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Research Article

STUDY ON THE EFFECT OF FOLIAR NUTRITION ON PRODUCTIVITY OF PIGENPEA [*Cajanus cajan* (L.) Millsp.] UNDER KAYMORE PLATEAU OF MADHYA PRADESH

RAI S.[1]*, KUSHWAHA H.S.[1], LILHARE S.[2] AND JAISWAL R.[1]
[1]Department of Agronomy, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, 485334, Madhya Pradesh, India
[2]Department of Agronomy, AKS University, Sherganj, Satna, 485001, Madhya Pradesh, India
*Corresponding Author: Email - sanskritirai925@gmail.com

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Abstract: The field experiment was conducted on a well leveled field at Agriculture farm of the Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna, Madhya Pradesh during *kharif* season of 2019. The farm is situated under agro-climatic zone Kymore Plateau of Eastern Madhya Pradesh. Geographical Chitrakoot is situated between 25°10´N latitude, 80°32´E longitude and 190-210 meter above mean sea level. The experiment consisted of randomize block design in three replications. Eight treatment of foliar feeding nutrition of observation on the plant population, growth characters, yield attributes, yield and economics of treatment were recorded at different stages of crop. Foliar spraying of T_2: RDF + 0.5% N:P:K (19:19:19) at flower initiation stage and T_5: RDF + 2% urea at FI was found better treatment in term of growth , grain and stover. Foliar application of T_2:RDF + 0.5% N:P:K (19:19:19) with RDF was found best treatment for production higher grain yield of pigeonpea (1364 kg/ha), treatment T_2: RDF + 0.5% N:P:K (19:19:19) at FI, T_3: RDF+ 1% MAP at FI , T_4: RDF + 1% Pulse magic at FI , T_5: RDF + 2% urea at FI , T_6: 0.5% $ZnSO_4$ at FI , T_7: RDF + 0.5% $FeSO_4$ at FI , T_8: RDF + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at FI produced higher grain yield by a margin of 209 kg (18.09 %), 47 kg (4.06 %), 124 kg (10.73 %), 138 kg (11.94 %), 102 kg (8.83 %), 47 kg (4.06 %), 65 kg (5.62 %) RDF, respectively.

Keywords: *Pigeonpea, Plant, Grains/Pod, Grain Weight, Stover Yield*

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Introduction

Pigeonpea [*Cajanus cajan* (L.) Millspp.] is one of the major pulse crops of the tropics and sub-tropics. It can be grown in wide range of soils, from sandy to heavy soils. It is able to tolerate drought conditions during dry seasons but not light frost during any stage of its growth. It appears to be better adopted to marginal climatic conditions than any other pulse crops. Pigeonpea is a multipurpose crop, used for fodder, soil fertility enhancement, soil erosion control and for fuel. Seeds are rich in iron, iodine and essential amino acids like lysine, cysteine and arginine. Deeper root system of the crop also helps in breaking the plough pans and improving soil structure and hence it is called as crop of "Biological plough". Pigeonpea being a leguminous plant can fix atmospheric nitrogen and thereby restore lot of nitrogen in the soil. It contains B- complex vitamins. It also contains minerals like calcium, iron, phosphorus etc. Pigeonpea contains 19-23% proteins, 1-2% fat, 45-55% carbohydrates, 1-5% fibers, soluble sugars 3-5% water 1.5% and energy 16-18% [1]. Pigeonpea seeds have roughly two to three times the protein value of cereals. The proteins of pigeonpea are nutritionally superior and important. In Thailand and North Bengal, pigeonpea serves as host for the scale insect which produces lac or stick lac. Dried stalks serve for fuel, thatch and basketry. Fallen leaves from the plants provide vital nutrient to the soil and enrich soil through symbiotic nitrogen fixation. When it comes to area and productivity, pigeonpea comes in sixth place among other grain legumes like chickpeas, peas, and beans. The state used trend show that Maharashtra ranks first both in respect of area and production (29.19% and 29.68%) followed by Karnataka (29.19% and 29.68%). The third place occupied by Madhya Pradesh (13.17% and 13.3%). The highest yield recorded by Bihar (1739 kg/ha) followed by Haryana (1111 kg/ha). In Madhya Pradesh, it is cultivated in area of 690 thousand hector and production of 781.7 thousand tone productivity of 1133 kg/ha.

Globally pigeon pea is cultivated on 4.60 million hectare with annual production of 3.83 million tones. India accounts for 90% of the global output with current production of 4.25 million to from 6.78 million hectare [2].

Foliar application of urea at 50% flowering increased the yield and seed protein. In legumes, leaf senescence starts earlier before competition of maturity which break the source to sink relation, thereby reduce the yield. It has been discovered that nitrogen spray can postpone leaf senescence and increase output. Foliar spray of 2% urea exhibited higher yield about 2% over control. Foliar spray of urea showed and distinct effect in retarding the leaf senescence and in turn higher dry matter and grain yield. It was due to longer retention of the effective photo assimilatory surface [3].

Foliar application of nutrients along with recommended dose of fertilizer increased the yield components due to foliar spray as it facilitates the higher photosynthates translocation to sink by increasing the photosynthesizing area and its capacity of particular crop [4]. N:P:K (19:19:19) is a complete water soluble, ideal fertilizer which provides all major macronutrients N-P-K in a balanced ratio to the plants through foliar spray or fertigation at the time of maximum requirement with the lowest losses. NPK (19:19:19) reduces the cost of basal fertilizers and can address any deficiencies in any of the three major plant nutrients. It ensures a more prudent and long-lasting use by boosting net returns, lowering the cost of production per unit agricultural yield, minimizing the chemical load on the environment, and enabling the nation to fortify its fertilizer supplies in the event of shortages or price hikes. Zinc is a micronutrient required by plant in relatively very less quantities but it is essential to normal growth and development like including major role in photosynthesis, DNA transcription and auxin activity [5].

Mono Ammonium Phosphate is a highly water- soluble fertilizer and having compatibility with plant protection chemicals.

Table-1 Growth and yield parameters of pigeonpea as influenced by foliar nutrition

Treatment	Plant height (cm) at Harvest	Number of branches/ plant	Pods/ plant	Grain weight/ plant(g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Biological yield(kg/ha)
T_1 – RDF	211	17.47	189.63	48.27	1155	5148	6303
T_2 - RDF + 0.5% N:P:K (19:19:19) at FI	211	18.93	216.5	52.17	1364	6134	7498
T_3 - RDF + 1% Mono Ammonium Phosphate (MAP) at FI	211	20.13	191.53	50.4	1202	5347	6549
T_4 - RDF + 1% Pulse magic at FI	199.87	18.07	185.33	57.43	1279	5744	7023
T_5 - RDF + 2% Urea at FI	216.7	22.33	191.47	54.6	1293	6800	8094
T_6 - RDF + 0.5% $ZnSO_4$ at FI	205.4	20.8	189.33	52.57	1257	5694	6952
T_7 - RDF + 0.5% $FeSO_4$ at FI	197.13	18.27	200.67	52.2	1202	5513	6715
T_8 - RDF+ 0.5% $ZnSO_4$+0.5% $FeSO_4$ at FI	209.2	21.33	197.2	51.17	1220	5703	6924
SEm±	4.79	0.84	5.46	1.46	36	204	222
CD (P=0.05)	14.52	2.54	16.55	4.44	109	619	674.36

Table-2 Economics of pigeonpea as influenced by foliar nutrition

Treatment	Gross returns(₹/ha)	Net returns (₹/ha)
T_1-RDF	77317	52919
T_2-RDF+ 0.5% N:P:K (19:19:19) at FI	91407	65917
T_3-RDF + 1% Mono Ammonium Phosphate (MAP) at FI	80453	54760
T_4-RDF + 1% Pulse magic at FI	85675	60693
T_5- RDF+ 2% Urea at FI	88625	63703
T_6-RDF + 0.5% $ZnSO_4$ at FI	84339	59153
T_7-RDF + 0.5% $FeSO_4$ at FI	80781	55714
T_8- RDF + 0.5% $ZnSO_4$+ 0.5% $FeSO_4$ at FI	82201	56762
SEm ±	2302	2302
CD (P =0.05%)	6984	6984

In red gram, pod setting is most important for getting higher yield to reduce flower drop and seed set percentage. It is involves Conversion of energy from source to sink. It is known that leaf development depends on high degree of P concentration in the tissue because P plays an important role in the synthesis of sucrose and starch in photosynthesis, which increases plant dry weight [6].

Materials and Methods

The field experiment was conducted on a well leveled field at Agriculture farm of the Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot, Satna, Madhya Pradesh, 485334, India during *kharif* season of 2019. The farm is situated under agro-climatic zone Kymore Plateau of Eastern Madhya Pradesh. Geographical Chitrakoot is situated between 25°10´N latitude, 80°32´E longitude and 190-210 meter above mean sea level. Agro-ecologically Chitrakoot is characterized by semi- arid and sub- tropical climate with hot dry summer and cold winter. The mean annual rainfall of Chitrakoot is 950 mm. May and June is the hottest month with maximum temperature of 45°C. January is the coldest month of the year with average minimum temperature of 6°C. Agro-Climatically Chitrakoot is characterized by semi - arid and sub-tropical climate with hot dry summer and cold winters. The soil of the experiment site had 228.30 kg ha^{-1} alkaline permanganate method and 30.51 kg ha^{-1} available phosphorus as Chlorimetric method (Olsen et al ,1954) and 246.46 kg ha^{-1} as Flame photometer morgan extraction method (Jackson, 1973). The pH of the soil 6.7 and organic carbon 0.45 % Walkey and Black rapid titration method (Piper, 1966) and EC 0.21 Solu bridge method (Piper, 1966) in 2019-20 respectively. In the experimental year 2019, the crop received 1120.81 mm rainfall from July to October. However, the maximum (42°C) and minimum (3°C) temperature was recorded in July and December month, respectively. Humidity was observed maximum (100%) in the month of July and minimum in October.

Experimental Treatments and Design

Three replications of the experiment were carried out using a randomize block design. This experiment, 8 treatments including (T_1 – RDF, T_2 - RDF + 0.5% N:P:K (19:19:19) at flower initiation stage, T_3 - RDF + 1% Mono Ammonium Phosphate (MAP) at flower initiation stage, T_4 - RDF + 1% Pulse magic at flower initiation stage, T_5- RDF + 2% Urea at flower initiation stage, T_6- RDF + 0.5% $ZnSO_4$ at flower initiation stage, T_7- RDF + 0.5% $FeSO_4$ at flower initiation stage, T_8- RDF+ 0.5% $ZnSO_4$+0.5% $FeSO_4$ at flower initiation stage). The experimental plots were fertilizers as per recommended dose. Each spray of N:P:K (19:19:19) and $ZnSO_4$, $FeSO_4$ @ 0.5% supplied 3.33 kg/ 666 lit of water/ ha^{-1} same quantity use , each spray of MAP and Pulse magic both are applied in similar quantity @1 % supplied 6.66 kg/ 666 lit of water/ha^{-1} and Urea @ 2% supplied 13.32 kg /666 lit of water /ha^{-1}. Foliar spray of such nutrient are applied at flowering stage on 16 October 2019. The gross and net plot size was 5.0 m × 3.6m =18 m² and 4.0 m× 1.80m = 7.2 m², respectively.

Crop husbandry

The field was prepared by one deep ploughing followed by one cross ploughing by tractor drawn cultivator. Planking was done after each ploughing to make soil friable for proper germination of seed. Layout of the experiment was laid out on 18 July 2019 as per layout plan. The crop was fertilized uniformly @ 20 kg N + 60 kg P_2O_5 + 20 kg K_2O/ha Phosphorus and nitrogen was supplied through DAP (130.43kg/ha) while, potassium was given through muriate of potash @ 33.33 kg/ha. The entire quantity of DAP and MOP were applied as basal in the furrows at sowing uniformly in all treatment. The seeds of pigeonpea were treated uniformly with thiram 75 %WP @ 2.5 g/kg of seed followed by seed inoculation with Rhizobium culture @ 20 g/kg seed + PSB (Phosphate solubilizing Bacteria) @ 40 g/kg seed. The inoculation of seeds was dried under shade up to 30 minutes and sown in the prepared field. The seeds were drilled manually in furrows using recommended seed rate of 20 kg/ha. Thinning of excess plant was done at 30 days after to keep plant to plant spacing of 15 cm.

The pigeonpea was sown using variety UPAS 19 July 2019. To control the weeds in all plots, Pendimethaline 30 EC @ 1 kg a.i./ha days after sowing was applied as pre- emergence (22 July 2019) and one hand weeding with khurpi was done on 25/8/19. Crop was protected from insect- pest with the application of Quinolphos @2 ml/lit of water and TEGATA (Lambda – Cyhalothrin 9.5% + Thiamethoxam 12.6% ZC). Six hundred liters of water is needed in one hectare area.

Recording yield of pigeonpea

The crop was harvested on 21st December 2019 in their full maturity and pods turn dark brown colour. The border row of plot of each side and 0.5 m of row each side length was harvested and keep away from plot. There after net plot (4.0 m×1.8 m) was harvested and tagged. The harvesting was done by labour with the help of sickle. The threshing was done by beating the produce plot wise. After threshing the grains were weighed in kilograms after cleaning the seeds.

Statistical analysis

Various data collected and observation recorded during investigation were analysed statically by using analysis of variance technique appropriate to randomized block design as per the procedure suggested by Panse and Sukhatne (1978). The level of significance used for the comparison was 5%.

Result and Discussion

Growth parameters of pigeonpea *viz*., plant height at harvest was observed significantly higher under T_5: RDF + 2% urea spray at FI (216.70 cm). The foliar spray showed favourable effects on net photosynthesis and leaf metabolites *viz*., total chlorophyll, starch, reducing sugars and soluble protein as well as nitrate reductase activity. Interaction of phytohormones and nutrients on growth and development of crop plant cause positive responses on plant growth rate. The increased in plant height due to application of Urea were also reported by [7,8] in different crop. Primary branches were found significant higher under treatment T_5: RDF + 2% urea spray at FI (22.33 branches/plant, 4.80 branches/plant) followed by T_8: RDF + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at flower initiation (21.33 branches/plant). This increase in branches /plant could be ascribed due to higher growth parameters as per foliar application of urea and iron. Such enhance is chlorophyll content in leaf, formation of higher amount of photosynthesis, physiological and metabolism process nitrogen metabolism, and enzyme function. Similar results were observed [9,10].

Yield attributes *viz*., grain weight was found significantly higher under T_4: RDF + 1% pulse magic spray at FI (57.43 g/ plant). While, pods/ plant was observed significantly more in T_2: RDF + 0.5% N:P:K (19:19:19) spray at FI (216.50 pods/plant) followed by T_7: RDF + 0.5% $FeSO_4$ spray at FI (200.67 pods/plant). The better yield attributers under foliar application treatment ware due to improve growth characters of pigeonpea *viz*., plant height, number of trifoliate leaves and dry matter accumulation per plant. The supply of nutrients through foliar application increased the nutrients availability for uptake and better partitioning of dry matter from source to sink. Foliar nutrition preferentially increased levels of nucleic acids, soluble proteins, carbohydrates which resulted in higher dry matter production and sink size. The findings agree with the result [11, 12].

Grain yield of pigeonpea was recorded significantly maximum under treatment T_2: RDF + 0.5% N:P:K (19:19:19) spray at FI (1364 kg/ha) followed by in T_5: RDF + 2% urea at FI (1293 kg/ha).While, stover yield and biological yield of pigeonpea was noted significant maximum under treatment T_5: RDF + 2% urea at FI (6800 kg/ha, 8094.39 kg/ha) followed by T_2: RDF + 0.5% N:P:K (19:19:19) spray at FI (6134 kg/ha, 7498.70 kg/ha). The higher seed and stover yield of pigeonpea due to foliar nutrition of 0.5% N:P:K (19:19:19) and 2% urea could be ascribed due to higher value of yield attributes. Positive effect of supplying legume plant with supplementary nitrogen or balance dose of nutrients particularly at flowering stage was found to have beneficial effect on increasing seed yield [13].

Gross returns and net returns was obtained significantly higher under treatment T_2: RDF + 0.5% N:P:K (19:19:19) spray at flower initiation (₹91407/ha, ₹65917/ha) followed by T_5: RDF + 2% Urea at flower initiation (₹88625/ha, ₹63703/ha). However, all foliar fertilized treatments also exhibited significantly greater gross returns than that of RDF. This increase was due to significantly higher values of grain and stover yield of concerning treatment. The results were supported [14, 15].

Conclusion

Based on experimental data, it is concluded that Foliar application of T_2:RDF + 0.5% N:P:K (19:19:19) with RDF was found best treatment for production higher grain yield of pigeonpea (1364 kg/ha), treatment T_2: RDF + 0.5% N:P:K (19:19:19) at FI, T_3: RDF+ 1% MAP at FI , T_4: RDF + 1% Pulse magic at FI , T_5: RDF + 2% urea at FI , T_6: 0.5% $ZnSO_4$ at FI , T_7: RDF + 0.5% $FeSO_4$ at FI , T_8: RDF + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at FI produced higher grain yield by a margin of 209 kg (18.09 %), 47 kg (4.06 %), 124 kg (10.73 %), 138 kg (11.94 %), 102 kg (8.83 %), 47 kg (4.06 %), 65 kg (5.62 %) RDF, respectively.

Application of research: Study on the effect of foliar nutrition on productivity of pigenpea

Research Category: Agronomy

Abbreviations: MAP- Mono Ammonium Phosphate,
PSB- Phosphate solubilizing Bacteria

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****Research Guide or Chairperson of research: Dr H.S. Kushwaha**
University: Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, 485334, Madhya Pradesh, India
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Study area / Sample Collection: Agriculture farm, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, 485334, Madhya Pradesh, India

Cultivar / Variety / Breed name: Pigenpea [*Cajanus cajan* (L.) Millsp.]

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
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References

[1] Lawn R.J. and Troedson R.J. (1990) *Pigeonpea physiology of yield formation. In; Nene, YL, Hall, SD and Shella, Y K. (Eds.) the pigeonpea CAB International, Wallingford, UK*, 179-258.
[2] Agriculture Statistics (2018) *Pocket Book of Agriculture Statistics. Department of Agriculture, Cooperation & Farmers Welfare, Directorate of Economics and Statistics, New Delhi, India* 24-26.
[3] Prabakaran K. (2002) M.*Sc. (Ag) thesis, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu, India*.
[4] Thakur V., Teggelli Raju G. and Meena M. K. (2017) *International Journal Pure Application Bioscience and Technology*, 5(3), 201-278.
[5] Bromley B.J. (2011) *Nutrient deficiency symptoms. Mercer Country Horticulturist,* 10, 18-31.
[6] Cakmak I., Hengeler C., Marschner H. (1994) *Journal of Experimental Botany*, 45(9), 1245-1250.
[7] Srinatharan N., Rajavel M. and Senthi Kumar R. (2015) *Legume Research*, 38(1), 91-93.
[8] Aliloo A.A., Khorsandy H. and Mustafavi S.H. (2012) *Cercet Agron Mold*, 4, 49-55.
[9] Verma C.B., Yadav R.S., Singh I.J .and Singh A.K. (2009) *Legume Research*, 32, 103-07.
[10] Ghandali V.V. and Dehsorkhi A.N. (2017) *Journal Applied Research Plant Ecophysiology*, 4, 109-36.
[11] Rajesh N. (2011) *M.Sc. (agri.) Thesis, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu, India*.
[12] Patil J.R., Thakur V.S. and Teggelli R.G. (2018) *Advances In Research*, 15 (3), 1-5.
[13] Venkatesh M.S. and Basu P.S. (2012) *Journal of Food Legumes*, 24, 110-12.
[14] Navaz Mo., Kumar S., Chandrakar D., Dameshwar and Ahmad A. (2017) *Journal of Pharmacognosy and Phytochemistry*, 6(5), 1683-1686.
[15] Mamathashree C., Shilpa H.D., Sadashivanagouda S.N.O., Tahshildar M. and Amrutha T.G. (2014) *Trends in Biosciences*, 7(24), 4140-4142.