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Impact of Different Nutrient Sources on Growth and Yield Attributes of Black Gram Under Organic Farming

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ABSTRACT

The field experiment was carried out on Black gram cv. GU 3 at Organic Farm, ACH, NAU, Navsari, Gujarat, India during the summer of 2021. The experiment was laid out in Randomized Block Design with a Factorial concept (FRBD) having two factors each having three levels i.e. soil application viz., S_1(100 % RDN through NADEP compost), S_2(Ghan-jivamrut @ 500 kg/ha) and S_3(Ghan-jivamrut @ 500 kg/ha + Jivamrut @ 500 L/ha) and foliar application viz., F_0 (Control), F_1 (Novel organic liquid nutrient @ 1 %) and F_2 (Moringa leaf extract@ 3 %) was given thrice at 15, 30 and 45 DAS. The result revealed that the S_1 treatment recorded significantly the highest plant height at harvest, number of branches per plant, number of pods per plant, and seed yield. For foliar application, the treatment F_2 recorded significantly the highest plant height at 40 DAS and higher number of branches per plant, plant height at 60 DAS and at harvest, number of pods per plant, pod length, number of seeds per pod, seed yield and stover yield but remained at par with F_1 treatment. It can be concluded that the soil application of 100 percent RDN through NADEP compost and foliar application of either 3 percent Moringa leaf extract or 1 percent Novel organic liquid nutrient at 15, 30, and 45 DAS accomplished higher yield and higher net profit.

Keywords: *Black gram, Ghan-jivamrut, Jivamrut, Moringa leaf extract, NADEP compost, Novel organic liquid nutrient, Organic farming, PSB, Rhizobium*

INTRODUCTION

Black gram (*Vigna Mungo* L. Hepper) is the third most important pulse crop grown after chickpeas and pigeon peas in India. It belongs to the family *Fabaceae* and originated from South Asia mainly India. In India, it is commonly known as urd, urad bean, and Masha bean. It is quite a versatile crop grown for seeds, green manure, and forage. Black gram is an all-season crop grown in the *kharif, rabi and zaid* season. It can be grown on all types of soil ranging from sandy loam to heavy clay soil except alkaline and saline soils, with pH ranging from 6.5 to 7.8. Black gram is consumed as whole, split beans and dehusked split beans (dal), fermented alone, fermented in combination with white polished rice, or cooked, steamed, or fried (Ajila and Rao, 2009). Dal in combination with polished white rice is fermented for preparing South Indian cuisine like dosa, idli, *etc.,* and used as non-fermented for preparing papad, baris and cooked dal. Traditionally black gram flour and jaggery are mixed to prepare sweets like ladoo, halwa and imarti which are considered healthy food in India (Senthil *et al.,* 2006). Due to growing awareness of health and environment-related issues in agriculture organic farming is gaining a gradual momentum across the world. Organic farming prioritizes natural methods to cultivate crops and raise livestock, emphasizing soil health, biodiversity and ecological balance. It avoids synthetic pesticides, fertilizers and genetically modified organisms. By promoting sustainability and environmental stewardship, organic farming aims to produce nutritious food while minimizing harm to the ecosystem and supporting local communities. Due to this, the trends of increasing consumer demand for organics are becoming discernible; sustainability of the crops has become the prime concern in agricultural development (Reddy, 2019). Black gram being a legume crop can fix atmospheric nitrogen in the soil for this reason they can perform better under organic farming. Different organic nutrients *viz*., NADEP compost, jivamrit, ghan-jivamrit, NOVEL organic nutrient, *Moringa* leaf extract, *etc*. can be used under organic farming to increase the yield of the crop.

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MATERIALS AND METHODS

The present investigation was carried out at a certified Organic Farm (Fig 1), ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat, India during the summer season of 2021, in Plot No. F-17, which is geographically situated at the coastal region of South Gujarat at 20º57 N latitude and 72º54 E longitude with an altitude of 10 m above the mean sea level. The weather conditions during the growing season were normal and favorable for crop growth. The experiment was laid out in Randomized Block Design with a Factorial concept which included two factors *i.e.* soil application and foliar application, each having three levels and replicated three times. The total nine combinations of treatments were made from Factor I: Soil application (S) (S_1:100 % RDN through NADEP compost, S_2 :Ghan-jivamrut @ 500 kg/ha and

S_3: Ghan-jivamrut @ 500 kg/ha + Jivamrut @ 500 L/ha) and Factor II: Foliar application (F) (F_0: Control, F_1: Novel organic liquid nutrient @ 1 % and F_2: *Moringa* leaf extract@ 3 %). Here, the soil application of organic sources *viz*., NADEP compost and Ghan-jivamrut was done before sowing and a single application of jivamrut was given at the time of first irrigation as per the treatments. However, the foliar applications of liquid organic nutrients were applied at 15, 30 and 45 DAS as per the treatment. Before sowing the seeds were inoculated with *Rhizobium* and PSB each @ 10 ml/kg seed for all the treatments. The five plants were taken as samples from each plot and their growth and yield attributes were noted. While the harvest index was calculated using the formula (Donald, 1963):

$$\text{Harvest Index (\%)} = \frac{\text{Economic yield (kg/ha)}}{\text{Biological yield (kg/ha)}} \times 100$$

Fig. 1: General view of experimental plot

RESULTS AND DISCUSSION

Growth Attributes

The result about plant population (Table 1) noted at 15 DAS and at harvest indicated that there was no significant difference noticed due to soil and foliar application of different organic nutrient sources as well as their interaction effect also failed to show a significant difference in the plant population. So, it can be concluded from the results that the plant population did not influence the growth parameters, yield attributes and yield as statistically no variation was observed in the plant population recorded at 15 DAS and at harvest.

A successive increase was noticed in plant height (Table 1) recorded at different stages of plant growth. The plant height recorded at 20 DAS did not show any significant variation, but the plant height recorded at 40, 60 DAS and at harvest showed significant differences due to the influence of soil application of organic sources. The treatment recorded significantly higher plant height *i.e.* 31.28 cm which was found at par with S_3treatment measuring 30.62 cm plant height at 40 DAS. At 60 DAS, the S_3 treatment recorded significantly higher plant height (40.01 cm) which was statistically similar to the S_1 treatment *i.e.* 39.94 cm. While at harvest significantly the highest plant height was noted for the S_1 treatment *i.e*. 52.97 cm. The foliar application of liquid nutrient sources influenced the plant height significantly and variation was observed at 40, and 60 DAS and harvest in plant height except for plant height recorded at 20 DAS. The result revealed that the F_2 treatment significantly recorded the highest plant height 32.79 cm at 40 DAS. The F_2 treatment also recorded significantly higher plant height (40.40 cm and 54.30 cm) but it remained at par with the F_1 treatment (39.80 cm and 51.89 cm) for plant height recorded at 60 DAS and at harvest, respectively. The interaction effect between soil and foliar application of various organic sources did not show any difference in the plant height recorded at 20, 40 and 60 DAS and at harvest as the results were found statistically non-significant. The higher plant height was obtained in *Moringa* leaf extract spray because it contains zeatin a natural cytokinin that helps in promoting cell division and cell elongation and also stimulates the growing cell tissues. The results obtained were by previous experiment carried out by Chaudhari (2013) in green gram, Rathva (2013) in pigeon pea, Abohassan and Abusuwar (2017) in green gram, Gunasekar *et al.* (2018) in black gram, Nivethadevi *et al.* (2021) in black gram and Irshad *et al*. (2022) in chickpea.

The result obtained for the number of branches per plant (Table 1) was found statistically significant and it was revealed that the treatment S_1 resulted in the significantly the highest number of branches per plant *i.e*. 6.17 at the time of harvest. The prevailing data showed that foliar application of liquid organic nutrient sources influenced the number of branches per plant recorded at harvest and gave significant results. The F_2 treatment recorded a significantly higher number of branches per plant (6.00) which was statistically similar to the F_1 treatment *i.e.* 5.89.The cytokinin present in the *Moringa* leaf extract helps to reduce plastochron increases cell division and enhances vegetative growth resulting in a higher number of branches per plant. The number of branches per plant was not significantly inferred due to the interaction effect of soil and foliar application of various organic nutrient sources and the result obtained was statistically non-significant. The findings of this experiment are in agreement with those reported by Rathva (2013) in pigeon peas, Gunasekar *et al.* (2018) in black gram, Nivethadevi *et al.* (2021) in black gram, and Irshad *et al.* (2022).

It was observed that the number of nodules per plant observed at 45 DAS was more than that observed at 30 DAS (Fig 2).The soil application as well as the foliar application of different organic nutrient sources failed to influence the number of nodules per plant and dry weight of nodules per plant so at 30 and 45 DAS. Numerically the highest numbers of nodules per plant were recorded with S_1 treatment *i.e*. 19.89 and 35.67 at 30 and 45 days after sowing, respectively. While, for foliar application, the numerically highest number of nodules per plant was recorded with F_1 treatment (20) and F_2 treatment (34.78) at 30 and 45 DAS, respectively. Numerically the S_1 (100 % RDN through NADEP compost) treatment recorded the highest 7.53 mg and 13.30 mg of dry weight of nodules at 30 and 45 DAS, respectively. From the foliar application, the highest dry weight of nodules per plant was recorded for the F_1 treatment *i.e.* 7.53 mg and 13.06 mg at 30 DAS and 45 DAS, respectively. The result obtained due to the interaction effect of soil and foliar application was statistically non-significant for the number of nodules per plant and dry weight of nodules per plant (mg) at 30 and 45 DAS. The results of this experiment were closely related to the findings of Khatkar *et al.* (2007) and Irshad *et al*. (2022) in chickpeas.

Table 1: Effect of different organic nutrient sources on growth attributes of Black gram

Tr. No.	Plant population (ha)		Plant height (cm)				No. of branches per plant (At harvest)
	15 DAS	At harvest	20 DAS	40 DAS	60 DAS	At harvest	
Factor I : Soil application (S)							
S_1	146825	143889	10.79	31.28	39.94	52.97	6.17
S_2	145063	143302	9.51	28.77	35.48	48.67	5.50
S_3	145651	144476	10.10	30.62	40.01	49.48	5.56
SEm ±	1356	1468	0.34	0.62	1.26	0.98	0.16
CD at 5 %	NS	NS	NS	1.85	3.77	2.95	0.49
Factor II : Foliar application (F)							
F_0	143889	142714	9.84	27.29	35.23	44.94	5.33
F_1	146825	145063	10.24	30.58	39.80	51.89	5.89
F_2	146825	143889	10.31	32.79	40.40	54.30	6.00
SEm ±	1356	1468	0.34	0.62	1.26	0.98	0.16
CD at 5 %	NS	NS	NS	1.85	3.77	2.95	0.49
Interaction							
S x F	NS	NS	NS	NS	NS	NS	NS
CV %	2.79	3.06	9.98	6.12	9.80	5.86	8.57

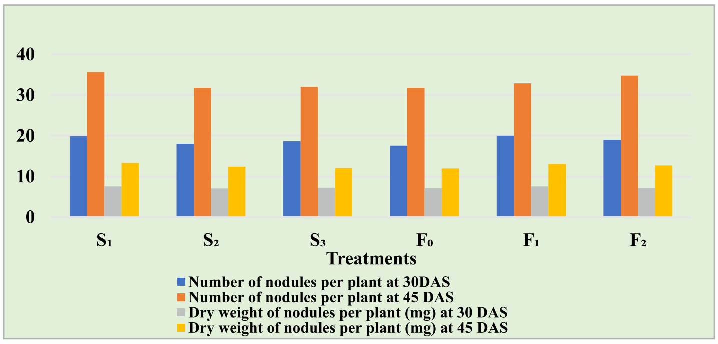

Figure 2: Effect of different treatments on the number of nodules and dry weight of nodules per plant (mg) of black gram

Yield Attributes

The result obtained for the influence exerted by the soil application and foliar application of the organic sources on the number of pods per plant was found to be statistically significant (Table 2). The highest numbers of pods per plant *i.e.* 37.16 were obtained during the application of 100 percent RDN through NADEP compost. While the S_2 treatment recorded the lowest number of pods per plant *i.e.* 28.88.The F_2 treatment of foliar spray recorded a significantly higher number of pods per plant *i.e.* 36.74 but it remained at par with F_1 treatment *i.e.* 34.99 pods per plant. The reason for the higher number of pods per plant due to foliar application of MLE is that it helps to improve crop performance by enhancing water status, membrane stability, enzyme system, and growth of the plant. The interaction between soil and foliar application of organic sources did not statistically influence the number of pods per plant recorded at harvest. The findings of this experiment were similar to the results recorded by Chaudhari (2013) on the green gram, Rathva (2013) on pigeon pea, Abohassan, and Abusuwar (2017) on the green gram, Gunasekar *et al*. (2018) on the black gram, Nivethadevi *et al.* (2021) in black gram and Irshad *et al*. (2022) in chickpea.

The pod length was not significantly influenced by the soil application and foliar application of the various organic nutrient sources and the result obtained was non-significant (Table 2). Numerically the maximum pod length of 4.88 cm was recorded for the S_1 treatment followed by the S_3 treatment (4.74 cm) and then the S_2 treatment (4.58 cm).

A significantly higher pod length of 4.90 cm was recorded for the F_2 treatment and it was found statistically similar with F_1 treatment which recorded a pod length of 4.68 cm. The interaction effect between the soil and foliar application did not show any significant difference in pod length noted at harvest. The reported results of the present investigation were closely related to the findings of Rathva (2013) in pigeon peas, Gunasekar *et al.* (2018) in black gram and Nivethadevi *et al.* (2021) in black gram.

The result of soil application of organic sources failed to influence the number of seeds per pod (Table 2). The number of seeds per pod ranged from 6-7 seeds per pod. While the foliar application of various organic nutrient sources significantly influenced seed per pod. A significantly higher number of seeds per pod (6.67) was obtained with the F_2 treatment and was found statistically similar to the F_1 (6.26) treatment. The number of seeds per pod was not affected due to the interaction between the soil and foliar application of various organic sources and was found non-significant. The present findings are similar to the results reported by Gunasekar (2018) in black gram and Nivethadevi *et al.* (2021) in black gram.

The result revealed that the data obtained for test weight was found to be non-significant as soil application, as well as foliar application of organic sources, did not have much impact on it (Table 2). Numerically the highest test weight was recorded for S_2 (Ghan-jivamrut @ 500 kg/ha) treatment *i.e.* 51.63 g followed by treatment *i.e.* 50.47 g and then S_3 treatment with the lowest 49.41 g and for foliar application the highest weight was obtained in (51.25 g) F_2 treatment followed by the control treatment (50.64 g).The interaction effect of soil and foliar application of different nutrient sources failed to show any significant variation in the test weight recorded at harvest.

Seed Yield

An appraisal of seed yield data indicated that soil application of organic nutrient sources and foliar spray of liquid organic sources significantly influenced the seed yield and showed a positive impact on it (Table 2). The result revealed that the application of 100 percent RDN through NADEP compost significantly recorded the highest seed yield *i.e.* 1041 kg/ha. While the S_2 treatment where 500 kg/ha Ghan-jivamrut was applied recorded the lowest yield of 836 kg/ha. The F_2 treatment resulted in a significantly higher seed yield (1051 kg/ha) and was statistically similar to the F_1 treatment (937 kg/ha). While the F_0 treatment where no foliar application was given recorded the lowest seed yield *i.e.* 805 kg/ha. The reason for the higher seed yield due to *Moringa* leaf extract may be that it increases the loading and unloading of assimilates across membrane boundaries of the vascular tissues leading to an increase in yield. Cytokinins present in MLE also promote carbohydrate metabolism and create new source-sink relationships leading to increased yield of crop. The influence of the interaction effect of soil and foliar application on the seed yield was found to be statistically non-significant. No variation in seed yield was observed due interaction effect. The previous experiment results noted by Chaudhari (2013) in green gram and Rathva (2013) in pigeon peas, Abohassan and Abusuwar (2017) in green gram, Gunasekar *et al.* (2018), Nivethadevi *et al.* (2021) in black gram and Irshad *et al.* (2022) in chickpea were found to be closely related with the findings of present research work.

Stover Yield

From the result obtained it was concluded that the stover yield (Table 2) was significantly influenced by the soil application and foliar application of the organic nutrient sources. The S_1 treatment recorded a significantly higher stover yield of 2696 kg/ha and it remained at par with the S_3 treatment which recorded a 2536 kg/ha stover yield. The result revealed that the foliar application of *Moringa* leaf extract @ 3 percent *viz*., F_2 treatment recorded a significantly higher stover yield of 2725 kg/ha but was statistically similar with F_1 treatment and it recorded 2446 kg/ha stover yield. The F_0 treatment where no spray was given recorded the lowest 2228 kg/ha stover yield. The statistically non-significant result was obtained for the stover yield due to the interaction effect between the soil and foliar application of various nutrient organic sources. The results of the present study conform with the previously reported findings of Chaudhari (2013) in green gram Rathva (2013) in pigeon pea, Gunasekar *et al.* (2018) in black gram, Nivethadevi *et al.* (2021) in black gram and Irshad *et al*. (2022) in chickpea.

Harvest Index

The result indicated that the harvest index (Table 2) did not significantly differ due to the influence of soil application and foliar application of the various organic nutrient sources. Numerically, the S_1 treatment recorded the highest harvest index followed by S_2 and S_3 treatments *i.e*. 28.24 %, 27.82 % and 26.49 %, respectively. In foliar application, the F_1 treatment recorded numerically the highest harvest index of 27.98 percent in comparison to the F_2 treatment and F_0 treatment which recorded 27.83 percent and 26.75 percent harvest index, respectively. The harvest index was not significantly inferred due to the interaction between the soil and foliar application of the various organic nutrient sources and the result obtained was statistically non-significant.

CONCLUSION

Based on the results obtained from the present study, it can be concluded that higher yield, net profit and to maintain soil fertility for the summer black gram *cv*. GU 3 was accomplished with soil application of 100 percent RDN through NADEP compost and foliar application of either 3 percent *Moringa* leaf extract or 1 percent Novel organic liquid nutrient at 15, 30, and 45 days after sowing under organic farming.

Table 2: Effect of different organic nutrient sources on yield attributes and yield of Black gram cv. GU 3

Tr. No.	Number of pods per plant	Pod length (cm)	Number of seeds per pod	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
Factor I : Soil application (S)							
S_1	37.16	4.88	6.33	50.47	1041	2696	28.24
S_2	28.88	4.58	6.37	51.63	836	2166	27.82
S_3	32.92	4.74	6.30	49.41	917	2536	26.49
SEm ±	1.28	0.08	0.16	0.91	40	123	1.17
CD at 5 %	3.85	NS	NS	NS	120	379	NS
Factor II : Foliar application (F)							
F_0	27.22	4.62	6.07	50.64	805	2228	26.75
F_1	34.99	4.68	6.26	51.25	937	2446	27.98
F_2	36.74	4.90	6.67	49.62	1051	2725	27.83
SEm ±	1.28	0.08	0.16	0.91	40	126	1.17
CD at 5 %	3.85	0.24	0.47	NS	120	379	NS
Interaction							
S x F	NS	NS	NS	NS	NS	NS	NS
CV %	11.67	5.00	7.37	5.42	12.89	15.36	12.74

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