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Krutika Subodh Patel
Department of Agronomy, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

PK Dubey
Department of Natural Resource Management, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat, India

AR Kaswala
Department of Natural Resource Management, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat, India

AP Italiya
Soil and Water Management Research Unit, Navsari Agricultural University, Navsari, Gujarat, India

Neethu TM
Department of Soil Science and Agricultural Chemistry, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Corresponding Author:
Krutika Subodh Patel
Department of Agronomy, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Economic feasibility of black gram [*Vigna mungo* (L.) Hepper] under organic farming

Krutika Subodh Patel, PK Dubey, AR Kaswala, AP Italiya and Neethu TM

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Abstract
An experiment was conducted to find out the economic feasibility of Black gram under organic farming at Organic Farm, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat in summer season of the year 2021. The experimental design used was Randomized Block Design with two factors *i. e.*, three levels of each Soil application (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 (F_0: Control, F_1: Novel organic liquid nutrient @ 1 percent and F_2: *Moringa* leaf extract@ 3 percent). From the total nine treatments, the S_1 treatment resulted in significantly the highest seed yield and maximum net return and BCR. While from foliar application the F_2treatment recorded significantly higher seed yield and stover yield which was at par with F_1 treatment. The F_2 treatment also recorded the highest net return and BCR. The findings of the study conclude that, in order to achieve higher productivity and profitability 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 in summer black gram cv. GU 3 can be carried out, as these treatments are economically feasible under organic farming.

Keywords: Black gram, economics, Ghan-Jivamrut, jivamrut, *Moringa* leaf extract, NADEP compost, novel organic liquid nutrient, organic farming, yield

Introduction
In a world where environmental problems are becoming increasingly acute and health concerns are coming to the fore, organic farming is no longer just a trend but the indispensable future of agriculture. Organic farming is not just a production method, but a philosophy of sustainability that minimizes the use of synthetic fertilizers, pesticides, and growth regulators, relying instead on natural processes. This approach is not only about growing food, but also about actively engaging with nature, focusing on biodiversity conservation and environmental sustainability (Anon., 2023) [3]. It also helps to reduce the use of high cost chemical fertilizers. In pulse crop where low inorganic fertilizers are needed, these low rate can be easily replaced by organic sources. Black gram (*Vigna mungo* L. Hepper) one of the most important short duration pulse crop grown in India. It can be used for seed, green manure as well as fodder purpose (Ajila and Rao, 2009) [2]. It has high protein contain nearly about 26% (Selvakumar *et al.*, 2012) [17]. Being pulse crop it has ability to fix atmospheric nitrogen in soil which reduces use of high cost inorganic fertilizers (Zahran, 1999) [18]. NADEP compost is one of the most effective and beneficial method of biological recycling by which waste is converted into organic manure. The Reduces the cost of cultivation as all the materials are easily available on-field (Kumawat *et al*., 2017) [12]. A good alternative can be the cow based organic nutrient sources like jivamrut, bijamrut, Panchagavya, Ghan-jivamriit, etc. which helps to enhance microbial activity of soil which improves its fertility. It is eco-friendly and helps to yield good quality produce (Kaur, 2020) [11]. To lower the burden of chemical fertilizers, the *Moringa* leaf extract would be better option. It acts as a cost effective bio-stimulants that enhance several physiological processes and stimulate the growth and development of crops by increasing nutrient use efficiency and reducing fertilizers without affecting the quality and crop yield (Bulgari *et al.*, 2015) [5]. Fresh *Moringa oleifera* leaves have been shown to have zeatin, a cytokinin related hormone (Fuglie,

2000) [7] as well as organic environmentally compatible materials (Karthiga *et al*., 2022) [10]. Nowadays, Enriched banana pseudo stem sap is proving itself as a remedy for the harmful effect caused due to inorganic farming. The liquid obtained from banana pseudo-stem while separating fiber is called as sap from which enriched banana pseudo-stem sap is prepared. A patent product "NOVEL- Liquid Organic Nutrient" has been developed by the Banana Pseudo-stem Processing Unit, Navsari Agricultural University, Navsari, Gujarat. The foliar spray of this saphelps to promote crop growth, protect crop from harmful pest and enhances crop yield. The banana pseudo-stem contained macro elements in the range of 1 - 1.12 percent N, 0.50 - 0.71 percent P, 2.39 to 20.2 percent K and micro-nutrients also (Salunke, 2010) [16]. The use of these cost effective nutrient sources in crop production would be a boom to future agriculture and to overcome the above problems organic farming may be a better strategy for promoting the environmental and socio-economic sustainability of agrarian life than conventional farming (Reganold, 2012; Avasthe *et al*., 2013) [15, 4].

Materials and Methods

The field investigation was undertaken during summer season of the year 2021 at Organic Farm, ASPEE College of Horticulture, Navsari Agricultural University, Navsari under South Gujarat heavy rainfall zone. The experiment was laid out in Randomized Block Design with Factorial concept (FRBD) and replicated thrice. There were two factors each having three levels the first factor *viz*., soil application (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 second factor was foliar application(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), So total of nine treatments were there. The soil of experimental field was clayey in texture, fertility level was high for OC and available K_2O, although available N and P_2O_5 was found in medium range. The weather condition during the experimental period favored growth and development of black gram.

Results and Discussion

Seed yield: The significant result was obtained for the seed yield as the effect of soil application of organic nutrient sources showed positive impact on it. 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_2treatment where 500 kg/ha Ghan-jivamrut was applied recorded the lowest seed yield of 836 kg/ha.An appraisal of seed yield data indicated that foliar spray of liquid organic sources significantly influenced the seed yield as much variation was observed. The foliar spray of 3 percent *Moringa* leaf extract (F_2 treatment) resulted in significantly higher seed yield (1051 kg/ha) and was statistically similar with foliar spray of 1 percent Novel organic liquid nutrient (F_1 treatment) which recorded 937 kg/ha seed yield. While the F_0 treatment as control where no foliar application was given recorded the lowest seed yield *i. e.* 805 kg/ha (Fig. 1).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 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 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) [6] in green gram and Rathva (2013) [14] in pigeon pea, Abohassan and Abusuwar (2018) [1] in green gram, Gunasekar *et al.* (2018) [8], Nivethadevi *et al.* (2021) [13] in black gram and Irshad *et al.* (2022) [9] in chickpea were found to be closely related with the findings of present research work.

Stover yield

The stover yield was significantly influenced by the soil application of the organic nutrient sources and the S_1 (100% RDN through NADEP compost) treatment recorded significantly higher stover yield of 2696 kg/ha and it remained at par with S_3 (Ghan-jivamrut @ 500 kg/ha + Jivamrut @ 500 l/ha) treatment which recorded 2536 kg/ha stover yield. The result revealed that the foliar application of *Moringa* leaf extract @ 3 percent *viz*., F_2 treatment recorded significantly higher stover yield of 2725 kg/ha but was statistically similar with F_1 treatment where, Novel organic liquid nutrient @ 1 percent was sprayed and it recorded 2446 kg/ha stover yield. The F_0 treatment, control where no spray was given recorded the lowest 2228 kg/ha stover yield (Fig. 1). 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 present study are in conformity with the previously reported findings of Chaudhari (2013) [6] in green gram and Rathva (2013) [14] in pigeon pea, Gunasekar *et al.* (2018) [8] in black gram, Nivethadevi *et al.* (2021) [13] in black gram and Irshad *et al*. (2022) [9] in chickpea.

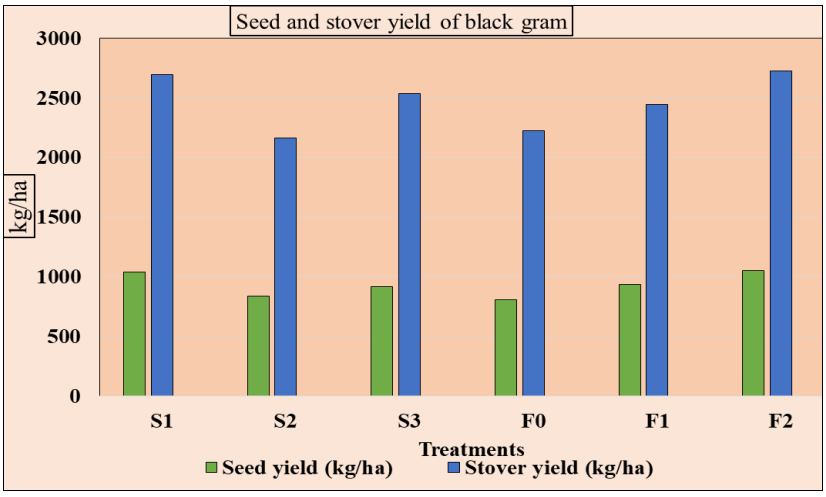

Fig 1: Effect of different treatments of seed and stover yield of black gram

Economics

Based on the prevailing market prices of the inputs and produce, the economics of the different treatments *i. e*., the cost of cultivation, net benefit and BCR was calculated on hectare basis which is depicted in Table 1.The economics analysis of different soil application treatment revealed that the highest gross income (Rs. 88674 /ha) and net return (Rs. 55237 /ha) was noted for the S_1*i. e*.100% RDN through NADEP compost treatment followed by S_3 *i. e*., Ghan-jivamrut @ 500 kg/ha + Jivamrut @ 500 l/ha treatment with gross income of Rs.78430/ha and net return of Rs. 43432 /ha. However, the cost of cultivation was lowest Rs. 33437 /ha for S_1 treatment while it was the highest for the S_3 treatment *i. e*. Rs. 34998 /ha. The result concluded that S_1 treatment was considered best as it recorded maximum Benefit-Cost ratio of 1.65.

The result regarding foliar spray of different liquid organic sources indicated that F_2 *i. e*. *Moringa* leaf extract @ 3 percent treatment as the best because it recorded maximum yield which generated higher gross income of Rs. 89540 /ha and net return of Rs. 54024 /ha. So, it recorded the highest BCR 1.52 among the various treatment. The gross return (Rs. 79842 /ha) and net return (Rs. 43606 /ha) of F_1 *i. e*. Novel organic liquid nutrient @ 1 percent treatment was found better than the control treatment but due to the highest cost of cultivation (Rs. 36236 /ha) it recorded the lowest BCR *i. e.* 1.20 (Table 1).

From the various combination treatments as shown in Table 1 of soil and foliar application of different nutrient organic sources, it was observed that the S_1F_2 combination (100% RDN through NADEP compost + *Moringa* leaf extract @ 3%) resulted in the highest seed yield (1156 kg/ha) and stover yield (2991 kg/ha) with the maximum net return of Rs. 6360/ha and BCR of 1.83 followed by the S_1F_1 (100% RDN through NADEP compost + Novel organic liquid nutrient @ 1%) combination also gave good resulted in terms of seed yield (1086 kg/ha), net return (Rs. 56571 /ha) and BCR (1.59).

Table 1: Effect of different treatments on yield and economics of black gram

Treatments	Seed yield (kg/ha)	Stover yield (kg/ha)	Cost of cultivation (₹/ha)	Gross income (₹/ha)	Net returns (₹/ha)	BCR
Factor I: Soil application (S)						
S_1 - 100% RDN through NADEP compost	1041	2696	33437	88674	55237	1.65
S_2 - Ghan-jivamrut @ 500 kg/ha	836	2166	33998	71169	37171	1.09
S_3 - Ghan-jivamrut @ 500 kg/ha + Jivamrut @ 500 l/ha	917	2536	34998	78430	43432	1.24
Factor II: Foliar application (F)						
F_0 – Control	805	2228	30680	68891	38211	1.25
F_1 - Novel organic liquid nutrient @ 1%	937	2446	36236	79842	43606	1.20
F_2 - *Moringa* leaf extract @ 3%	1051	2725	35516	89540	54024	1.52

*Selling price: Seed = Rs. 80 per kg and Stover = Rs. 2 per kg

Conclusion

The findings of the study conclude that, in order to achieve higher productivity and profitability 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 in summer black gram cv. GU 3 can be carried out, as these treatments are economically feasible under organic farming.

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