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Influence of Foliar Nutrition on Yield and Nutrient Uptake in Cowpea [*Vigna unguiculata* L.]

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A B S T R A C T

An experimental trial was carried out at Field No. A5, College Farm, Department of Agronomy, College Farm, SRM College of Agricultural Sciences, Baburyanpettai, Chengalpattu to investigate the effect of foliar application on grain yield, stover yield and nutrient uptake on cowpea during *kharif* season 2024. Six treatment combinations in a randomized block design were tested in replication of four. Vamban 3 variety of cowpea planted at a row-to-row spacing of 45 cm and plant-to-plant spacing of 15 cm. Foliar application of pulse wonder @ 1% on 30 and 45 DAS has given significantly higher yield (993 kg ha^{-1}).

Introduction

Cowpea (*Vigna unguiculata* (L.) Walp) is an important legume crop for human and livestock feed because it is a cheap source of protein. When compared to other grain legumes cowpea is highly resistant to low fertility because of its remarkable nitrogen-fixing ability, well-organised symbiosis with mycorrhizae and ability to thrive in soil with a wider range of Ph. Excessive or immoderate yield, uplifted or decreased development of crop and physiological changes of the crop are all brought about by variation in nutrient availability of the crop. The productivity of cowpeas in India is deprived, so there is a necessity to allocate several agronomic strategies to elevate the output of the crop.

Under existing scenarios, foliar application of mineral nutrients has become an inevitable agricultural practice for sustainable crop production worldwide (Chaudhary *et al.,* 2023) which fully puts to use the genetic potential of the crop. Foliar application of nutrients has several benefits easy and effective absorption of nutrients, avoidance of nutrient loss through leaching and volatilization, fixation and regulating plant nutrient uptake.

Materials and Methods

The field trial was carried out during *kharif* 2024, at College Farm, Department of Agronomy, SRM College of Agricultural Sciences, Baburayenpettai,

Chengalpattu. The site location is geographically positioned in the northeastern zone of Tamil Nadu at 12° N latitude and 79° E longitude and at also about 20 meters above mean sea level. This region features a tropical wet and dry climate with an average annual rainfall of about 1400 mm.

Six foliar nutrients treatment combinations were performed in a randomized block design, each with four replications, list of treatment details are, T_1- foliar spray of pulse wonder @ 1% on 30 and 45 DAS, T_2 - foliar spray of polyfeed @ 2% on 30 and 45 DAS, T_3 - foliar spray of DAP @ 2% on 30 and 45 DAS, T_4 - foliar spray of seaweed extract @ 5% on 30 and 45 DAS, T_5 - foliar spray of humic Acid @ 2% on 30 and 45 DAS, T_6 - control (No spray). The crop was fertilized with a recommended fertilizer dosage of 25 kg N, 50 kg P_2O_5, 25kg K_2O ha $^{-1}$ which was applied through urea, SSP and MOP in lines, incorporated at the time of sowing. The experimental plots were measured at 4 m× 5m (20m^2).

For this field experiment, cowpea variety VBN 3 was used, and it was adapted with 45 cm ×15 cm to maintain optimum plant population. Biometric observations were recorded by five plants from each net plot area were chosen randomly and tagged. These plants were used for recording all biometric observations of crop growth at different stages. Observations are recorded on plant nutrient uptake, grain yield, and stover yield (kg ha^{-1}).

Representative samples were taken from the output of each net plot to estimate the amounts of nitrogen, phosphorous, and potassium in the plant. The plant materials were mechanically ground and oven-dried at 60°C for 24 hours before the nutrients were calculated using Micro Kjeldhal's method, Vanadomolybdo phosphoric yellow colour method and Flame photometric method respectively and it was calculated for each treatment separately using the following formula.

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient concentration (\%)}}{100} \times \text{Dry matter (kg ha}^{-1}\text{)}$$

Results and Discussion

Effect on yield

Foliar feeding improved photosynthate synthesis and transit from source to sink, leading to increased production. Because of the delivery of nutrients, the crop may have benefited from a prolonged time of optimal nutritional circumstances and nutrient uptake, allowing the plant to continue producing all yield components and yield.

Among the different treatments, foliar application of pulse wonder @ 1% on 30 and 45 DAS (T_1) has gained significantly higher grain yield (993 kg ha^{-1}) and stover yield (2572 kg ha^{-1}) compared to all other treatments.

However, it was statistically on par with the application of foliar spray of seaweed extract @ 5% on 30 and 45 DAS (953 kg ha^{-1} and 2469 kg ha^{-1} respectively).

The management of nutrients in a cumulative and coordinated manner to the crop could have benefited from adequate nutritional conditions for a lengthier duration and nutritional absorption hence enabling the plant to continue producing all of its constituent parts and give up foliar feeding boosted photosynthate synthesis and translocation from source to sink, which consequently recorded increased pod $plant^{-1}$, seeds pod^{-1}, and hundred seed weights. The crop may have benefited from adequate nutritional conditions for a longer amount of time and nutrient uptake because of the cumulative and conjunctive application of nutrients, enabling the plant to persist with all the yield components and yield. These outcomes were consistent with the research findings of Vighnesh *et al.,* (2021) and Subba Rami Reddy *et al.,* (2011). However, lower grain (794 kg ha^{-1}) and stover yield (2058 kg ha^{-1}) were obtained in no spray (control T_6).

Effect on nutrient uptake

The application of several foliar chemical treatments had a substantial impact on the concentration of N, P, and K content in seed and haulm. During crucial growth phases, foliar spraying plants with readily available forms of nutrients contributes to an even higher concentration of nutrients within the plant. The nutrient

uptake in cowpeas under foliar application is depicted in Table 2. Among various treatments of foliar application of nutrients foliar application of pulse wonder @ 1% on 30 and 45 DAS shows significantly higher values of nitrogen, phosphorus and potassium uptake (28.47 kg ha^{-1} N, 5.78 kg ha^{-1} P and 30. 17 kg ha^{-1} K, respectively) at harvest and it was on par with foliar application of seaweed extract @ 5% on 30 and 45 DAS (Fig.1).

Foliar application of pulse wonder @ 1% on 30 and 45 DAS(T_1) enhanced nitrogen intake may be the result of higher biomass production, increased nitrogen availability to the crop, delayed chlorophyll and leaf nitrogen loss through increased photosynthesis, and increased nitrogen delivery throughout the cowpea's flowering and pod-filling stages. The foliar application of micro and macronutrients, along with growth hormones, has been linked to an increase in the uptake of phosphorus and potassium.

Improved nutrient translocation to reproductive structures, such as pods, seeds, and other plant parts, was the outcome of improved nutrient uptake with foliar spray due to an increased balance supply of nutrients and good response by the plants (Mondal *et al.,* 2011). Treated foliar fertilizers had greater N, P, and K contents on grain and straw, it follows that these treatments also enhanced the mechanisms involved in nutrient absorption.

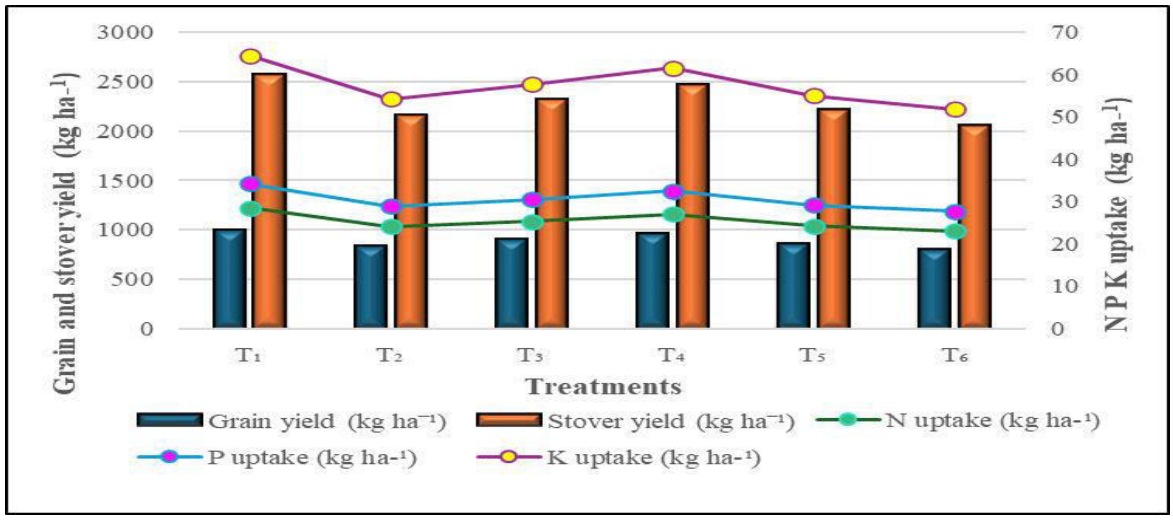
Table.1 Effect of foliar nutrition on number of grain yield and stover yield (kg ha-1) of cowpea

T. No	Treatments	*Kharif* 2024	
		Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1	Foliar spray of Pulse Wonder @ 1% on 30 and 45 DAS	993	**2572**
T_2	Foliar spray of poly feed @ 2% on 30 and 45 DAS	834	**2160**
T_3	Foliar spray of DAP @ 2% on 30 and 45 DAS	894	**2315**
T_4	Foliar spray of seaweed extract @ 5% on 30 and 45 DAS	953	**2469**
T_5	Foliar spray of humic acid @ 2% on 30 and 45 DAS	854	**2212**
T_6	Control	794	**2058**
	SEd	33	**86**
	CD (p=0.05)	**71**	**183**

Table.2 Effect of foliar nutrition on nutrient uptake (kg ha-1) by cowpea

T. No	Treatments	Nutrient uptake (kg ha^{-1})		
		N	P	K
T_1	Foliar spray of Pulse Wonder @ 1% on 30 and 45 DAS	28.47	5.78	**30.17**
T_2	Foliar spray of poly feed @ 2% on 30 and 45 DAS	24.06	4.88	**25.34**
T_3	Foliar spray of DAP @ 2% on 30 and 45 DAS	25.34	5.14	**27.15**
T_4	Foliar spray of seaweed extract @ 5% on 30 and 45 DAS	27.05	5.49	**28.96**
T_5	Foliar spray of humic acid @ 2% on 30 and 45 DAS	24.20	4.91	**25.95**
T_6	Control	23.06	4.68	**24.14**
	SEd	0.95	0.19	**1.01**
	CD (p=0.05)	**2.03**	**0.34**	**2.15**

Figure.1 Influence of foliar nutrition on yield and nutrient uptake in cowpea



The quick availability and absorption of nutrients under foliar spray without requiring much energy for their transportation and without any loss in transit may be the cause of the large impact of foliar feeding on nutrient uptake (Venkatesh and Basu, 2011). Conversely, the reduced intake of potassium, phosphorus, and nitrogen was noted in T_6 (no spray) (23.06 kg ha^{-1} N, 4.68 kg ha^{-1} P and 24.14 kg ha^{-1} K, respectively).

The results of the investigation showed that cowpea produced more yield and nutrient uptake when grown in *kharif* with foliar spray of TNAU pulse wonder at 1% and seaweed extract at 5% on 30 and 45 DAS with applied entire basal, recommended fertilizer dose of 25 kg N, 50 kg P_2O_5, 25 kg K_2O ha^{-1}.

Author Contributions

D. Gowsalya: Investigation, formal analysis, writing—original draft. H. A. Archana: Validation, methodology, writing—reviewing. R. Jeyajothi:—Formal analysis, writing—review and editing. R. Angelin Silviya: Investigation, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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