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Effect of foliar application of organic and inorganic nutrients sources on growth, yield attributes, yield and quality of blackgram (*Vigna mungo* (L.) Hepper)

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Abstract
A Field experiment was conducted on loamy sand soil during *Kharif* seasons of 2018, 2019 and 2020 on study "effect of foliar application of organic and inorganic nutrients sources on growth, yield attributes, yield and quality of blackgram (*Vigna mungo* (L.) Hepper)" at Agricultural Research Station, Anand Agricultural University, Derol, Ta. Kalol, Dist. Panchmahal, (Gujarat). The experiment was laid out in RBD in ten treatments with three replications and lay out plan is given as follow: T_1: Control (No NPK); T_2: RDF Only (20:40:00 kg NPK ha^{-1}); T_3: 50% RDF *fb* 2% DAP at flowering stage; T_4: 50% RDF *fb* 2% urea phosphate at pre- flowering stage; T_5:50% RDF *fb* 2% urea spray at pod formation stage; T_6: 50% RDF *fb* 3% panchagavya at flowering stage; T_7: 50% RDF *fb*3% cow urine at pre- flowering stage; T_8:50% RDF *fb* 10% vermiwash at pre-flowering and pod formation stage; T_9: 50% RDF *fb* sea weed extract@3% foliar spray treatment at pre- flowering stage and T_{10}: 50% RDF *fb* banana pseudo stem @1% spray treatment at pre- flowering stage. Results showed that effect of foliar application of organic and inorganic nutrients sources treatments had significant at 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 blackgram. The maximum value of these parameters was recorded in the treatment T_8: 50% RDF *fb* 10% vermiwash at pre-flowering and pod formation stage followed by treatment T_7: 50% RDF *fb* 3% cow urine at pre-flowering stage.

Keywords: Organic, inorganic, foliar application, blackgram

Introduction
Blackgram (*Vigna mungo* L.) is one of the important pulse crop of *kharif* season. It is also known as urdbean and consumed in the form of "dal". In India, blackgram is cultivated in area of 52.79 lakh hectare with the production of 34.92 lakh tonne and productivity of 662 kg ha^{-1} (Anonymous, 2017-18) [1]. The crop can be grown on all types of soils ranging from sandy loam to heavy clay except the alkaline and saline soil. In Gujarat, blackgram is cultivated in area of 1.36 lakh hectare, while its production is 0.87 lakh tonne and productivity is 636 kg ha^{-1} (Anonymous, 2017-18) [1]. The productivity of pulse crop in our country, including blackgram is not sufficient enough to meet the domestic demand of the population. Several steps were made to boost the productivity of blackgram (Senthil Kumar *et al.*, 2008) [5]. One among and the easiest way foliar application of organic and inorganic spray for increasing and exploiting genetic potential of the crop (Senthil Kumar *et al.*, 2008) [5]. This is considered as an efficient and economic method of supplementing the nutrient requirement. Application of organic and inorganic spray will also enhance the nutrient availability and in turn increase the productivity. Therefore, the present study was conducted to study effect of foliar application of organic and inorganic nutrients sources on growth, yield attributes, yield and quality of blackgram (*Vigna mungo* (L.) Hepper).

Materials and Methods
The field experiment was carried out on blackgram during *kharif* seasons of year 2018, 2019 and 2020 conducted at Agricultural Research Station, Anand Agricultural University, Derol, Panchmahal (Gujarat). 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.*, T_1: Control (No NPK); T_2: RDF Only (20:40:00 kg NPK ha^{-1}); T_3: 50% RDF *fb* 2% DAP at flowering stage; T_4: 50% RDF *fb* 2% urea phosphate at pre- flowering stage; T_5:50% RDF *fb* 2% urea spray at pod formation stage; T_6: 50% RDF *fb* 3% panchagavya at

flowering stage; T_7: 50% RDF *fb*3% cow urine at pre-flowering stage; T_8:50% RDF *fb* 10% vermiwash at pre-flowering and pod formation stage; T_9: 50% RDF *fb* sea weed extract@3% foliar spray treatment at pre- flowering stage and T_{10}: 50% RDF *fb* banana pseudo stem @1% spray treatment at pre- flowering stage. The organic and inorganic nutrients were applied in knapsack sprayer use and mixing in 500 litre of water ha^{-1} as per treatments for plot size. Blackgram cv. T-9 was sown manually keeping the distance of 45 cm between two rows in three years of experimentation. The plot size was 3.60 m 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 except control plot. Plant protection measures were followed as per general recommendations. The data on plant stand (No. m row length^{-1}), plant height (cm), number of branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, test weight (g) and protein content(%) were measured. The seed and haulm yield (kg ha^{-1}) 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

Growth Parameters, yield attributes, yield and quality

Plant stand at 15 DAS and at 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 (36.6 cm), 60 DAS (50.5 cm) and at harvest (56.8 cm) under application of 50% RDF *fb* 10% vermiwash at pre-flowering and pod formation stage. Plant height at harvest was recorded significantly superior recorded in treatment T_8 but it was remained at par with treatment T_6, T_7, T_2, T_5 and T_3 (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 but it was at par with treatment T_3, T_6 and T_7 (Table 1).

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

Sr. No.	Treatment	Plant stand (No. m row length^{-1})		Plant height (cm)			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)	10.9	10.3	33.3	43.6	51.5	3.1	32.4	4.8	32.0	18.2	575	876
T_2	RDF Only (20: 40:00 NPK kg ha^{-1})	11.6	10.4	34.8	47.5	55.0	3.6	35.4	5.6	34.0	20.4	645	975
T_3	50% RDF *fb* 2% DAP at flowering stage	11.6	10.9	36.2	47.1	54.3	3.7	37.3	5.8	35.0	20.1	702	1003
T_4	50% RDF *fb* 2% Urea phosphate at pre-flowering stage	11.4	10.8	33.5	45.1	51.9	3.5	35.1	5.7	36.0	21.5	648	977
T_5	50% RDF *fb* 2% Urea spray at pod formation stage	11.5	11.0	35.0	45.7	54.5	3.5	38.7	5.9	36.0	21.7	709	1001
T_6	50% RDF *fb* 3% panchagavya at flowering stage	11.1	10.6	34.7	48.3	55.9	3.7	38.5	6.3	37.0	22.9	719	1053
T_7	50% RDF *fb*3% Cow Urine at pre-flowering stage	11.5	10.8	36.1	48.2	55.1	3.7	40.5	6.3	38.0	22.9	735	1138
T_8	50% RDF *fb* 10% Vermiwash at pre-flowering and pod formation stage	11.5	11.2	36.6	50.5	56.8	3.9	42.6	6.4	39.0	23.8	811	1235
T_9	50% RDF *fb* Sea weed extract@3% foliar spray treatment at pre- flowering stage	11.1	10.7	35.4	47.1	52.7	3.6	36.8	5.7	37.0	21.4	663	992
T_{10}	50% RDF *fb* Banana pseudo stem @1% spray treatment at pre- flowering stage	11.3	10.7	35.1	44.5	53.2	3.5	36.9	5.7	36.0	21.8	672	994
S. Em. ±		0.24	0.20	0.62	0.84	1.07	0.07	1.38	0.18	0.60	1.07	23.02	36.48
C.D. at 0.05		NS	NS	1.76	2.37	3.01	0.20	4.09	0.54	1.80	NS	64.97	102.98
Y x T		0.45	0.39	1.19	1.47	1.87	0.12	1.59	0.19	1.10	--	39.73	63.98
C.D. 0.05		NS	NS	NS	NS	NS	NS	4.52	0.55	NS	--	NS	NS
CV%		6.79	6.21	5.89	5.44	6.00	5.81	7.38	5.73	5.32	8.33	10.00	10.80

Further, it was observed that number of pods plant^{-1} (42.6) was recorded maximum under application of 50% RDF *fb* 10% vermiwash at pre-flowering and pod formation stage but it remained at par with treatment T_5, T_6 and T_7 (Table 1). The number of seeds pod^{-1} at harvest was recorded significantly higher (6.4 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 treatment T_5, T_6 and T_7 (Table 1). The lowest seeds pod^{-1} was recorded under control plot (4.8 seeds pod^{-1}). Statistical analysis indicated that treatment T_8 was recorded significantly higher test weight (39.0 g) being at par with treatment T_7 as compared to rest of treatments. It is evident from data furnished in (Table 1) that the protein content in blackgram seed was non significant due to foliar application of organic and inorganic nutrients sources (Table 1). Similar observation reported by Sutar *et al.,* (2019) [8] 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) [11] 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 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 of the crop was distinctly influenced by the foliar application of organic and inorganic nutrients sources. Maximum seed yield (811 kg ha^{-1}) obtained under application of 50% RDF *fb* 10% vermiwash at pre-flowering and pod formation stage as compared to rest of the treatment. Whereas, significantly higher haulm yield (1235 kg ha^{-1}) was recorded under 50% RDF *fb* 10% vermiwash at pre-flowering and pod formation stage but it was at par with treatment T_7 (Table 1). Selvarani *et al.,* (2021) [4] 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) [7] revealed that vermiwash spray enhanced the growth and yield parameters in brinjal. Present finding also conformity with Ansari (2008), Hatti *et al.* (2010), Gajjela and Chatterjee (2019) and Sonali Rajasooriya and Karunarathna (2020). Yadav *et al.* (2017) [2, 3, 6, 10] also reported that application of vermiwash 10% 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 blackgram indicated that application of 50% RDF *fb* 3% cow urine at pre- flowering stage (T_7) recorded highest BCR of 1.83 along with maximum net return (Rs. 19991 ha^{-1}) and closely followed by application of 50% RDF *fb* 10% vermiwash at pre-flowering and pod formation stage (T_8) with net return of Rs.19452 ha^{-1} (Table 2). The results confirm the findings of Verma *et al.* (2018) [9].

Table 2: 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)	575	876	34527	-	22183	12344	1.56
T_2	RDF Only (20: 40:00 NPK kg ha-1)	645	975	38715	2324	24507	14208	1.58
T_3	50% RDF fb 2% DAP at flowering stage	702	1003	42020	2096	24279	17741	1.73
T_4	50% RDF fb 2% Urea phosphate at pre- flowering stage	648	977	38890	2366	24549	14341	1.58
T_5	50% RDF fb 2% Urea spray at pod formation stage	709	1001	42415	1918	24101	18314	1.76
T_6	50% RDF fb 3% panchagavya at flowering stage	719	1053	43089	2753	24936	18153	1.73
T_7	50% RDF fb3% Cow Urine at pre- flowering stage	735	1138	44171	1997	24180	19991	1.83
T_8	50% RDF fb 10% Vermiwash at pre-flowering and pod formation stage	811	1235	48697	7062	29245	19452	1.67
T_9	50% RDF fb Sea weed extract @ 3% foliar spray treatment at pre- flowering stage	663	992	39775	12662	34845	4930	1.14
T_{10}	50% RDF fb Banana pseudo stem @1% spray treatment at pre- flowering stage	672	994	40292	2447	24630	15662	1.64
Price of Produce	Blackgram seed = ₹. 57 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 of three years field experiment, it can be concluded that application of organic and inorganic nutrients sources for the blackgram 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 blackgram.

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