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Effect of foliar application of organic and inorganic nutrients sources on growth, yield and quality of greengram (*Vigna radiata* (L.) Wilczek)

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Abstract
Field experiment was conducted at Agricultural Research Station, Anand Agricultural University, Derol, Dist. Panchmahal, Gujarat during *Kharif*, 2018, 2019 and 2020 to study the effect of foliar application of organic and inorganic nutrients sources on growth, yield and quality of greengram (*Vigna radiata* (L.) Wilczek). Ten treatments for weed management were studied in randomized block design with three replications. Among the different foliar application of organic and inorganic nutrients sources for the Balckgram indicated that application of 50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage enhance the plant height, number of branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, seed yield, haulm yield, net return and BCR of greengram.

Keywords: Organic, inorganic, foliar application, greengram

Introduction
The production of pulse crops in India in general and especially green gram in particular is not enough to meet the domestic demand of the ever growing population (Krishnaveni *et al.*, 2021) [6]. Greengram *Vigna radiata* (L.) is a protein rich staple food. Green gram is a good source of high quality protein. It contains about 25% protein, 1.3% fat, 3.5% minerals, 4.1% fiber and 56.7% carbohydrate (Mori, 2021) [7]. Green gram improves soil physical properties and fixes atmospheric nitrogen. The potential yield of green gram is very low because of the fact that the crop is mainly grown in rainfed conditions with poor management practices and also due to various physiological, biochemical as well as inherent factors associated with the crop. Foliar feeding is often the most effective and economical way to improve plant nutrient deficiency in green gram (Dixit and Elamathi, 2007) [3]. If foliar nutrition is applied, it also reduces the cost of cultivation due to minimum amount of fertilizer requirement, reduces losses and also economizes crop production (Rao *et al.*, 2016). Therefore, the present study was conducted to study effect of foliar application of organic and inorganic nutrients sources on growth, yield and quality of greengram (*Vigna radiata* (L.) Wilczek).

Materials and Methods
The field experiment was conducted at Agricultural Research Station, Anand Agricultural University, Derol, Panchmahal (Gujarat) during *Kharif* season of the year 2018, 2019 and 2020. The soil of the experimental field was loamy sand in texture having low in available nitrogen and medium in available phosphorus and high in potassium with pH 8.2. The experiment was laid out in randomized block design with three replications. Ten treatment comprised *viz.*, Control (No NPK) (T_1), RDF Only (20: 40:00 NPK kg ha^{-1}) (T_2), 50% RDF *fb* 2% DAP at flowering stage (T_3), 50% RDF *fb* 2% Urea phosphate at pre-flowering stage (T_4), 50% RDF *fb* 2% Urea spray at pod formation stage (T_5), 50% RDF *fb* 3% panchagavya at flowering stage (T_6), 50% RDF *fb*3% Cow Urine at pre- flowering stage (T_7), 50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage (T_8), 50% RDF *fb* Sea weed extract 3% foliar spray treatment at pre- flowering stage (T_9) and 50% RDF *fb* Banana pseudo stem 1% spray treatment at pre- flowering stage (T_{10}). The organic and inorganic nutrients were applied by using knapsack sprayer by mixing in 500 litre of water ha^{-1} as per treatments. Greengram cv. GAM 5 was sown manually keeping the distance of 45 cm between two rows in all the three years of experimentation. The plot size was 3.60 x 5.00 m. All the recommended package of practices was adopted to raise the crop. The recommended dose of NPK was applied in the entire plot escape control plot.

Plant protection measures were followed as per general recommendations. The data on plant stand, plant height, number of pods plant^{-1}, number of branches plant^{-1}, number of root nodules plant^{-1}, number of seeds pod^{-1} and test weight (g) were measured. The seed and haulm yield was recorded from the net plot prevailing market price on the basis of pooled yield data and benefit cost ratio were calculated.

Results and Discussion

Effect of Growth, yield and quality attributes

Plant stand at 15 DAS and harvest was not affected significantly by foliar application of organic and inorganic nutrients sources (Table 1). Plant height was recorded significantly higher at 30 DAS (47.4 cm), 60 DAS (68.1 cm) and harvest (73.2 cm) under application of 50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage. Plant height at harvest significantly superior recorded in treatment T_8 but it was remained at par with treatment T_7 (Table 1). Among different foliar spray of organic and inorganic nutrients sources, more number of branches (3.9 branches plant^{-1}) was noticed under application of 50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage as well as in 50% RDF *fb* 3% Cow Urine at pre- flowering stage but it was at par with T_3, T_4, T_5, T_6 and T_9 (Table 1). Further, Significantly maximum number of pods plant^{-1} (25.4 pods plant^{-1}) was recorded under application of 50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage as compared rest of the treatments (Table 1).

The number of seeds pod^{-1} at harvest was recorded significantly higher (12.2 seeds pod^{-1}) under application of 50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage and it was remained at par with T_7 (Table 1). Sgnificantly higher test weight (46.7 g) recorded under foliar application of 50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage and it was at par with T_6 and T_7 (Table 1). Protein content not affected significantly by different foliar application of organic and inorganic nutrients sources. Sutar *et al.,* (2019) [13] reported that application of RDF + Vermiwash @ 10% foliar Spray at pod formation stage and at harvest stage in soybean significantly increased the number of pod plant^{-1}, Straw and Grain yield. Yassen *et al.,* (2020) [16] also reported that effect of vermicompost fertilizer and foliar spray of vermiwash (50-100 and 150 ml L^{-1}) in combination to improve vegetative growth like as A plant height, number of leaves, leaf area, fresh and dry weight of leaves and head, head diameter and total yield ton fed $^{-1}$ and yield of lettuce plants.

Seed and haulm yield

Seed and haulm yield of the crop was distinctly influenced by the foliar application of organic and inorganic nutrients sources. Higher seed yield (1147 kg ha^{-1}) was recorded under application of 50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage as compared to rest of the all treatment. Whereas, significantly maximum haulm yield (1441 kg ha^{-1}) was recorded under 50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage but it was remained at par with T_7 (Table 1). Selvarani *et al.,* (2021) [9] reported the application of organic foliar spray 5% vermiwash significantly increased the vegetative growth and higher yield per unit area in cluster bean crop. Similarly, Sundararasu, and Jeyasankar (2014) [12] revealed that vermiwash spray enhanced the growth and yield parameters in brinjal. Present finding also conformity with Ansari (2008) [2], Hatti *et al.,* (2010) [5], Gajjela and Chatterjee (2019) [4] and Sonali Rajasooriya and Karunarathna (2020) [11]. Yadav *et al*., (2017) [15] also reported that application of vermiwash 10 per cent increase the number of pods plant^{-1}, seed yield and haulm yield.

Economics

The economic analysis of the different foliar application of organic and inorganic nutrients sources for the Balckgram indicated that application of 50% RDF *fb*3% Cow Urine at pre- flowering stage recorded highest BCR of 2.95 along with net return (Rs. 49508 ha^{-1}) and was closely followed by application of 50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage with BCR of 2.74 and maximum net return of Rs.52771 ha^{-1} (Table 2). The results confirm the findings of Verma *et al.,* (2018) [14].

Table 1: Growth yield and quality attributes of green gram as influenced by foliar application of organic and inorganic nutrient source (Mean of three years)

Sr. No.	Treatment	Plant stand (No. m^{-1} row length)		Plant height (cm) at harvest			No. of branches plant^{-1}	No. of pods plant^{-1}	No. of seeds pod^{-1}	Test weight (g)	Protein content (%)	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
		15 DAS	At harvest	30 DAS	60 DAS	At harvest							
T_1	Control (No NPK)	11.5	10.3	38.7	57.4	64.3	3.1	16.1	9.8	38.9	17.6	729	930
T_2	RDF Only (20: 40:00 NPK kg ha$^{-1)}$	11.3	10.5	43.2	60.3	69.3	3.5	18.2	10.6	41.4	16.9	880	1078
T_3	50% RDF *fb* 2% DAP at flowering stage	11.7	10.4	44.3	59.9	66.8	3.6	19.8	11.1	42.1	17.7	932	1177
T_4	50% RDF *fb* 2% Urea phosphate at pre-flowering stage	11.4	10.7	44.5	61.2	68.8	3.7	19.4	11.1	41.0	17.1	885	1131
T_5	50% RDF *fb* 2% Urea spray at pod formation stage	11.7	10.1	41.7	59.4	67.4	3.8	21.2	11.0	42.8	18.6	980	1189
T_6	50% RDF *fb* 3% panchagavya at flowering stage	11.8	10.4	44.4	63.3	69.2	3.6	21.4	11.4	43.5	17.4	981	1224
T_7	50% RDF *fb*3% Cow Urine at pre- flowering stage	12.1	10.7	45.4	65.9	70.5	3.9	22.5	12.0	45.9	19.3	1032	1302
T_8	50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage	12.0	10.9	47.4	68.1	73.2	3.9	25.4	12.2	46.7	19.5	1147	1441
T_9	50% RDF *fb* Sea weed extract@3% foliar spray treatment at pre- flowering stage	11.8	10.2	44.3	63.4	69.3	3.7	19.7	11.2	41.4	18.4	888	1138
T_{10}	50% RDF *fb* Banana pseudo stem @1% spray treatment at pre- flowering stage	11.6	10.3	43.2	63.8	69.4	3.6	19.6	11.0	41.6	19.0	890	1142
S. Em. ±		0.22	0.18	0.85	1.17	1.27	0.12	0.85	0.21	1.30	0.62	40.6	49.31
C.D. at 0.05		NS	NS	2.40	3.30	3.59	0.35	2.53	0.60	3.80	NS	114.6	139.18
Y x T		0.41	0.34	1.63	1.98	2.17	0.12	1.09	0.37	1.30	--	65.05	79.45

C.D. 0.05	NS	NS	NS	NS	NS	0.35	3.09	NS	NS	--	NS	NS
CV%	6.11	5.65	6.46	5.51	5.45	5.89	9.30	5.73	5.47	5.92	12.06	11.71

Table 2: Yield and economics of blackgram as influenced by foliar application of organic and inorganic nutrient source (Mean of three years)

Sr. No.	Treatment	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Gross return (₹ ha^{-1})	Cost of treatment (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C
T_1	Control (No NPK)	729	930	52890	-	23339	29551	2.27
T_2	RDF Only (20: 40:00 NPK kg ha-1)	880	1078	63756	2324	25663	38093	2.48
T_3	50% RDF *fb* 2% DAP at flowering stage	932	1177	67594	2096	25435	42159	2.66
T_4	50% RDF *fb* 2% Urea phosphate at pre- flowering stage	885	1131	64212	2366	25705	38507	2.50
T_5	50% RDF *fb* 2% Urea spray at pod formation stage	980	1189	70978	1918	25257	45721	2.81
T_6	50% RDF *fb* 3% panchagavya at flowering stage	981	1224	71118	2753	26092	45026	2.73
T_7	50% RDF *fb* 3% Cow Urine at pre- flowering stage	1032	1302	74844	1997	25336	49508	2.95
T_8	50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage	1147	1441	83172	7062	30401	52771	2.74
T_9	50% RDF *fb* Sea weed extract@3% foliar spray treatment at pre- flowering stage	888	1138	64436	12662	36001	28435	1.79
T_{10}	50% RDF *fb* Banana pseudo stem @1% spray treatment at pre-flowering stage	890	1142	64584	2447	25786	38798	2.50
Price of Produce	Greengram seed = 70 kg^{-1} (MSP- 2019-20) and haulm `.2.0 kg^{-1}							
Cost of inputs	DAP	26 kg^{-1}			Cow urine	10 L^{-1}		
	Urea Phosphate	56 kg^{-1}			Vermiwash	50 L^{-1}		
	Urea	6.22 kg^{-1}			Sea weed extract	800 L^{-1}		
	Panchagavya	66 L^{-1}			Banana pseudo stem	130 L^{-1}		

Conclusion

From the above result it can be concluded that application of organic and inorganic nutrients sources for the greengram indicated that application of 50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage enhance the plant height, number of branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, seed yield, haulm yield, net return and BCR of greengram.

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