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Effect of Insecticides and Foliar Nutrients Application on Growth, Yield and Economics of Pigeon Pea (*Cajanus cajan* L.) under Hadoti Region of Rajasthan

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A B S T R A C T

A field experiment was conducted during *kharif* 2019-20 at Agriculture Research Station, Rajasthan to find out the effect of insecticides and foliar nutrients application on growth, yield and economics of pigeon pea (*Cajanus cajan* L. Millsp.). The experimental field was laid out in a Randomized Block Design with eight treatments and three replications and the variety was ICPL 88039. The results revealed that treatment RDF + multimicronutrient @2ml/lt + indoxacarb at flowering *fb* Dimethoate 30 EC @ 0.03 % after 15 days after first spray recorded maximum plant height (200.3 cm), number of branches (17.8), pods per plant (150.3), seed per pod (4.51), grain yield (1225 kg/ha), straw yield (3650 kg/ha), NMR (33650 Rs/ha) and B: C (2.04)ratio which was followed bt RDF + multimicronutrient 2 ml/l at 50 % Flowering.

Introduction

Pigeonpea (*Cajanus cajan* L. Millsp.) is the fifth prominent pulse crop in the world and second in India after chickpea. Pigeonpea has high protein content, and is therefore commonly used as a substitute for meat in a largely vegetarian population in India. India ranks Ist in area and production in the world with 80% and 67% of world's acreage and production respectively. It is one of the most important *Kharif* pulses suitable for rainfed situation with an area of 4.4 m ha, production 4.2 mt and productivity 954 kg/ha in the country (Anonymous, 2017-18). However, Area of pigeonpea in Rajasthan is 8859 ha and production 5196 t/ha with average productivity 587 kg/ha (Anonymous, 2019-20). Among the pulses, the pigeonpea is the most important dietary component of human beings. India is the largest producer contributing more than 90 per cent of the world's production of redgram. Though the area has increased, the productivity remains almost constant causing burden on government exchequer on the behalf of import. Being a pulse, it plays an important role for improving the soil fertility and consequently the productivity of succeeding crops. To meet the demands of pulse crops of ever increasing population of our country, it is necessary to improve the production and productivity of pulse crops. In order to increase the production further there is no other option except to increase productivity by using available resources most efficiently. Fertilizers use continued to play a key role in augmenting higher crop productivity but reckless use of it deteriorates soil health, energy conserving ecosystem and economics. Eventually, an adequate fertilizer management appreciable for higher yield is needed to be worked out. However, the productivity of pigeonpea is now slowing down coupled with decline in soil fertility.

Low and imbalanced use of fertilizers is one of the major reasons for low productivity. It has been recognized that N, P and K fertilizers alone are not always sufficient to provide balanced nutrition for optimal yield and quality of pigeonpea (Jain *et al.,* 2007). Pigeonpea flowers profusely during November-December, a higher per cent of them drop (70-96%) without setting into pods. Grain yield depends upon percentage of flowers transforming into pods. Mineral nutrients are known to develop economic source-sink relationship in plants that ultimately increase the flower, fruit set and seed filling, thereby increasing the yield. Pre-mature droping of flowers and fruits lead to reduced realization of sink potential. Thus, flower or fruit dropping is considered as a bottleneck in productivity. Plant nutrition is key input to increase the productivity. Fertilizer is an important option that should be adopted in order to improve crop yield. Considering low yield, agronomic practices of pigeonpea are required to be standardized for realizing yield potential. Among the different agronomic practices, foliar spray of micronutrients is most important factor in determining the yield. Retention of flowers produced by the plant helps to get more yield than expected.

Another major constraint that limit the realization of potential yield of pigeonpea include biotic and abiotic stresses prevalent across the pulses growing areas. It includes podfly and pod borer damage causing substantial losses. Among abiotic stresses, terminal drought, moisture stress and sudden drop in temperature coupled with frost and foggy weather during the pod development stage inflict major yield losses and instability in production. Keeping all the views in mind an experiment was conducted to find out the effect of different compatible insecticides and foliar nutrients application on growth, yield and economics of pigeon pea (*Cajanus cajan* L. Millsp.).

Materials and Methods

The field experiment was conducted during the *kharif* 2019-20 at Agriculture Research Station, Ummedganj, Kota Rajasthan (25^0 $18^{'}$N; 77^0 $23^{'}$E, 271 m of above mean sea level). The soil was clay loam having low organic carbon (0.40%) and medium in available N (280.6 kg/ha) & P (19.6 kg/ha) and high in K (292 kg/ha) and (pH 7.2). The experiment was laid out in randomized block design with eight treatments with three replications and variety was ICPL 88039. The treatments were [Recommended dose of fertilizers (20:50:20:25kg NPSZn kg/ha); 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+ multimicronutrient spray @ 2ml/litre at 50% flowering; RDF + Indoxacarb 15.8 EC @ 375 ml/ha at flowering + Dimethoate 30 EC @ 0.03 % 15 days after first spray; RDF+ multimicronutrient spray @ 2ml/litre at 50% flowering + Indoxacarb 15.8 EC @ 375 ml/ha at flowering + Dimethoate 30 EC @ 0.03 %15 days after first spray] taken. Two irrigations were applied to the crop before flowering and pod formation stage. Pre emergence application of pendimethalin (Dost 30 EC) @ 3 lt/ha was applied one day after sowing. A knapsack sprayer was used for spraying herbicides using a spray volume of 500 litres/ha. Two hand weeding operation was done at 20 and 40 DAS with the help of *Khurpi* in all treatments. Sowing was done with '*pora*' method in rows spaced at 60 cm with average depth of 5 cm and seed rate of 20 kg/ha. All the plant protection measures were adopted to take health crop. At maturity stage, after leaving two rows on each side as well as 50 cm along the width of each side, a net plot area of 5 m x 7.0 m was harvested separately for recording the yield attributes and yields. The harvested material was tied and tagged and kept on threshing floor for sun drying. Pigeonpea seeds were cleaned by winnower and yield was recorded. Straw yield was obtained by subtracting seed yield from total biomass yield. Yield was expressed in kg/ha. All the observations were statistically analyzed for their test of significance using the *F*-test (Gomez and Gomez, 1984). The significant of difference between treatment means were compared with t critical difference at 5 % level of probability.

Results and Discussion

Effect of different nutrients and insecticides on growth indices

Results showed that plant height and number of branches per plant were significantly influenced by different foliar application and significantly higher plant height and number of branches was found in RDF + multimicronutrient @ 2ml/lt + indoxacarb at flowering *fb* Dimethoate 30 EC @ 0.03 % after 15 days after first spray which was closely followed by RDF + multimicronutrient 2 ml/lt at 50 % flowering. The better performance of RDF + multimicronutrient @ 2ml/lt + indoxacarb at flowering *fb* Dimethoate 30 EC @ 0.03 % after 15 days after first spray and RDF + multimicronutrient 2 ml/lt at 50 % flowering may be attributes its better vegetative growth over RDF and rest of the treatments (Table 1).

Table.1 Effect of insecticides and foliar nutrients on growth attributes of pigeonpea

Treatment	Plant height (cm)	Number of branches/ plant
T1:RDF(20:50:20:25 kg NPSZn/ha)	178.1	10.4
T2:T1 + 2 % urea spray at 50 % flowering	190.5	13.6
T3: T1 +0.5 % borax spray at 50 % flowering	187.4	12.3
T4: T1 +0.5 % ZnSO4 spray at 50 % flowering	183.3	12.6
T5:T1+1%urea+0.25%$ZnSO_4$ +0.25% Borax at 50 % F	197.4	14.7
T6:T1 + multimicronutrient 2 ml/l at 50 % F	192.3	16.8
T7:T1+Indoxacarb at Flowering *fb*Dimethoate 30 EC @ 0.03 % after 15 days after first spray	183.2	16.4
T8: T6+ indoxacarb at flowering *fb* Dimethoate 30 EC @ 0.03 % after 15 days after first spray	200.3	17.8
C D (P=0.05)	35.54	2.91

Table.2 Effect of insecticides and foliar nutrients on yield and yield attributing characters of pigeonpea

Treatment	Pods per plant	Seed per pod	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	HI (%)	NMR (Rs/ha)	B:C ratio
T1:RDF(20:50:20:25 NPSZnSO$_4$ kg/ha)	127.0	3.51	81.68	855	3005	22.15	14170	1.44
T2:T1 + 2 % urea spray at 50 % F	129.2	3.69	87.05	1065	3394	23.90	25504	1.80
T3: T1 +0.5 % borax spray at 50 % flowering	125.9	3.71	85.34	890	3366	20.91	16040	1.50
T4: T1 +0.5 % ZnSO4 spray at 50 % F	127.8	3.62	85.35	1005	2910	25.63	22260	1.70
T5:T1+1%urea+0.25%ZnSO$_4$ +0.25% Borax at 50 % F	135.2	4.38	88.46	1070	3598	22.92	25754	1.80
T6:T1 + multimicronutrient 2 ml/l at 50 % F	148.3	4.08	87.65	1140	3405	25.07	29310	1.91
T7:T1+Indoxacarb at F *fb*Dimethoate 30 EC @ 0.03 % after 15 days after first spray	137.6	3.86	87.23	1095	3374	24.50	26880	1.83
T8: T6+ indoxacarb at flowering *fb* Dimethoate 30 EC @ 0.03 % after 15 days after first spray	150.3	4.51	88.16	1225	3650	25.22	33650	2.04
C D (P=0.05)	21.44	0.85	18.46	177	538	2.28	4327	0.30

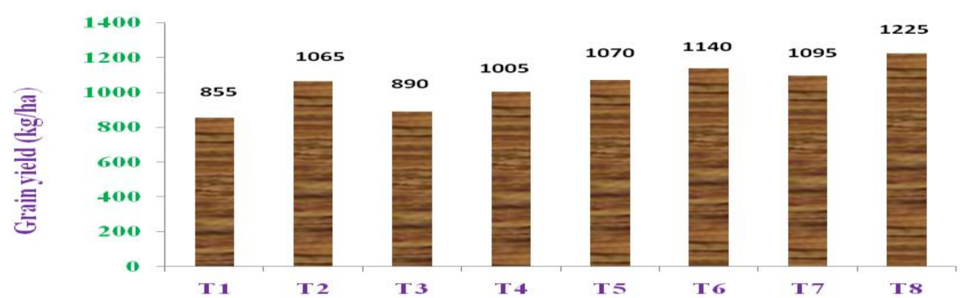

Fig 1. Effect of different insecticide and foliar nutrient application on grain yield

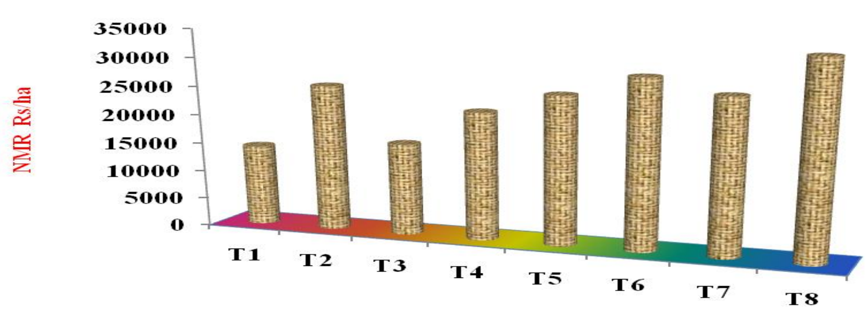

Fig. 2 Effect of insecticide and foliar nutrient application on NMR (Rs/ha) on pigeopea

These finding are well supported by Muthul (2016). 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 internodes elongation and vigorous root system. Multimicronutrient spray improves the root, flower growth and development thus improves overall health of the crop.

Effect of different nutrients and insecticides on yield and attributing character and profitability

Yield and yield attributing characters, NMR and B:C ratio were significantly influenced by different treatments are presented in table 2, Fig. 1 and Fig. 2. The treatment RDF + multimicronutrient @ 2ml/lt + indoxacarb at flowering *fb*Dimethoate 30 EC @ 0.03 % after 15 days after first spray recorded maximum pods per plant (150.3), seed per pod (4.51), grain yield (1225 kg/ha), straw yield (3650 kg/ha), NMR (33650 Rs/ha) and B: C (2.04) ratio. RDF + multimicronutrient + indoxacarb at flowering *fb* Dimethoate 30 EC @ 0.03 % after 15 days after first spray. This treatment showed 31.8 % increase over RDF treatment. The next better treatment was RDF + multimicronutrient 2 ml/lt at 50 % flowering. The better yield attributes in treatment T8 (RDF + multimicronutrient @ 2ml/lt + indoxacarb at flowering *fb* Dimethoate 30 EC @ 0.03 % after 15 days after first spray) might be due to better growth attributes like number of branches per plant, number of leaves per plant which reflected into better source sink relationship as compared to RDF ((20:50:20:25 NPSZnSO_4 kg/ha)) Only. These results are in accordance with the results reported by Singh *et al.*, (2015). Insect pest like pod borer were also controlled due to + indoxacarb at flowering *fb* Dimethoate 30 EC @ 0.03 % after 15 days after first spray which resulted into healthy pods thus returns higher yield due to reduction in damaged pods and seed. RDF+ multimicronutrient spray @ 2ml/lt produced significantly higher grain yield (1140 kg/ha) mainly due to the increased nutrient supply and reduced nutrient losses. It perhaps helped in quick absorption of N, P, S, Zn and micronutrient at the time of reproductive stage where the nutrient crop demand is at the peak due to indeterminate growth habit of crop. Hence, it reduced the flower drop and ultimately enhanced the pod setting and resulted in higher seed yield.

As number of pods per plants is considered to be the major determinants in pulses, foliar feeding of micronutrient through multi micronutrient was able to enhanced number of seed per pod. It was also reported by Barrik and Rout (1990) and Elumle *et al.,* (2019) where foliar application of nutrients at flowering and pod development stage might have been easily absorbed and better translocated in the plant and maintained constant requirement of nutrients at the reproductive stage of the crop. The increase in straw yield is directly related mainly to increase in the vegetative growth of the plant. It was mainly due to the maximum plant height. Higher supply of nutrients at 50%flowering of crop growth might have caused efficient translocation of photosynthesis from source to sink.

Flower drop decreased due to foliar spray of RDF + Multimicronutrient @ 2ml/litre at 50 % flowering stage. Pod number plays an important role in yield determination.

It might be due to continuous supply of nutrients as basal and as nutrient spray which in turn increased the leaf area and dry matter accumulation resulting in higher straw yield. This is also attributed to the higher nutrient uptake throughout the crop growth period. Similar finding is confirmed with the report by Mondal *et al.*, (2012).

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