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Effect of foliar nutrition on dry matter production, yield attributes and yield of cowpea (*Vigna unguiculata.* L. Walp)

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Abstract
A field experiment was conducted to investigate the effect of foliar nutrition on growth and yield of cowpea in Northern Eastern Zone of Tamil Nadu" in clay soil at SRM College of Agricultural Sciences, Baburayanpettai during summer 2024. The experiment treatments consisted of different organic and inorganic foliar nutrition were applied and this research trial was laid out in a randomized block design (RBD) with seven treatments that are replicated thrice. Results revealed that foliar spray of pulse wonder 1% @ 30 and 45 DAS recorded significantly higher plant height (40.25 cm), leaf area index (4.83), dry matter production (21.08 g plant^{-1}) and yield attributes viz., higher number of pods plant^{-1} (25.32), pod length (13.33 cm), number of seeds pod^{-1} (12.10), 100 seeds weight (11.25g), grain yield (1003 kg ha^{-1}), and stover yield (2475 kg ha$^{-1)}$ compared to rest of all the foliar nutrition treatments.

Keywords: Foliar spray, cowpea, pulse wonder, yield attributes

Introduction
Cowpea (*Vigna unguiculata* (L.) Walp) is the most commonly grown in the state's arid and semi-arid regions. As *kharif* pulse crop is grown for green maturing, grain, vegetables, fodder and a substitute for cultivation on dry land farming. It also functions as a weed-smothering crop with a low weed infestation level (Kavitha *et al.,* 2019) [3]. It also has the useful ability to fix atmospheric nitrogen through its root nodules and it grows well in poor soils with more than 85% sand and with less than 0.2% organic matter and low levels of phosphorus. It also has an excellent ability against soil erosion from rainwater and being denoted as prominent cover crop (Mandre *et al*., 2020) [5].

Effective nutrient management is crucial for optimizing cowpea yields and maintaining crop health. While traditional soil fertilization practices are helpful, they may fall short in meeting the nutrient needs of the crop, particularly in low fertility soils. To overcome these limitations, foliar nutrient application has emerged as a promising approach for sustainable crop production worldwide (Pea *et al.,* 2018) [6]. Foliar fertilization draws attention as a quick, target-oriented, and environmentally compatible insurance to pursue higher crop productivity under optimal and unfavorable growth conditions (Shahna *et al.,* 2023) [7]. It is also helpful to minimize the soil barriers for higher nutrient use efficiency and advantageous to optimize crop yield, produce quality and reduce environmental concerns, especially nutrients leaching and volatilization losses. In this view, the present study was carried out with different foliar nutrients to improve the growth and yield of cowpea.

Materials and Methods
The field experiment was conducted during summer 2024, at College Farm, Department of Agronomy, SRM College of Agricultural Sciences, Baburayanpettai, Chengalpattu. The site is geographically positioned in the North-eastern Zone of Tamil Nadu at 12° N latitude and 79° E longitude and at an altitude of 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.

Seven foliar nutrients treatment combinations were accomplished in a randomized block design, each with three replications, where the details of treatments are listed as: T_1- foliar spray of pulse wonder @ 5 kg/ha 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 - foliar spray of phosphorus solubilizing bacteria @ 2% on 30 and 45 DAS, T_7 - control (No spray). The crop was fertilized with recommended fertilizer dosage of 25 kg N, 50 kg P_2O_5, 25 kg K_2O ha $^{-1}$ whereas applied through urea, SSP and MOP in lines, and incorporated at the time of sowing. The experimental plots were sized at 4 m× 5 m (20 m^2).

For this field experiment, cowpea variety VBN 3 was used, and it was adapted with row-to-row spacing of 45 cm and plant-to-plant spacing of 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 at different stages of crop growth. Observations are recorded on growth parameters like plant height (cm), dry matter production, leaf area index (LAI), and yield attributes *viz*., number of pods plant^{-1}, pod length, number of seeds pod^{-1}, seed index (g), grain and stover yield (kg ha^{-1}). The data were statistically analysed by adopting Fishers method of Analysis of Variance (ANOVA) as sketched by Gomez and Gomez (2010). The value of critical difference (CD) were calculated whenever the 'F' test was evaluated significance at level of 5%.

Result and Discussion

The growth characters of a plant are manifested in many ways. Plant growth characters *viz*., plant height, leaf area index and dry matter production were estimated at different growth stages. The source-sink relationship mainly depends on these important growth parameters. The data collected were analysed statistically and presented in appropriate tables and the results and discussion obtained from the experiments are furnished below. At 30 DAS, recorded data of growth parameters of plant height, leaf area index and dry matter production were not statistically significant duo to not application of foliar nutrients upto early flowering stage of cowpea.

Plant height (cm)

The mean data as compelled by various treatments of foliar spray are presented in table 1.0. At 45 DAS and harvest stage, foliar spray of pulse wonder @ 5 kg ha^{-1} on 30 and 45 DAS recorded higher plant height (22.64 cm and 55.54 cm) and it was statistically at par with foliar spray of seaweed extract @ 5% on 30 and 45 DAS. Foliar application of pulse wonder significantly enhanced level of nutrient available in the rhizo ecosystem of the foliar applied nutrients resulting in better plant growth and development (Vighnesh *et al.*, 2023) [8]

Dry matter production

Dry matter accumulation at 45 DAS and at harvest stage was recorded significantly higher with the application of 1% TNAU pulse wonder @ 5 kg ha^{-1} on 30 and 45 DAS. The corresponding values of dry matter accumulation were 21.08 and 39.88 g plant^{-1} at 45 DAS and harvest stages respectively. It might be due to foliar application of pulse wonder provides optimum availability of nutrients to the crop resulting osmotic turgor of cell, cell division and cell elongation in cowpea. Enhanced uptake of nutrients and higher photosynthetic activity by the application of foliar spray of nutrients during the critical stages of crop thereby increasing in dry matter production of plants. These finding were well supported by the work of Kumar and Simaiya (2019) [4].

Significantly lower dry matter accumulation was noted at 45 DAS (12.23 g plant^{-1}), and at harvest (25.63 g plant^{-1}) under (T_7) control. The recorded phenomenon could likely be attributed to improved nutrient absorption facilitated by foliar application. This in turn results in the uplifting of root and shoot growth augmentation of leaf area increased dry matter production and build up nutrient uptake. Therefore, these processes resulted in a notable enhancement in the overall dry weight of the plant.

Leaf area index

The significantly higher value of LAI was recorded at 45 DAS and harvest stage, foliar spray of pulse wonder @ 5kg ha^{-1} (3.79) on 30 and 45 DAS and it was on par with DAP @ 2% foliar spray at 30 and 45 DAS. The remarkable increase of dry weight/ plant with application of 1% pulse wonder might be because N helps in restoring higher level of auxin which would have concluded in better leaf area apparently chlorophyll content of the leaves where the above fact observed to be similar with findings of (Chaudhary *et al.*, 2023) [1].

Table 4.0: Effect of foliar nutrition on yield and yield attributes of cowpea

T. No	Treatments	Plant height (cm)			Leaf area index			Dry matter production (g plant^{-1})		
		30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest
T_1	Foliar spray of Pulse wonder @ 5 kg ha^{-1} on 30 and 45 DAS	22.64	40.25	55.54	3.79	4.83	2.68	6.24	21.08	39.88
T_2	Foliar spray of polyfeed @ 2% on 30 and 45 DAS	20.12	33.05	45.61	3.54	3.97	2.22	5.55	16.78	38.38
T_3	Foliar spray of DAP @ 2% on 30 and 45 DAS	20.24	33.83	46.69	3.59	4.06	2.32	5.58	21.00	41.44
T_4	Foliar spray of seaweed extract @ 5% on 30 and 45 DAS	21.54	38.57	53.23	3.38	4.63	2.49	5.94	16.13	34.73
T_5	Foliar spray of humic acid @ 2% on 30 and 45 DAS	21.23	34.03	46.96	3.40	4.08	2.27	5.85	18.07	38.23
T_6	Foliar spray of phosphorus solubilizing bacteria @ 2% on 30 and 45 DAS	19.86	30.65	42.30	3.32	3.68	2.04	5.47	14.96	31.35
T_7	Control	18.75	24.30	33.53	3.13	2.92	1.62	5.17	12.23	25.63
	SEd	1.13	1.92	2.71	0.19	0.24	0.13	0.31	0.96	1.99
	CD (P=0.05)	NS	4.18	5.9	NS	0.51	0.28	NS	2.09	4.33

Yield and yield attributes

Foliar nutrition increased the synthesis and translocation of photosynthates from source to sink which in turn registered higher yield and yield attributes of cowpea namely number of pods plant^{-1} and pod length (cm), number of seeds pod^{-1} and seed index (g), number of grain yield (kg ha^{-1}) and stover yield (kg ha^{-1}) are as persuaded by different foliar nutrition that are listed in the following tables 4 and Fig.1.

At the time of harvest higher number of pods per plant (25.32), length of the pods (13.33), number of seeds per pod (12.10), hundred seed weight (11.25), grain yield (1003 kg ha^{-1}), stover yield (2475 kg ha^{-1}) of cowpea were estimated with application of pulse wonder 5 kg ha^{-1} @ 30 and 45 DAS (T_1). The accumulative and conjunctive application of nutrients for crops can benefit from sufficient nutrients for a long period of time, and by allowing plants to absorb nutrients continuously, this can improve the yield components and thereby increasing the yield. Similarly, Chaudhary *et al.* (2023) [1] and Kavitha *et al.*, (2019) [3] reported that application foliar spray of nutrients increases yield and yield components by reducing flower loss.

Lower the number of pods per plant (19.28), length of the pods (8.23), number of seeds per pod (7.31), hundred seed weight (6.79), grain yield (582 kg ha^{-1}), stover yield (1421 kg ha^{-1}) were anticipated with water spray (control).

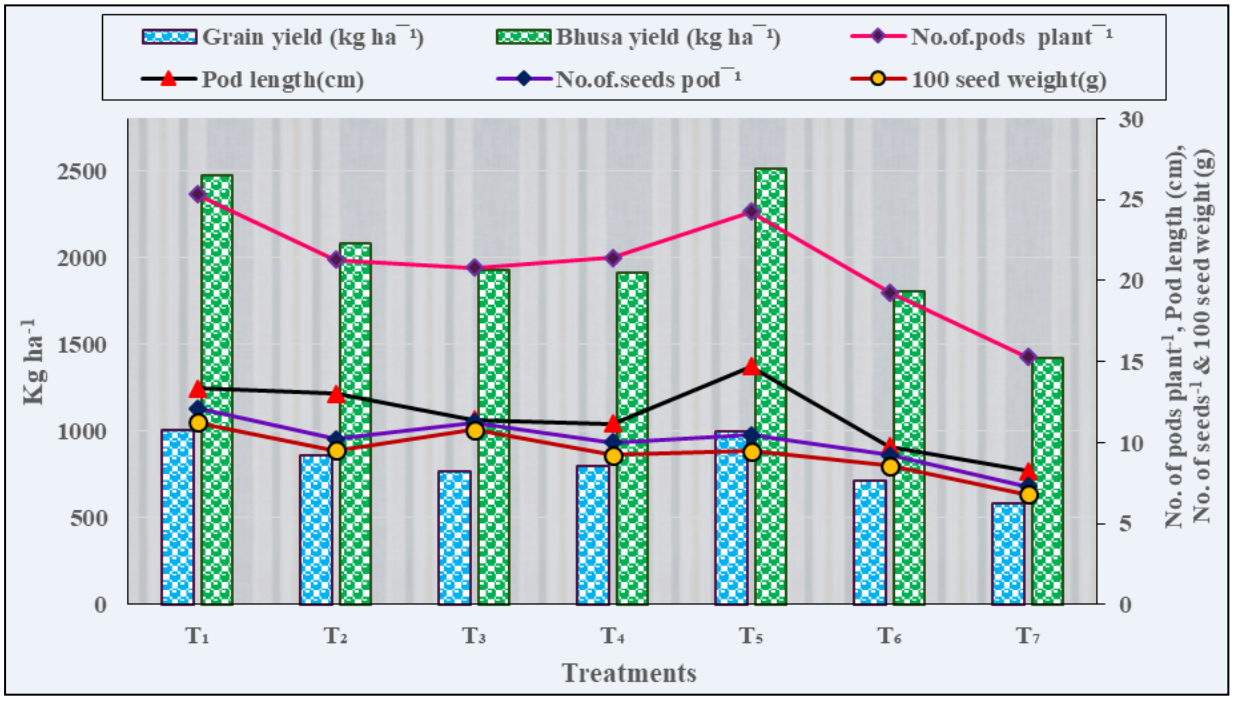

Fig 1: Effect of foliar nutrition on growth and yield of cowpea

Table 5.0: Effect of foliar nutrition on yield and yield attributes of cowpea

T. No	Treatments	Summer 2024					
		Number of pods plant^{-1}	Pod length (cm)	Number of seeds pod^{-1}	100 seeds weight (g)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1	Foliar spray of Pulse wonder @ 5 kg ha^{-1} on 30 and 45 DAS	25.32	14.71	12.10	11.25	1003	2514
T_2	Foliar spray of polyfeed @ 2% on 30 and 45 DAS	21.28	13.03	10.22	9.46	767	1911
T_3	Foliar spray of DAP @ 2% on 30 and 45 DAS	21.41	11.40	10.48	9.51	860	2079
T_4	Foliar spray of seaweed extract @ 5% on 30 and 45 DAS	24.27	13.33	11.25	10.78	999	2475
T_5	Foliar spray of humic acid @ 2% on 30 and 45 DAS	20.79	11.18	10.00	9.24	798	1930
T_6	Foliar spray of phosphorus solubilizing bacteria @ 2% on 30 and 45 DAS	19.28	9.76	9.22	8.57	712	1808
T_7	Control	15.29	8.23	7.31	6.79	582	1421
	SEd	1.18	0.65	0.56	0.54	46	114
	CD (P=0.05)	2.57	1.41	1.23	1.17	101	249

Conclusion

Based on the investigation results it was determined that growing of cowpea in summer with foliar spray of TNAU pulse wonder @ 5 kg ha $^{-1}$ and seaweed extract @ 5% on 30 and 45 DAS or DAP @ 2% 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} resulted in higher vegetative growth and productivity of the cowpea.

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