ml l^{-1} at 50% flowering was next in order of efficacy and other parameters being statistically at par with RDF+1% urea+0.25% $ZnSO_4$+0.25% borax spray at 50% flowering. Whereas, the treatment RDF (20 kg N, 50 kg P_2O_5, 20 kg S, 25 kg Zn ha^{-1}) was found less effective in comparison to other treatments in all the parameters.

Keywords: Pigeonpea, foliar, multi-micronutrient, dimethoate, indoxacarb, yield

1. Introduction

India grows the large number of varieties of pulses in the World accounting for about 32% of the area and 23% of the world production (Chattopadhyay, 2016). The pigeonpea (*Cajanus cajan* (L.) Millsp.) is the most important pulse crop in India. Seeds of arhar are also rich in iron, iodine, essential amino acids like lycine, threonine, cystine and arginine etc. Economically it is the second most important pulse crop after chickpea in India accounting for about 20% of total pulse production. In India, pigeonpea was cultivated on 4.25 mha area with 4.78 mt of production at an average productivity of 8.89 q ha^{-1} (Anonymous, 2018). In Rajasthan, pigeonpea was cultivated on 1.78 mha area with 1.94 mt of production at an average productivity status of 10.88 q ha^{-1} (Anonymous, 2016).

The yield of pigeonpea is limited by a number of factors such as agronomic, pathogenic, entomological, genetic and their interaction with environment. Among all 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 metabolism of plant. Foliar applied nutrients usually penetrate the leaf cuticle or stomata easily and enter the cells facilitating easy entry of nutrients. Foliar application is credited with remarkably rapid absorption and nearly completes utilization of applied nutrients; reduce leaching losses and fixation of nutrients and helps in regulating the uptake of nutrient by plants (Manonmani and Srimathi, 2009). Nutrient limitations to legume production result from deficiencies of not only major nutrients but also micronutrients such as molybdenum (Mo), zinc (Zn), boron (B) and iron (Fe) (Bhuiyanet al., 1999). Inadequate nodulation of pigeon pea can be associated with low plant available molybdenum (Mo). Increase in flower numbers, pod set improvement, and reduction in days to flowering are influenced by Mo (Prasad et al., 1998). Application of recommended doses of fertilizers (RDF), the macro and micronutrients to pigeonpea is essential for enhancing yield and productivity.

Another major constraint in the production of pigeonpea is the damage caused by insect-pests. In India, nearly three hundred species of insects are known to infest pigeonpea at its various growth stages of these pod borer, *Helicoverpa armigera* (Hubner), plume moth, *Exelastis atomosa* (Walsingham) and pod fly, *Melanagromyza obtuse* (Malloch) are important feeder of pigeonpea, which are collectively referred to as the pod borer complex (Lal and Katti, 1998). Pod fly is a hidden pest of pigeonpea inflicted 21.00 to 38.50% pod damage, 12.29 to 19.87% grain damage (Khan et al., 2014) and 31.35% mean pod damage (Patra et al., 2016). Hence, the present investigation was carried out to study the impact of nutrient and pest management on yield attributes, yield and economics of pigeon pea.

2. Materials and Methods

A field experiment was conducted at Agricultural Research Station, Kota during two consecutive *kharif* seasons from the last June to mid January (2017-18 and 2018-19) to find out suitable combination compatibility between insecticides and foliar nutrients for enhancing productivity and profitability of pigeon pea. This station is situated at 73°.23' E longitude 25°.18' N latitude, and an altitude of 271 m above mean sea level. The soil of experimental field was clay loam in texture, alkaline in reaction, medium in organic carbon (0.52 and 0.54%), medium in available nitrogen (343.0 and 338.0 kg ha^{-1}), medium in phosphorus (23.75 and 24.52 kg ha^{-1}), high in available potash (395.0 and 399.0 kg ha^{-1}), respectively.

The experiment was laid out in RBD design comprising eight treatments with three replication and the variety was ICPL 88039.The treatments were RDF (20 kg N, 50 kg P_2O_5, 20 kg S, 25 kg Zn ha^{-1}), RDF+2% urea spray at 50% flowering, RDF+ 0.5% Borax spray at 50% flowering, RDF+0.5% $ZnSO_4$ spray at 50% flowering, RDF+1% urea+0.25% $ZnSO_4$+0.25% Borax spray at 50% flowering, RDF+multi-micronutrient (Zn 5.0%, Mn 2.0%, Fe 2.0%, Bo 0.5%, Cu 0.5% and Mo 0.05%) spray @ 2ml l^{-1} at 50% flowering, RDF+Indoxacarb 15.8 EC @ 375 ml ha^{-1} at flowering+Dimethoate 30 EC @ 1 l ha^{-1} at 15 days after first spray, RDF+multi-micronutrient spray @ 2 ml l^{-1} at 50% flowering+Indoxacarb 15.8 EC @ 375 ml ha^{-1} at flowering+Dimethoate 30 EC @ 1 l ha^{-1} at 15 days after first spray.

The crop was raised under rainfed condition with 60 cm as inter row spacing and 20 cm is followed as intra row spacing having 20 kg ha^{-1} seed rate and maintained 83.3 thousand ha^{-1} plant population of pigeonpea at harvest. A uniform dose of recommended dose of fertilizer (RDF) was applied to all plots as a basal dose. RDF (20 kg N+50 kg P_2O_5+20 kg S+25 kg $ZnSO_4$ ha^{-1}) applied through urea, SSP and zinc sulphate. Whereas, application of Zn through $ZnSO_4$, boron through borax and multi-micronutrients. Data were recorded on biometrical characters *viz.*, number of pods $plant^{-1}$, number of seeds pod^{-1}, test weight (g) and grain yield (kg ha^{-1}). The statistical analysis was calculated as per the standard procedures (Fisher, 1950).

The observations were also recorded on % pod damage caused by pod borer and pod fly by randomly collecting hundred pods from five randomly selected plants from each treatment at harvest. The irregular hole and pin hole on pod exhibited the damage caused by pod fly, *M. obtuse*. Later, these pods were threshed and grains were added to the yield of respective plots. Similarly, the observations were also recorded on % grain damage caused by *M. obtuse* by randomly collecting hundred grains at harvest from grains threshed from five randomly selected plants from each treatment. The small round hole on grain and galleries on grain exhibited the damage caused by *M. obtusa*. The pod borer, *Helicoverpa armigera* H.,is another important pest of pigeonpea throughout the country. It slowly enters and feeds on the seeds inside the pods. The half portion of larvae remains inside the pod while feeding on the developing seeds. They can cut hole on one to another locale and feed 20-25 pods in its lifetime. Later, these grains were added to the yield of respective plots. The data on % pod damage and grain damage were transformed into angular transformation before statistical analysis to know the significance of difference among different treatments.

3. Results and Discussion

3.1. Yield contributing characters and pests management

It is explicit from data (Table 1) that yield contributing characteristic of pigeonpea was significantly influenced by different treatment combination than the application of recommended dose of fertilizer. A critical appraisal of data in Table 1 indicates that application of RDF+multi-micronutrient spray @ 2 ml l^{-1} at 50% flowering+Indoxacarb 15.8 EC @ 375 ml ha^{-1} at flowering+Dimethoate 30 EC @ 1 l ha^{-1} at 15 days after first spray, being at par with application of RDF+multi-micronutrient spray @ 2ml l^{-1} at 50% flowering and RDF+1% urea+0.25% $ZnSO_4$+0.25% Borax spray at 50% flowering, recorded maximum and significantly higher branches $plant^{-1}$

Table 1: Effect of nutrient management and insecticide spray on yield attributes, yield and economics and insect damage of pigeonpea during *kharif* 2017 and 2018 (Pooled data)

Treatments	Pods plant^{-1} (Nos)	Seeds pod^{-1} (Nos)	Test weight (g)	Pod damage by pod borer (%)	Pod damage by pod fly (%)	Grain yield (kg ha^{-1})	Harvest index (%)	Net return (₹ ha^{-1})	B:C ratio
RDF (20 kg N, 50 kg P_2O_5, 20 kg S, 25 kg Zn ha^{-1})	156	3.33	87.21	10.39 (18.40)*	15.65 (22.28)	1377	36.70	51910	2.36
RDF+2% urea spray at 50% flowering	162	3.51	92.72	10.63 (18.61)	13.78 (20.84)	1600	36.97	63169	2.80
RDF+0.5% borax spray at 50% flowering	160	3.49	90.46	10.22 (18.25)	13.03 (20.23)	1474	37.07	54252	2.29
RDF+0.5% $ZnSO_4$ spray at 50% Flowering	159	3.48	90.47	8.28 (16.37)	12.66 (19.93)	1465	37.06	57527	2.58
RDF+1% urea+0.25% $ZnSO_4$+0.25% Borax spray at 50% flowering	168	3.97	93.51	8.15 (17.91)	11.77 (19.20)	1645	37.11	63850	2.71
RDF+multi-micronutrient spray @ 2 ml lat^{-1} 50% flowering	169	4.03	93.82	9.87 (14.14)	11.85 (19.25)	1654	37.05	66339	2.92
RDF+Indoxacarb 15.8 EC @ 375 ml ha^{-1} at flowering+Dimethoate 30 EC@ 1 l ha^{-1} at 15 days after first spray	165	3.78	93.16	6.22 (12.97)	5.69 (13.21)	1618	37.03	64085	2.80
RDF+micronutrient spray @ 2 ml l^{-1} at 50% flowering+Indoxacarb 15.8 EC @ 375 ml ha^{-1} at flowering+Dimethoate 30 EC @ 1 l ha^{-1} at 15 days after first spray	179	4.39	93.81	5.25 (13.24)	5.39 (12.85)	1767	37.43	70729	2.96
SEm±	3.98	0.16	2.14	0.42	0.31	40.24	0.58	2372	0.12
CD (p=0.05)	12.07	0.49	6.50	1.29	0.93	122.05	1.75	7195	0.38

*Figures in parentheses are angular transformed values

(18.6), pods plant^{-1} (179.7), seeds pod^{-1} (4.39) and test weight (93.81 g) over rest of the treatment combinations. The yield characters were increased with the application of macronutrients along with micronutrients might be due to increased photosynthetic ability of plant which in turn favoured and increased accumulation of dry matter during growth stage and also efficient portioning of photosynthates towards sink (Mondal et al., 2011). Foliar spray met constant requirement of nitrogen and phosphorus at reproductive stage of the crop and variation in the yield components like number of pods plant^{-1}, number of seeds pod^{-1}, pod length and test weight, which had direct influence on the grain yield. Other factors which directly influenced the grain yield and growth attributes like plant height, leaf area index and total dry matter production. Dixit and Elamathi (2007), Mondal et al. (2011) and Ganapathy et al. (2008) also endorsed the result obtained in the present study. It is also reported by Muthal (2016) where foliar application of nutrients increased plant height it might be readily due to absorption of nutrients through foliar application. Increased plant height is due to the internodes elongation and the vigorous root system. The significant increase of dry matter accumulation was due to nitrogen increases chlorophyll content and effective root system by which absorption of solar energy and nutrition absorption capacity of plant increased and 2% DAP spray increased roots, flower growth and development, the multi-micronutrient improves overall crop health. The minimum pod damage caused by pod fly and pod borers was also observed in the treatment RDF+multi-micronutrient spray @ 2 ml l^{-1} at 50% flowering+Indoxacarb 15.8 EC @ 375 ml ha^{-1} at flowering+Dimethoate 30 EC @ 1.0 l ha^{-1} at 15 days after first spray, being at par with application of RDF+multi-micronutrient spray @ 2 ml l^{-1} at 50% flowering as indicated by Table 1. However, Srinivasan and Durairaj (2007) reported that spinosad 45 SC indicated least population of *H. armigera* (2.0 plant^{-1}) followed by indoxacarb 14.8 SC (2.4 plant^{-1}) on pigeonpea. While, Satpute and Barkhade (2012) revealed significant reduction in pod damage due to pod borer complex with Rynaxypyr 20 SC (Chlorantraniliprole).

3.2. Yield and economics

Data presented in Table 1 shows that yield of pigeonpea was significantly influenced by different treatment combination than the application of recommended dose of fertilizer.

Pooled analysis of data revealed that application of RDF+multi-micronutrient spray @ 2 ml l^{-1} at 50% flowering+Indoxacarb 15.8 EC @ 375 ml ha^{-1} at flowering+ Dimethoate 30 EC @ 1 l ha^{-1} at 15 days after first spray recorded maximum and significantly higher grain yield (1767 kg ha^{-1}) maximum net return (₹ 70729 ha^{-1}) and B:C ratio (2.96) over the application of RDF (20 kg N, 50 kg P_2O_5, 20 kg S, 25 kg Zn ha^{-1}), RDF+2% urea spray at 50% flowering, RDF+ 0.5% borax spray at 50% flowering, RDF+0.5% $ZnSO_4$ spray at 50% Flowering RDF+Indoxacarb 15.8 EC @ 375 ml ha^{-1} at flowering+Dimethoate 30 EC @ 1.0 l ha^{-1} at 15 days after first spray, but remained statistically at par with application RDF+multi-micronutrient spray @ 2 ml l^{-1}at 50% flowering, RDF+1% urea+0.25% $ZnSO_4$+0.25% borax spray at 50% flowering over rest of treatments. Which was registered to the tune of 390 kg ha^{-1}, ₹ 18819 ha^{-1} and B: C ratio 0.60 over RDF, respectively. These results are in accordance with the results reported by Priyanka (2019). Pigeonpea crop fertilized with RDF along with 2% DAP+multi-micronutrient spray @ 2 ml l^{-1} produced significantly higher grain yield mainly due to the increased nutrient supply and reduced nutrient losses. The application of insecticides Indoxacarb 15.8 EC @ 375 ml ha^{-1} at flowering+Dimethoate 30 EC @ 1.0 l ha^{-1} at 15 days after in the experimental plots resulted unique reduction of pest population reflected lower pod damage incidence and maximum yield. In present investigation, indoxacarb exhibited higher degree of population reduction of both *Helicoverpa* and *Melanagromyza.* High initial larval mortality was found after application of those chemicals. High efficacy of indoxacarb against *Helicoverpa* and *Melanagromyza* was reported earlier by many authors (Singh and Yadav, 2006, Dhaka et al., 2010 and Das et al., 2015) their reports are in close conformity of the present findings. It perhaps helped in quick absorption of N, P and micronutrients, at the time of reproductive stage where the nutrient demand is at the peak due to indeterminate growth habit of the crop. It might be due to continuous supply of nutrients as basal and as nutrient spray which in turn reduced the flower drop and ultimately enhanced the pod setting and resulted in higher seed yield. As pod number is considered to be the major yield determinant in pulses, foliar feeding of N through as urea source, P through 2% DAP and other micronutrients was able to increase the pod number in this experiment.

4. Conclusion

Application of RDF+multi-micronutrient spray @ 2 ml l^{-1} at 50% flowering+Indoxacarb 15.8 EC @ 375 ml ha^{-1} at flowering+Dimethoate 30 EC @ 1 l ha^{-1} at 15 days after first spray was recorded maximum branches $plant^{-1}$, pods $plant^{-1}$, grain yield, net return and B:C ratio and least damage of pod borer and pod fly as compared to alone RDF and other treatments.

5. Acknowledgement

The authors are highly thankful to All India Coordinated Research Project on Pigeonpea and Zonal Director Research, ARS, Kota for providing all facilities to conduct the research work.

5. References

Anonymous, 2016-17. Rajasthan Agriculture Statistics at a glance 2016-17, Department of Agriculture, Government of Rajasthan, 83. Available at http://www.agriculture.rajasthan.gov.in/

Anonymous, 2018-19. AICRP Pigeonpea, Project Cordinator's Report, ICAR-IIPR, Kanpur 208024 Uttar Pradesh, 2018-19, 23.

Bhuiyan, M.A.H., Khanam, D., Ali, M.Y., 1999. Chickpea root nodulation and yield as affected by micronutrient application and *rhizobium* inoculation. International Chickpea and Pigeonpea Newsletter 6, 28–29

Chattopadhyay, N., 2016. Impact of monsoon rains on pulses production in India in last decade. Pulses Hand Book 2016, Foretell Business Solutions Private Limited, Bangalore, 74–77.

Das, B.C., Patra, S., Dhote, V.W., Alam, SK.F., Chatterjee, M.L., Samanta, A., 2015. Mix formulations: An alternative option for management of gram pod borer, *Helicoverpa armigera* H. and pod fly, *Melanagromyza obtusa* M. in pigeon pea. Legume Research 38(3) 2015, 396–401

Dhaka, S.S., Singh, G., Ali, N., Arvind, Y., Adbhut, Y., 2010. Field evaluation of insecticides and bio-pesticides against *Helicoverpa armigera* on tomato. Annals of Plant Protection Sciences 18(1), 13–16.

Dixit, P.M., Elamathi, S., 2007. Effect of foliar application of DAP, micronutrients and NAA on growth and yield of green gram (*Vigna radiata* L.). Legume Research 30(4), 305–307.

Fisher, R.A., 1950. Statistical Methods for Research Workers. Oliver and Boyd, Edinburg, London, 57–63.

Ganapathy, M., Baradhan, G., Ramesh, N., 2008. Effect of foliar nutrition on reproductive efficiency and grain yield of rice fallow pulses. Legume Research 31(2), 142–144.

Manonmani, V., Srimathi, P., 2009. Influence of Mother Crop Nutrition on Seed and Quality of blackgram. Madras Agricultural Journal 96(16), 125–128.

Mondal, M.M.A., Rahman, M.A., Akhter, M.B., Fakir, M.S.A., 2011. Effect of foliar application of nitrogen and micronutrients on growth and yield of mungbean. Legume Research 34(3), 166–171.

Muthal, Y.C., Deshmukh, S.L., Sagvekar, V.V., Shinde, J.B., 2016. Response of foliar application of macro and micronutrients on growth, yield on quality of *kharif* green gram (*Vigna radiata* L.). International Journal of Tropical Agriculture 34(7), 2137–2141.

Patra, S., Firake, D.M., Azad Thakur, N.S., Roy, A., 2016. Insect pest complex and crop losses in Pigeonpeain medium altitude hill of Meghalaya. The Ecoscan 11(1), 297–300.

Prasad, M., Pillai, A., Faber, G., Field, S., Dowling, T., 1998. Molybdenum response of pigeonpea on Ferruginous Latosols in Fiji. International Chickpea and Pigeon pea Newsletter 5, 55–56.

Priyanka, E., 2019. Study of foliar nutrient management on growth and yield of pigeonpea (*Cajanus cajan*). M. Sc. Thesis Department of Agronomy, College of Agriculture, Badnapur (Jalna), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani Maharastra, (India).

Khan, M., Srivastava, C.P., Sitanshu, 2014. Screening of some promising Pigeonpea genotypes against major pests. The Ecoscan 6(Spl), 313–316.

Lal, S.S., Katti, G., 1998. Integrated pest management of pod borer complex infesting pigeonpea. IPM system in Agriculture, Aditya Book Pvt. Ltd. New Delhi, India, 79–128.

Satpute, N.S., Barkhade, U.P., 2012. Evaluation of rynaxypyr 20 SC against pigeonpea pod borer complex. Journal of Food Legumes 25(2), 162–163.

Singh, S.S., Yadav, S.K., 2006. Efficacy and economics of some modern insecticides, bio-insecticides and neem based formulations against pod borer, *Helicoverpa armigera*, in pigeonpea. Indian Journal of Entomology 68(2), 139–143.

Srinivasan, T., Durairaj, C., 2007. Newer insecticides against pod borer complex of pigeonpea with special reference to *Helicoverpa armigera* and *Melanagromyza obtusa*. Indian Journal of Plant Protection 35(1), 47.