Journal of Experimental Agriculture International

Volume 46, Issue 12, Page 507-511, 2024; Article no.JEAI.128659
ISSN: 2457-0591
(Past name: American Journal of Experimental Agriculture, Past ISSN: 2231-0606)

Effect of Organic Sources of Nutrients on Yield and Economics of Black Gram

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jeai/2024/v46i123156

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/128659

Original Research Article

Received: 15/10/2024
Accepted: 20/12/2024
Published: 24/12/2024

ABSTRACT

A research to study the effect of organic sources of nutrients on yield and economics of black gram was conducted at new experimental cum demonstration field, SVIAg, SVVV, Indore. The experimental soil was medium black clay in texture with low in available nitrogen (208.22 kg ha^{-1}), medium in phosphorus (15.12 kg ha^{-1}) and high in potassium (456.58 kg ha^{-1}). The soil organic carbon content, pH, and EC was 0.50 per cent, 7.35, and 0.70 dSm^{-1} respectively. The experiment consists of nine treatments and replicated three times in Randomized Block Design which consists the use of poultry manure, vermicompost and different bio inoculants. The treatments includes T1: Absolute control, T2: Vermicompost manure (2 ton ha^{-1}), T3: Poultry manure (2-ton ha^{-1}), T4: Vermicompost manure (2 ton ha^{-1}) + *Rhizobium*, T5: Vermicompost manure (2 ton ha^{-1}) + PSB, T6: Poultry manure (2 ton ha^{-1}) + *Rhizobium*, T7: Poultry manure (2 ton ha^{-1}) + PSB, T8: Vermicompost manure+ *Rhizobium* + PSB and T9: Poultry manure + *Rhizobium* + PSB. Application of poultry manure + *Rhizobium* + PSB recorded highest yield and yield attributes such as no. of pods plant^{-1} (19.93), pod yield plant^{-1} (8.40 g), seed yield plant^{-1} (5.38 g), seed yield (8.48 q ha^{-1}), straw yield (10.79 q ha^{-1}) and biological yield (17.22 q ha^{-1}) at harvest and was found to be at par with

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Cite as: *Menariya, Ajay, A. A. Kawade, and V. V. Panchal. 2024. "Effect of Organic Sources of Nutrients on Yield and Economics of Black Gram". Journal of Experimental Agriculture International 46 (12):507-11. https://doi.org/10.9734/jeai/2024/v46i123156.*

application of vermicompost + *Rhizobium* + PSB treatments. The highest value of gross monetary returns (₹ 71107.88 ha^{-1}), cost of cultivation (₹ 51780.65 ha^{-1}), net monetary returns (₹ 19327.23 ha^{-1}) and B:C ratio (1.37) was recorded from treatment with the application of poultry manure + *Rhizobium* + PSB followed by treatment receiving vermicompost + *Rhizobium* + PSB treatment.

Keywords: Rhizobium; PSB; vermicompost; poultry manure; black gram.

1. INTRODUCTION

The rapid increase in the world population is a challenge for agricultural experts to supply food for survival as well as to conserve natural resources. To avoid this challenge, we need to conserve natural resources so that natural resources maintain their productivity. India has the first place in pulses area and production in the world but due to its large population, the availability of per capita pulses is not being fulfilled. The per capita need of pulse is 70 g day^{-1}. To meet this deficiency, India needs to increase pulses production. Pulses are given second importance after cereals as they are rich in protein, fibres, vitamins and minerals such as magnesium, iron, zinc and low in fat, making them a great addition to any diet in Indian people which are unable to supply their body protein due to being vegetarian. “Therefore, pulses are an important tool for people to eliminate hunger and nutritional deficiency” (Bahadur & Tiwari, 2014).

Black gram (*Vigna mungo* L.) belongs to the family Leguminosae. India is the origin place of the black gram; it is highly valued pulse crop cultivated since ancient time. India currently represents the largest producer of black gram accounting more than 70 per cent of the global production. India is followed by Myanmar and Pakistan. In the northern part of country black gram is grown in *kharif* or *summer* only while in eastern and southern parts it is grown in *rabi* season and sometime grown as a green manuring crop (Kumar et al., 2020; Thimmisetty Raviteja et al., 2022; Kumar & Patil, 2021). Black gram stands next to soybean in its dietary protein content. MP, UP and AP are the major black gram growing states in India. India produces about 28.4 lakh tonnes of black gram annually from 47.6 lakh hectares of area, with an average productivity of 596 kg ha^{-1} in 2021-22. Black gram area accounts for about 29 per cent of India's total pulse acreage and contributes 10.25 per cent of total pulse production. (Directorate of Economics and Statistics, 2022).

It has perfect integration of all the nutrients that it includes protein (24 %), carbohydrate (60 %), fat (1.3 %), minerals, vitamins and it is 5-10 times richer than other pulses in phosphoric acid (P_2O_5), consumed as peeled and unpeeled form of “daal” with roti and boiled rice or other delicious food items can be prepared like idli, dosa, papad, bara, karhi, pudding, halva and imurthi (sweet) etc, For animal purpose whole black gram plant used as a nutritive fodder.

There are numerous reasons responsible for lower productivity of black gram. Among them, nutrient management is major factor contributing low yields of black gram. “The exact application of fertilizer and manure to the crop should be based on the soil testing, field trials and nutrient balances under the specific soil crop situation. Balance nutrition does not mean only added nutrient from outside but also include that nutrient which are inherently present in the soil” (Joshi et al., 2023).

Different sources of organic nutrients are available like cakes, dry blood and bone, farmyard manure, compost, Organic matters enhanced water infiltration, retention, soil aeration and reduce erosion. Bio-fertilizer is the products containing one or more carrier based living species of micro-organism which are capable to augment plant nutrient supplies in one way or other way. “Integration of manures and biofertilizer proved to be better for attaining higher crop yield as well as maintain the soil health” (Murugan et al., 2011).

2. MATERIALS AND METHODS

The experiment entitled “Effect of organic source of nutrients on yield and economics of black gram (*Vigna mungo* L.)” was carried out at new experimental cum demonstration field, Shri Vaishnav Institute of Agriculture, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore during 2023-24. The topography of experimental field was levelled and well drained. The soil type was medium black clay in texture with low in available nitrogen (208.22 kg ha^{-1}), medium in phosphorus (15.12 kg ha^{-1}) and high in potassium (456.58 kg ha^{-1}). The soil organic carbon content, pH, and EC was 0.50 per cent, 7.35, and 0.70 dSm^{-1} respectively. The experiment consists of nine treatments which were replicated thrice in Randomized Block Design. It included the use of poultry manure, vermicompost and different bio inoculants. The treatments includes T1: Absolute control, T2: Vermicompost manure (2 ton ha^{-1}), T3: Poultry manure (2-ton ha^{-1}), T4: Vermicompost manure (2 ton ha^{-1}) + *Rhizobium*, T5: Vermicompost manure (2 ton ha^{-1}) + PSB, T6: Poultry manure (2 ton ha^{-1}) + *Rhizobium*, T7: Poultry manure (2 ton ha^{-1}) + PSB, T8: Vermicompost manure+ *Rhizobium* + PSB and T9: Poultry manure + *Rhizobium* + PSB. Sowing was done using the dibbling method with a spacing of 30 x 10 cm. plot size: 3 X 4.5 m^2, black gram variety: T9, The field was divided into 27 plots with gross plot size of 3.00 m x 4.50 m each. Organic manures *viz*., vermicompost and poultry manure were analysed for their nutrient content by using standard analytical methods and applied a week before sowing on dry weight basis as per treatments. The seeds of black gram treated with *Rhizobium* and PSB as per the treatment before sowing. The gap filling was carried out as soon as the mortality was notice after sowing to maintain the optimum plant population. Five representative plants were selected randomly from each net plot to monitor periodical growth and development stages of crop. The selected plants were fixed with wooden sticks and labelled with tags. The same plants were harvested separately for recording bio-metric observations. The standard method of analysis of variance was used for analysing the data for Randomized Block Design (Panse and Sukhatme,1985). The f test of significance was used for testing the null hypothesis and appropriate standard error of mean (SE$\pm$) for each treatment effect and where the treatment effect was significant, critical difference (C.D.) at 5 per cent probability level was worked out for testing the significance of treatment differences.

3. RESULTS AND DISCUSSION

3.1 Yield Attributes

Highest values of black gram yield attributes such as number of pods $plant^{-1}$ (19.93), pod yield $plant^{-1}$ (8.40 g), seed yield $plant^{-1}$ (5.38 g) at harvest of crop growth was recorded in treatment plot T9 receiving poultry manure + *Rhizobium* + PSB. However, the values were at par with treatment vermicompost manure + *Rhizobium* + PSB for all the yield attributing characters. Absolute control treatment recorded minimum yield attributes at harvest observations. Significant increase in black gram yield attributes characters may be due to increase in the availability of nitrogen, phosphorous and other essential micro-nutrients through poultry manures and biofertilizer inoculation (*Rhizobium* and PSB) which helped to increased rates of primordial production and other yield attributes characters. Similar results were found by Bhadu et al., (2015), Bhadu K., (2017) and Gummadala et al., (2022).

The values of test weight as influenced by different treatments showed non-significant results.

3.2 Yield

Data presented in Table 2. reveals that the maximum seed yield (8.48 q ha^{-1}), straw yield (13.73 q ha^{-1}) and biological yield (22.22 q ha^{-1}) was recorded in treatment with the application of T9: poultry manure + *Rhizobium* + PSB. However, the values of all the parameters were it at par with treatment with application of vermicompost manure + *Rhizobium* + PSB. Minimum seed yield (3.51 q ha^{-1}), straw yield (8.07 q ha^{-1}) and biological yield (11.98 q ha^{-1}) was recorded in absolute control treatment at harvest.

Table 1. Yield attributes of black gram as influenced by different treatments

Treatments	Number of pods $plant^{-1}$	Pod yield (g) $plant^{-1}$	Seed yield (g) $plant^{-1}$	Test weight (g)
T_1: Absolute control	14.65	5.67	2.63	46.10
T_2: Vermicompost (2 t ha^{-1})	15.74	6.68	3.65	47.83
T_3: Poultry Manure (2 t ha^{-1})	15.87	7.00	3.97	45.60
T_4: Vermicompost + *Rhizobium*	16.93	7.27	4.30	48.57
T_5: Vermicompost + PSB	16.68	7.12	4.28	47.83
T_6: Poultry manure + *Rhizobium*	18.33	7.59	4.57	46.50
T_7: Poultry manure + PSB	17.85	7.51	4.50	48.07
T_8: Vermicompost + *Rhizobium* + PSB	19.02	7.78	4.77	47.00
T_9: Poultry manure + *Rhizobium* + PSB	19.93	8.40	5.38	48.93
S. Em. $\pm$	0.53	0.25	0.27	1.39
CD at 5%	1.59	0.76	0.80	NS
General mean	**17.22**	**7.22**	**4.23**	**47.38**

Table 2. Seed yield (q ha^{-1}), straw yield (q ha^{-1}), biological yield (q ha^{-1}) and harvest index of black gram as influenced by different treatments

Treatments	Yield (q ha^{-1})			
	Seed yield	**Straw yield**	**Biological yield**	**Harvest index (%)**
T_1: Absolute control	3.91	8.07	11.98	29.49
T_2: Vermicompost (2 t ha^{-1})	5.34	8.69	14.03	29.57
T_3: Poultry Manure (2 t ha^{-1})	5.91	9.59	15.50	32.49
T_4: VC + *Rhizobium*	6.30	10.47	16.76	34.14
T_5: VC + PSB	5.94	9.98	15.92	33.69
T_6: PM + *Rhizobium*	7.24	12.09	19.33	34.48
T_7: PM + PSB	7.13	11.55	18.68	34.87
T_8: VC + *Rhizobium* + PSB	7.66	12.92	20.57	36.61
T_9: PM + *Rhizobium* + PSB	8.48	13.73	22.22	36.46
S. Em. $\pm$	0.30	0.36	0.55	1.20
CD at 5%	0.91	1.07	1.64	3.59
General mean	**6.43**	**10.79**	**17.22**	**33.53**

Table 3. Economics of black gram as influenced by different treatments

Treatments	Economics			
	Gross monetary returns (₹ ha^{-1})	**Cost of cultivation (₹ ha^{-1})**	**Net monetary returns (₹ ha^{-1})**	**B: C Ratio**
T_1: Absolute control	23116.93	29452.82	-6335.90	0.78
T_2: Vermicompost (2 t ha^{-1})	33906.65	41292.78	-7386.12	0.82
T_3: Poultry Manure (2 t ha^{-1})	40358.53	46409.76	-6051.23	0.87
T_4: VC + *Rhizobium*	46673.13	43605.52	3067.61	1.07
T_5: VC + PSB	43076.55	42965.43	111.13	1.00
T_6: PM + *Rhizobium*	54168.28	48888.05	5280.24	1.11
T_7: PM + PSB	53125.00	48673.50	4451.50	1.09
T_8: VC + *Rhizobium* + PSB	63420.54	46982.76	16437.79	1.35
T_9: PM + *Rhizobium* + PSB	71107.88	51780.65	19327.23	1.37
S. Em. $\pm$	2618.02		2618.02	
CD at 5%	7848.83		7848.83	
General mean	**47661.49**		**3211.36**	

Significant improvement in growth and yield attributes of black gram due to application of poultry manure, *Rhizobium* and PSB resulted in production of superior growth and yield attributes over control. This helped in storage of more photosynthates and their translocation towards sink and this contributed to increased seed and straw yields. These findings are in accordance with those of Murugan et al., (2011), Bahadur and Tiwari, (2014).

Data presented in Table 2 reveals that the treatment T9 with the application of poultry manure + *Rhizobium* + PSB recorded significantly superior over absolute control, application of poultry manure and vermicompost alone and was at par with rest of the treatments.

3.3 Economic Studies

Data pertaining to economics of black gram as influenced by different treatments is presented in Table 3. The mean gross monetary returns and net monetary returns were ₹ 47661.49 ha^{-1} and ₹ 3211.36 ha^{-1}, respectively.

The highest value of gross monetary returns (₹ 71107.88 ha^{-1}), net monetary returns (₹ 19327.23 ha^{-1}) and B:C ratio (1.37) was recorded from treatment T9 with the application of poultry manure + *Rhizobium* + PSB followed by vermicompost + *Rhizobium* + PSB. These results are in confirmatory to Bhadu, (2017).

4. CONCLUSION

The application of poultry manure + *Rhizobium* + PSB demonstrated comparable outcomes. Consequently, this treatment resulted in higher growth, yield attributes and yield was at par with values those obtained from treatment with application of vermicompost + *Rhizobium* + PSB. Hence, it is advisable to apply organic manure (poultry or vermicompost) along with the seed treatment of *Rhizobium* + PSB for getting maximum yield of black gram.

In the context of using organic manure and bio-inoculants, considering economic factors, it could be said that combine application of poultry manure + *Rhizobium* + PSB or vermicompost + *Rhizobium* + PSB can be used to achieve elevated gross returns, net monetary returns and benefit-cost (B:C) as this treatment are at par with each others.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/128659