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Improving Yield Potential of Pigeonpea through Foliar Nutrition

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted in research farm at Department of Pulses, Tamil Nadu Agricultural University during *kharif* season of 2018 to 2020 to assess the effect of foliar nutrition to enhance the productivity of pigeonpea under rainfed condition. The experiment was laid out in randomized block design with three replications and eight treatments. Treatments consist of foliar application with urea 2%, MAP 1%, All nineteen 0.5%, Pulse magic 1%, $ZnSO_4$ 0.5 %, $FeSO_4$ 0.5 % and $ZnSO_4$ 0.5 % + $FeSO_4$ @ 0.5 % along with no foliar nutrition spray. 100% recommended dose of fertilizer (25:50:25:20 kg NPKS ha^{-1}) was applied to all treatments. The yield parameters such as number of pods per plant and number of seed per pods were significantly influenced by foliar nutrition. All the foliar spray treatments recorded higher seed yield as compared to control (without foliar spray). Among the different foliar nutrition, 0.5% all nineteen recorded significantly higher seed yield of 1118 kg ha^{-1}. Result concluded that retention of flowers is possible through foliar application of macronutrients during flower initiation stage and it helps to enhance the productivity of pigeonpea under rainfed situation.

Keywords: Foliar nutrition; yield potential; seed yield; pigeonpea.

1. INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.)] is one of the major grain legume crops of the tropics and subtropics, endowed with several unique characteristics. After gram, pigeonpea is the second most important pulse crop in the country and accounts for about 11.8% of the total pulse

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area and 17% of total pulse production of the country. It is a rich source of protein and supplies a major share of the protein requirement of the vegetarian population of the country.

A number of biotic and abiotic factors limit realization of the true potential of pigeonpea. The economic loss in pigeonpea production from abiotic constraints is higher than that from biotic constraints. The low yield of Pigeonpea is not only due its cultivation on sub-marginal lands, but also due to poor crop management and nutrient stress at critical growth stages, such as flowering and pod development which cause in significant reduction in grain yield [1].

"Pigeonpea is basically indeterminate in habit of flowering and fruiting and there is a competition for available assimilates between vegetative and reproductive sinks. On the other hand, always there is a limitation of source (leaves) particularly at flowering and pod development stages. Apart from its genetic makeup, the major physiological constraints limiting pigeonpea's yield are flower and fruit drop" [2]. Several research workers have reported that there is possibility to overcome these constraints by agronomic interventions such as foliar feeding of nutrient during critical stages. "Foliar application of nutrient and growth regulator at pre flowering and flowering stage reduced the flower drop percentage in green gram" [3]. "Application of macro and micronutrients as foliar spray at critical stages of the crop absorbed and translocated effectively to the developing pods and produced more number of filled pods" [4]. Hence, the present investigations were carried out to study the foliar application of different sources of nutrient on yield and economics of rainfed pigeonpea.

2. MATERIALS AND METHODS

2.1 Experimental Site and Conditions

Field experiments were conducted during *kharif* season of 2018-19 to 2020-21 at Pulses farm, Tamil Nadu Agricultural university, Coimbatore located in the north western agro climatic zone of Tamil Nadu at 11°N latitude 77°E longitude at an altitude of 426 m above the mean sea level. The soil type in the experimental field was reddish brown, slightly calcareous, sandy clay loam that belongs to the soil series Palladam (*TypicUstropept*). The nutrient status of experiment soil was low in available N (185 kg ha^{-1}), medium in available P (12 kg ha^{-1}) and high in K (445 kg ha^{-1}).

2.2 Experimental Design and Crop Management

The experiment was laid out with eight treatments in a Randomized Block Design (RBD) replicated thrice to study the effect of foliar application of multi nutrients on productivity of pigeonpea. Treatments consist of foliar application with urea 2%, MAP 1%, All nineteen 0.5%, Pulse magic 1%, $ZnSO_4$ 0.5 %, $FeSO_4$ 0.5 % and $ZnSO_4$ 0.5 % + $FeSO_4$ @ 0.5 % along with no foliar nutrition spray. 100% recommended dose of fertilizer (25:50:25:20 kg NPKS /ha) were applied in furrows before sowing the seeds. Pigeonpea variety CO8 was sown at 120 x 30 cm spacing.

2.3 Plant Sampling and Yield Measurement

The growth parameters (plant height, branches/plant, stem girth), yield attributes (pods/plant and seeds/pod) and seed yield of pigeonpea were recorded at harvest. Observation on growth and yield attributes were taken in five tagged plants in each plot and then averaged was calculated. For biological yield, crop was harvested in net plot area from each plot. Then, crops were sun dried and biological yield was converted into kg ha^{-1}. The seed yield of pigeonpea was estimated from the weight of sun-dried seeds (12% moisture content) obtained from each plot after threshing and cleaning.

2.4 Statistical Analysis

The experimental data pertaining to each parameter of the study were subjected to statistical analysis by using the technique of analysis of variance and their significance was tested by "F" test (Gomez and Gomez, 1984). The standard error of means (SEm±) and critical difference (CD) at 5% probability were worked out to evaluate the differences between treatment means for each parameter studied.

3. RESULTS AND DISCUSSION

3.1 Effect of Foliar Nutrition on Yield Parameters of Pigeonpea

"Number of pods $plant^{-1}$ is the most important yield attribute of pigeonpea. Foliar application of all nineteen (19:19:19) along with basal

application of 100% RDF increased the number of pods plant^{-1}. This would be due to the foliar application of nutrients at critical stage allows adequate nutrient supplementation essential for enhancing the number of floral buds, prevented the floral shedding by maintaining optimum bio - physiological conditions" [5]. Pod number is considered to be the major yield determinant in pigeonpea, foliar spray of N, P and K through all nineteen was able to increase the pod number in this experiment. These results are in conformity with the earlier findings of with Yasari et al. [6].

3.2 Number of Seeds per Pod

Number of seeds pod^{-1} of pigeonpea was significantly influenced by both basal as well as foliar application of multi-nutrients. Compared to all other treatments, foliar application of 0.5% 19: 19:19 spray recorded the higher number of seeds pod^{-1}. This could be due to the higher availability of nutrients supplied through supplemental foliar feeding during seed development stage that retarded senescence and resulted in larger pod filling period leading to greater seed yield plant. These results are in conformity with earlier findings of Venkatesh et al. [7].

3.3 Hundred Seed weight

Foliar applications of multi- nutrients showed the significant effect on hundred seed weight of Pigeonpea. Foliar application of 0.5% all nineteen spray along with soil application of 100% RDF resulted in significantly higher 100 seed weight but it remained at par with foliar spray of 1% MAP. This could be attributed due to the activity of cytokinin predominantly takes place in the root tips and play an active role in cell division. Thus enhanced root activity under foliar fertilization might have increased cytokinin synthesis resulting increased vegetative and reproductive growth of plants. These observations are in line with the findings of with Yasari et al. [6].

Table 1. Effect of foliar spray of nutrient on yield attributes and yield of Pigeonpea (pooled mean of 3 years data)

Treatments		No. of pods/plant	No. of seed /pod	Seed yield (kg /ha)
T_1	RDF only	90	3.0	784
T_2	RDF + foliar spray of 19:19:19 @0.5%	143	3.4	1118
T_3	RDF + foliar spray of MAP @ 1%	133	3.3	1052
T_4	RDF + foliar spray pulse magic @1%	111	3.3	968
T_5	RDF + foliar spray of urea @ 2%	99	3.1	910
T_6	RDF + foliar spray of $ZnSo_4$ @0.5%	115	3.1	895
T_7	RDF + foliar spray of $FeSo_4$ @0.5%	108	3.1	869
T_8	RDF + foliar spray of $ZnSo_4$ @0.5% + $FeSo_4$ @0.5%	126	3.3	938
	SEm±	2.76	0.33	29.8
	CD(p=0.05)	6.79	0.66	83.9

Table 2. Effect of foliar spray of nutrient on yield attributes and yield of pigeonpea (pooled mean of 3 years' data)

Treatments		Cost of cultivation (Rs. /ha)	Gross return (Rs./ha)	Net return (Rs./ha)	BCR
T_1	RDF only	30727	48409	25682	2.13
T_2	RDF + foliar spray of 19:19:19 @ 0.5%	47542	951265	53723	3.08
T_3	RDF + foliar spray of MAP @ 1%	42797	91158	48361	2.98
T_4	RDF + foliar spray pulse magic @1%	30907	65832	34925	2.42
T_5	RDF + foliar spray of urea @ 2%	27074	57668	30594	2.23
T_6	RDF + foliar spray of $ZnSo_4$ @0.5%	30367	64682	34315	2.42
T_7	RDF + foliar spray of $FeSo_4$ @ 0.5%	28804	61353	32549	2.33
T_8	RDF + foliar spray of $ZnSo_4$ @ 0.5% + $FeSo_4$ @ 0.5%	35082	74725	39643	2.69

3.4 Seed Yield

Seed yield of pigeonpea was significantly influenced by the foliar spray of nutrient. Foliar application of macro or micro nutrients at critical stage along with basal application of 100% RDF increased the seed yield of pigeonpea as compared to basal application of 100% RDF alone. Among the different foliar spray, application of all nineteen @ 0.5% recorded significantly higher grain yield of 1138 kg ha^{-1} but it was on par with foliar spray of MAP @ 1%. Foliar spray of all nineteen at flowering stage increased the supply of the essential macro nutrient *viz.,* Nitrogen, Phosphorus, potassium to crop and it perhaps helped in quick absorption of N, P, K at the time of reproductive stage where the nutrient demand is at the peak due to the indeterminate growth habit of crop. The increased seed yield was due to higher yield attributes. It might be due to continuous supply of nutrients as basal and as foliar spray which in turn reduced the flower drop and ultimately enhanced the pod setting and resulted in higher seed yield. Fakeerappa and Amit [8] and Meena et al. [9] reports are in close conformity of the present finding.

3.5 Economics

The major consideration with the farmers for the adoption of any production technology is economics. With regard to economics, application of 0.5% all nineteen (19:19:19) on flowering recorded higher net income and B:C ratio of Rs. 53723 /- an d 3.19, respectively. This was followed by application of 1.0% monoammonium phosphate (MAP). The economics was increased due to application of water soluble fertilizer [10].

4. CONCLUSION

Results of the study suggested that Application of 0.5% all nineteen on 50 per flowering (105 days) recorded yield parameters *viz*., number of pods per plant, number of seeds per pod and 100 seed weight resulting in higher seed yield, net income and B:C ratio. Maximum outcome of pigeonpea can be possible if it is provided supplemental nutrient through foliar feeding at critical stages i.e flowering period along with basal application of 25:50:25:20 kg NPKS ha^{-1} and enhance productivity and profitability of Pigeonpea under rainfed condition.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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