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Impact of foliar fertilization on growth and yield of *rabi* greengram (*Vigna radiata* L.)

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ABSTRACT

A field experiment was conducted during the *rabi*, 2023–24 and 2024–25 at J Farm, Agricultural Research Institute, PJTAU, Rajendranagar, to evaluate the impact of different foliar nutrient sprays on the growth and yield attributes of greengram (*Vigna radiata* L.). Results revealed that application of recommended dose of fertilizer & foliar spray of 19:19:19 @ 0.5 % at 20 & 40 DAS significantly enhanced growth parameters including plant height (55.31 cm), number of branches (4.75), number of trifoliate leaves (8.55) and dry matter accumulation plant^{-1} (11.36 g); yield attributes such as number of pods plant^{-1} (17.17), number of seeds pod^{-1} (11.33) and pod length (8.86 cm), seed yield (1490.74 kg ha^{-1}), haulm yield (3144.01 kg ha^{-1}), harvest index (32.16) and benefit-cost ratio (2.36 BCR). This treatment was statistically at par with T_5 (RDF + foliar spray of DAP @ 2% at 20 & 40 DAS). The lowest values for growth, yield attributes and seed yield were obtained in the control treatment (T_7), which did not receive any RDF or foliar spray. The study underscored the efficacy of foliar application of balanced nutrients, particularly 19:19:19, in improving the productivity and profitability of greengram cultivation under *rabi* conditions.

Keywords: *Foliar spray, Greengram, Nutrients and Recommended dose of fertilizer*

Greengram (*Vigna radiata* L.), or mung bean, is an important pulse crop widely grown in tropical and subtropical regions. It contributes to sustainable agriculture through its short growth cycle, nitrogen-fixing ability and high nutritional value. It also plays a key role in crop rotation by enhancing soil fertility and overall productivity. In India, greengram is cultivated on about 51.30 lakh hectares,producing 30.85 lakh tonnes with an average yield of 601 kg.ha^{-1} (Ministry of Agriculture and Cooperation, 2021). However, despite its benefits, productivity remains low mainly due to inadequate nutrient management, particularly in rainfed and marginal areas with limited nutrient availability and uptake.

A major challenge in greengram cultivation is meeting its nutrient demands within a short growing season. While soil application of fertilizers forms the basis of traditional nutrient management, it often fails to fully meet the crop's nutrient demand, especially during critical growth stages. In such contexts, foliar fertilization, the application of nutrients directly to plant foliage, has emerged as a viable supplemental strategy. Foliar feeding is one of the most efficient methods for correcting nutrient deficiencies (Dixit and Elamathi *et. al.,* 2007). It enables quicker assimilation of nutrients through the cuticle or stomatal openings, leading to faster physiological responses and improved crop performance (Latha and Nadanassababady, 2003). It also enhances nutrient use efficiency, promotes quicker uptake, and supports the crop during moisture stress or poor soil fertility conditions and reduces nutrient losses through leaching and fixation, making it economically and environmentally viable (Anandhakrishnaveni *et. al*., 2004). While foliar application is not a substitute for soil fertilization, it acts as a critical supplement, especially during critical growth phases where nutrient demand peaks. This study aimed to assess the impact of foliar fertilization on greengram growth and yield, seeking strategies to enhance productivity and sustainable nutrient management.

MATERIAL AND METHODS

The field experiment was conducted during the *rabi* season of 2023–24 and 2024–25 on silty clay loam soils at J Farm, Agricultural Research

Institute, PJTAU, Rajendranagar. The geographical coordinates of the field are 17.3850° N latitude and 78.4867° E longitude with 542 meters above mean sea level. The study was conducted in a randomized block design (RBD) with seven treatments (Table 1) and replicated thrice. The experimental site is characterized by low organic carbon content, medium levels of available nitrogen and phosphorus and high potassium availability, with a soil pH of 6.5. Sowing was carried out during the second fortnight of December 2023 and the first fortnight of December 2024 with cultivar MGG-295. The crop was sown at a spacing of 30 cm × 10 cm. All recommended agronomic practices were followed uniformly, except for nutrient management, which varied as per treatment. No significant pest or disease incidence was observed during the crop growth period. Biometric observations were recorded at 30, 50 days after sowing (DAS) and at harvest using a 0.5 × 0.5 m^2 quadrat and extrapolated to a per square meter basis. The pooled data of two years were statistically analysed following the procedures outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth attributes

The application of recommended dose of fertilizer (20 N-40 P, O… -20 K, O) combined with foliar spray of 19-19-19 @ 0.5% at 20 & 40 DAS significantly enhanced plant height (55.31 cm), number of branches (4.75), number of trifoliate leaves (8.55) and dry matter accumulation $plant^{-1}$ (11.36 g) at successive growth stages up to harvest. These results were comparable to the application of RDF + foliar spray of DAP 2% at 20 & 40 DAS (Table 1). The positive impact of this treatment might be attributed to the readily available nutrients, particularly nitrogen (N), phosphorus (P) and potassium (K), present in the water-soluble fertilizer (19:19:19). When applied as a foliar spray during the pre-flowering and early pod development stages, these nutrients were directly absorbed through the leaf cuticle or stomata. This likely enhanced photosynthetic activity, leading to increased vegetative growth, formation of more axillary buds and ultimately a higher number of branches and trifoliate leaves $plant^{-1}$. This vegetative boost contributed to greater dry matter accumulation $plant^{-1}$. Moreover, the combined application of RDF + 19:19:19 @ 0.5% ensured a timely and adequate nutrient supply during critical growth phases. The improved nutrient absorption by the leaves facilitated efficient assimilation and translocation within the plant. In particular, phosphorus in the 19:19:19 formulation likely played a key role in promoting cell division and development, resulting in increased branching and overall dry matter production. These findings are corroborating with the reports by Banasode and Math (2018) and Takankhar *et. al.,* (2017).

Yield attributes

The foliar application of 19:19:19 @ 0.5% at 20 & 40 days after sowing (DAS) in combination with the recommended dose of fertilizer (RDF) significantly improved key yield attributes such as the number of pods $plant^{-1}$ (17.17), number of seeds pod^{-1} (11.33) and pod length (8.86 cm). These results were statistically at par with the treatment involving RDF+DAP @ 2% applied at 20 & 40 DAS and were significantly superior to the other treatments. However, the application of fertilizers whether through soil or foliar spray, all the treatments failed to have significant effect on hundred-seed weight (Table 2). The enhanced performance in these yield parameters can be attributed to the beneficial effect of foliar nutrient application, which promotes better vegetative and reproductive growth. The immediate availability and absorption of nutrients through the foliar application, likely supported critical physiological processes during pod development, contributing to improved yield characteristics. These findings are in accordance with earlier reports by Bansal and Ahmad (2015), and Thakur *et. al.,* (2017), who also observed that foliar nutrient application can effectively, enhanced the yield traits.

The highest seed yield (1490.74 kg ha^{-1}), haulm yield (3144.01 kg ha^{-1}) and harvest index (32.16 %) were observed with the application of RDF along with a foliar spray of 19:19:19 @ 0.5% at 20 & 40 DAS. This treatment was significantly better than all others, followed by RDF + foliar spray of DAP @ 2% at the same intervals. The lowest values were observed in the control treatment without RDF & foliar spray (Table 2).The increase in seed yield can be attributed to better nutrient availability from the foliar spray, which improved the movement of photosynthates to the developing seeds. This likely enhanced photosynthesis and dry matter partitioning. Higher haulm yield was likely due to a steady nutrient

Table.1 Impact of foliar fertilization of different nutrients on growth attributes of *rabi* greengram (Pooled data of two years)

Treatments	Plant height (cm)			No.of branches plant^{-1}			No.of trifoliate leaves plant^{-1}			dry wt. plant^{-1}(g)		
	30 DAS	50 DAS	at Harvest	30 DAS	50 DAS	at Harvest	30 DAS	50 DAS	at Harvest	30 DAS	50 DAS	at Harvest
T_1-RDF (Recommended dose of fertilizer)	13.44	29.72	42.05	1.32	2.81	3.87	4.95	9.69	4.33	3.41	6.48	8.96
T_2- RDF+ Nano Urea @ 3 ml/lit at 20 & 40 DAS	16.97	33.03	45.24	1.27	3.26	4.2	5.33	11.96	5.29	3.73	7.11	9.65
T_3-RDF+ Nano DAP @ 3 ml/lit at 20 & 40 DAS	18.12	34.5	47.83	1.29	3.39	4.34	5.48	12.49	5.56	3.83	7.26	9.82
T_4- RDF+ Urea @ 2% at 20 & 40 DAS	18.02	36.09	50.25	1.33	3.44	4.34	5.74	12.77	5.64	3.93	7.46	10.05
T_5- RDF+ DAP @ 2% at 20 & 40 DAS	19.09	37.42	52.4	1.42	3.58	4.58	6.18	13.33	6.41	4.21	7.95	10.31
T_6- RDF+ 19-19-19 @ 0.5% at 20 & 40 DAS	20.26	40.15	55.31	1.58	3.67	4.75	6.94	13.74	8.55	4.48	8.75	11.36
T_7- Control (no RDF)	9.92	24.96	34.93	1.04	2.27	3.21	3.36	7.88	3.76	2.84	5.62	6.97
SEm (+)	0.96	1.8	2.71	0.1	0.19	0.28	0.3	0.79	0.32	0.22	0.51	0.65
CD (P=0.05)	2.97	5.53	8.36	0.3	0.58	0.85	0.91	2.42	1	0.67	1.57	2.01
CV (%)	10.1	9.23	10.03	12.64	10.21	11.4	9.43	11.63	9.91	9.97	12.19	11.76

Table 2. Impact of foliar spray of different nutrients on yield attributes, yield and economics of *rabi* greengram (Pooled data of two years)

Treatments	No. of pods plant^{-1}	No. of seeds pod^{-1}	Pod length	100 seed weight	Seed yield	Haulm Yield	Harvest Index	Cost of cultivation	Gross returns	Net returns	BCR
			(cm)	(g)	(kg ha^{-1})	(kg ha^{-1})	(%)	(₹ ha^{-1})	(₹ ha^{-1})	(₹ ha^{-1})	
T_1-RDF (Recommended dose of fertilizer)	10.15	8.74	6.6	3.5	928.1	2479.3	27.23	44760	65895.27	21135.27	1.47
T_2-RDF+ Nano Urea @ 3 ml/lit at 20 & 40 DAS	12.43	9.61	7.26	3.58	1023.66	2530.03	28.81	45100	72679.86	27579.86	1.61
T_3-RDF+ Nano DAP @ 3 ml/lit at 20 & 40 DAS	13.6	10.08	7.47	3.63	1142.32	2734.15	29.47	45310	81104.78	35794.78	1.79
T_4- RDF+ Urea @ 2% at 20 & 40 DAS	15.23	10.38	7.54	3.66	1286.78	2857.63	31.05	44470	91352.58	46882.58	2.05
T_5- RDF+ DAP @ 2% at 20 & 40 DAS	16.25	10.64	8.08	3.7	1384.68	3051.17	31.21	44680	98312.26	53632.26	2.2
T_6- RDF+ 19-19-19 @ 0.5% at 20 & 40 DAS	17.17	11.33	8.86	3.75	1490.74	3144.01	32.16	44860	105842.79	60982.79	2.36
T_7- Control (no RDF)	6.92	7.4	5.56	3.26	527.9	1682.36	23.88	41810	42760.24	950.24	1.02
SEm (+)	0.87	0.57	0.51	0.16	75.61	165.25	1.63	-	-	-	-
CD (P=0.05)	2.67	1.77	1.57	NS	232.98	509.18	5.01	-	-	-	-
CV (%)	11.44	10.21	12.04	7.73	11.78	10.84	9.68	-	-	-	-

supply that promoted overall plant growth and dry matter accumulation. An increase in harvest index was observed with balanced nutrient availability, which supported efficient transfer of assimilates to the reproductive parts, consistent with the results of Kumar *et. al.,* (2018), Phule and Raundal (2022), and Pratihar *et. al.,* (2023).

Economics

The results of the study demonstrated that the foliar application of 19:19:19 @ 0.5% at 20 & 40 DAS, in combination with the recommended dose of chemical fertilizers, significantly improved yield attributes, seed yield, and economic returns in greengram. The highest net returns (Rs60,982.79 ha^{-1}) and benefit-cost ratio of 2.36, were obtained with this treatment, indicating superior profitability (Table 2). Therefore, the integrated use of RDF with foliar spray of 19:19:19 @ 0.5% at 20 & 40 DAS can be recommended as an effective and economically viable strategy for enhancing grain yield in greengram cultivation.

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