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Effect of Different Organic Sources on Growth and Seed Quality Parameters of Black Gram [*Vigna mungo* (L.) Hepper]

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ABSTRACT

Background: Pulses play an important role in Indian agriculture for sustainable production, improvement in soil health and environmental safety. They are a cheaper source of protein to overcome malnutrition among vegetarians due to the presence of a high percentage of quality protein which is nearly three times more than that of cereals. They are more responsive to organic manures but indiscriminate and continuous use of chemical fertilizers has venomous effects on soil physical, chemical and biological properties thereby affecting the sustainability of crop production, besides causing environmental pollution.

Methods: The experiment consists of 12 treatments comprising organic amendments laid out in RCBD (completely randomized block design) with three replications. The black gram variety TAU-1 was sown with a spacing of 45 cm × 10 cm. The recommended dose of phosphorus for black gram was supplemented with different combinations of soil organic manures with equal proportions based on their P content. The required quantity of organic manures *viz*., Farmyard manure, vermicompost, Ghanajeevamrutha were uniformly incorporated into the soil as per the treatment three weeks before sowing. The organic manures to be applied were quantified equivalent to RDF (20 kg N+50 kg P_2O_5+0 kg K_2O ha^{-1}).

Result: The studies showed that application of vermicompost+ghanajeevamrutha based on 100% RDP (Recommended dose of Phosphorus)+*Rhizobium*+PSB (Phosphorus Solubilizing bacteria) recorded significantly higher plant height (87.67 cm), number of branches per plant (6.33), relative chlorophyll content (48.11) and dry matter (2740.00 kg ha^{-1}) with higher concomitant seed quality parameters like seed index (10.25 g) and protein content (22.7%) as compared to others. This study has demonstrated the importance of the usage of organics for improving the growth and seed quality parameters in black gram.

Key words: Blackgram, FYM (Farmyard manure), Ghanajeevamrutha, *Rhizobium*, Seed quality.

INTRODUCTION

Pulses play an important role in Indian agriculture for sustainable production, improvement in soil health and environmental safety. India is the largest producer and consumer of pulses in the world and it is a cheaper source of protein to overcome malnutrition among vegetarians. Pulses are more responsive to organic manures. Pulses contain a high percentage of quality protein which is nearly three times more than that of cereals. Indiscriminate and continuous use of chemical fertilizers has a deleterious effect on soil physical, chemical and biological properties thereby affecting the sustainability of crop production, besides causing environmental pollution. There is a scope to improve the productivity of pulses by enhancing the soil fertility and its productivity through increasing soil organic carbon, soil moisture storage capacity and adopting integrated nutrient management practices. The crop productivity under the organic production system can be enhanced by optimizing the nutrient requirement of the crop at different stages (Yadav *et al.,* 2017).

Blackgram [*Vigna mungo* (L) Hepper] is one of the most important pulse crops in India. It is an excellent source of high-quality protein. In India blackgram is grown in an area of 37.01 lakh ha with a production of 20.81 lakh tonnes and productivity of 459 kg ha^{-1} which is low compared to other pulse crops owing to its cultivation on marginal lands known to be poor in soil fertility (Indiastats, 2020).

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Intensive farming techniques, together with the heavy use of chemical inputs over the last four decades, have led not only to a loss of natural ecosystem balance and soil health but also resulted in many hazards such as soil salinization, soil erosion, reduction in groundwater levels and desertification, pesticide and fertilization contamination, ecological damage, genetic erosion, redness. The soil and climatic conditions in the drylands are well adapted to organic farming. The real potential of organic farming can

be witnessed in rainfed areas where the soil organic matter and organic carbon content are lesser. Low soil fertility is a major constraint in achieving sustainable black gram production and productivity. Continuous usage of chemical inputs will deteriorate soil physical, chemical and biological health (Ferreras *et al.,* 2005).

Ghanajeevamrutha plays an major role in increasing the activity of microbes there by solubilization and uptake of nutrients will enhance (Manjunatha *et al.,* 2009) and it contain several nutrients *viz.* macronutrients like nitrogen, phosphorus, potassium and micronutrients required for the growth and development of plants, various amino acids, vitamins and growth regulators like auxins, gibberellins will influence the necessary growth and development in plants. (Somasundaram *et al*., 2007).

The soil and climatic conditions in the drylands are well adapted to organic farming. The real potential of organic farming can be witnessed in rainfed areas where the soil organic matter and organic carbon content are lesser. Low soil fertility is a major constraint to achieving sustainable black gram production and productivity. Hence, the present investigation was carried out to know the effect of soil organic manures on crop growthand quality aspects of black gram.

MATERIALS AND METHODS

A field experiment was conducted during *Kharif,* 2019 at the IFS (Integrated Farming System) unit, College of Agriculture, Vijayapur, Karnataka, India. The texture of soil at the experimental site was clayey with a pH of about 7.82, an organic carbon of 0.57%. The initial soil analysis showed that the soil has N (262 kg ha^{-1}), P_2O_5 (32.5 kg ha^{-1}) and K_2O (390 kg ha^{-1}).

The experiment consists of 12 treatments comprising organic amendments laid out in RCBD (completely randomized block design) with three replications. The black gram variety TAU-1 was sown with a spacing of 45 cm × 10 cm. The recommended dose of phosphorus for black gram was supplemented with different combinations of soil organic manures with equal proportions based on their P content. The required quantity of organic manures *viz*., Farmyard manure, vermicompost, Ghanajeevamrutha were uniformly incorporated into the soil as per the treatment three weeks before sowing. The organic manures to be applied were quantified equivalent to RDF (20 kg N+50 kg P_2O_5+0 kg K_2O ha^{-1}).

The treatment details are as follows: T_1: Application of FYM+vermicompost based on 100% RDP, T_2: Application of vermicompost+ghanajeevamrutha based on 100 % RDP, T_3: Application of FYM+ghanajeevamrutha based on 100% RDP, T_4: Application of FYM+vermicompost based on 50 % RDP, T_5: Application of vermicompost + ghanajeevamrutha based on 50% RDP, T6: Application of FYM+ghanajeevamrutha based on 50 % RDP, T_7: Application of FYM+vermicompost based on 100% RDP+*Rhizobium*+PSB, T_8: Application of vermicompost+ghanajeevamrutha based on 100% RDP+*Rhizobium*+PSB, T_9: Application of FYM+ghanajeevamrutha based on 100% RDP+*Rhizobium*+PSB, T_{10}: Application of FYM+ vermicompost based on 50% RDP+*Rhizobium*+PSB, T_{11}: Application of vermicompost+ ghanajeevamrutha based on 50% RDP+*Rhizobium*+PSB, T_{12}: Application of FYM+ ghanajeevamrutha based on 50% RDP+*Rhizobium*+PSB.

Ghanajeevamrutha was prepared by using the following ingredients. Initially, 50 kg cow dung was spread on the polythene sheet. Black jaggery of 1 kg was pounded to powder and added to cow dung and mixed well. Horse gram flour (1 kg) was added slowly to the mixture by mixing with hand to avoid the formation of lumps. One and half handful of fertile soil was added to the above mixture and mixed thoroughly until it became homogenous. Then the measured quantity of cow urine (2.5 l) was added to the above mixture and this mixture was allowed to dry under the shade for 6-7 days.

To supply a recommended dose of Phosphorus (50 kg ha^{-1}) to the black gram crop, organic manures *viz.* compost, vermicompost and ghanajeevamrutha were used and the chemical composition of these manures is given in Table 1.

Total phosphorus content from different organic sources was analyzed. The total quantity of organic manures was calculated (16.07 kg, 6.54 kg, 21.65 kg of FYM, vermicompost, ghanajeevamrutha respectively were applied in 100% RDP plot to supply recommended dose of Phosphorus *i.e.,* 50 kg ha^{-1} as 8.03 kg; 3.27 kg and 10.81 kg FYM, vermicompost and ghanajeevamrutha respectively, were applied in 50% RDP plot) based on their respective phosphorus content to meet the recommended dose of P (50 kg ha^{-1}). Further, treatment wise calculated quantities of these organic manures were applied by mixing them homogenously in the respective plots three weeks before sowing.

The height of the plants was measured from the base of the plant up to the tip of the main shoot at harvest. The number of branches, number of trifoliate leaves was also recorded at the time of crop harvest. After harvesting the crop, the plants were collected from each net plot, oven-dried and dry matter yield was recorded in kilograms per

Table 1: The major nutrients content of different organic manures.

Particulars	FYM	Vermicompost	Ghanajeevamrutha	Method employed	References
Total N (%)	0.50	1.00	1.32	Kjeldhal distillation method	Singh *et al.* (1999).
Total P_2O_5 (%)	0.35	0.86	0.26	Vanadomolybdate phosphoric yellow colour method	Singh *et al.* (1999).
Total K_2O (%)	0.50	0.95	0.80	Flame photometer method	Singh *et al.* (1999).

net plot andconverted to kilogram per hectare. The chlorophyll content of green leaves was recorded at 60 DAS by using spectro-radiometer (SPAD-502). The procedure was followed as given by Markwell *et al.* (1995).The seed index was calculated from each net plot and was expressed in gram

Grain samples collected from each treatment were analyzed for nitrogen content using the modified micro Kjeldahl method (Piper, 1966). Then the grain protein content was calculated (treatment wise) by multiplying the nitrogen content (%) in the grains by the factor of 6.25 and was expressed in percentage (%).

The data collected from the experiment on different aspects were subjected to statistical analysis as described for randomized complete block design given by Gomez and Gomez (1984). The level of significance used in the F test was 0.05. A critical difference value was calculated wherever the 'F' tests were found to be significant.

RESULTS AND DISCUSSION

Growth, yield attributes and yield

The combinations of vermicompost+ghanajeevamrutha, FYM+ghanajeevamrutha, FYM+vermicompost based on 100% RDP along with *Rhizobium*+PSB treatments recorded significantly higher growth parameters *i.e.,* plant height (87.67 cm), number of branches per plant (6.33), number of trifoliate leaves per plant (19), relative chlorophyll content (48.11), dry matter (2740 kg ha^{-1}) and among the yield attributes likenumber of pods per plant (19.33), number of seeds per pod (6.33), greater haulm yield (2038.67 kg ha^{-1}) and seed yield (701.33 kg ha^{-1}) compared to all other treatments which were on par with the combinations of vermicompost+ghanajeevamrutha, FYM+ghanajeevamrutha, FYM+vermicompost based on 100% RDP without *Rhizobium* +PSB treatments followed by the combinations of vermicompost+ghanajeevamrutha, FYM+ghanajeevamrutha, FYM+vermicompost based on 50% RDP along with *Rhizobium*+PSB. The lower growth and yield attributes were recorded in the combinations of vermicompost+ ghanajeevamrutha, FYM+ghanajeevamrutha, FYM+ vermicompost based on 50% RDP without *Rhizobium* + PSB (Table 2 and 3).

The increase in growth and quality parameters of black gram by application of organic manures might be due to the prolonged and steady availability of major nutrients during the crop growth period. Inclusion of *Rhizobium* and PSB with nutrient-rich organics *viz.,* vermicompost, ghanajeevamrutha. *Rhizobium* has a pivotal role in the fixation of atmospheric nitrogen which might have enhanced the supply and translocation of N which influences the development of photosynthetic organs (Kumari and Kumari, 2002). Hence, there was better efficiency of chlorophyll during photosynthesis. Inoculation of PSB solubilizes the

Table 2: Effect of organics on plant height (cm), SPAD value (%), no. of pods per plant, no. of seeds per pod, no. of branches, trifoliate leaves in black gram variety TAU-1.

Treatments	Plant height (cm) at harvest	SPAD Value (%)	No. of pods per plant	No. of seeds per pod	No. of branches	Trifoliate leaves
T_1: Application of FYM+vermicompost based on 100% RDP	81.47	42.70	14.67	5.33	4.67	14.00
T_2: Application of vermicompost+ghanajeevamrutha based on 100% RDP	83.33	44.33	15.67	5.67	5.33	16.00
T_3: Application of FYM+ghanajeevamrutha based on 100% RDP	82.03	43.76	15.00	5.33	5.00	15.00
T_4: Application of FYM+vermicompos tbased on 50% RDP	74.70	39.83	7.33	4.67	2.67	8.00
T_5: Application of vermicompost+ghanajeevamrutha based on 50% RDP	75.07	40.90	9.00	5.00	3.33	10.00
T_6: Application of FYM+ghanajeevamrutha based on 50% RDP	74.80	40.23	8.33	4.00	3.00	9.00
T_7: Application of FYM+ vermicompost based on 100% RDP+ *Rhizobium* +PSB	84.60	45.00	17.00	6.00	5.33	17.00
T_8: Application of vermicompost+ghanajeevamrutha	87.67	48.11	19.33	6.67	6.33	19.00
T_9: Application of FYM+ghanajeevamru thabased on 100% RDP+ *Rhizobium*+PSB	85.43	46.67	18.00	6.33	5.67	18.00
T_{10}: Application of FYM+vermicompost based on 100% RDP+ *Rhizobium*+PSB	78.00	41.33	10.33	4.67	3.33	11.00
T_{11}: Application of vermicompost+ghanajeeva mrutha based on 50% RDP+*Rhizobium*+PSB	78.87	42.37	13.00	5.00	4.33	12.67
T_{12}: Application of FYM+ghanajeevamrutha based on 50% RDP+ *Rhizobium*+PSB	80.57	41.50	11.67	5.00	3.67	13.00
SEm±	2.83	1.37	0.61	0.40	0.23	0.47
CD (p=0.05)	8.30	4.03	1.79	1.17	0.69	1.37

Note: FYM- Farm yard manure, RDP- Recommended dose of phosphorus (50 Kg ha^{-1}), PSB- Phosphorus solubilizing bacteria.

Table 3: Effect of organics on dry matter (stover) yield (kg ha^{-1}), seed yield (kg ha^{-1}), Haulm yield (kg ha^{-1}), seed index (g), protein content (%) in black gram variety TAU-1.

Treatments	Dry matter yield (kg ha^{-1})	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Seed index (g)	protein content (%)
T_1: Application of FYM+vermicompost based on 100% RDP)	2317.33	610.00	1707.33	8.00	21.6
T_2: Application of vermicompost+ghanajeevamrutha based on 100% RDP	2441.33	634.00	1807.33	9.08	22.0
T_3: Application of FYM+ghanajeevamrutha based on 100% RDP	2350.00	622.00	1728.00	8.27	21.6
T_4: Application of FYM+vermicompost based on 50% RDP	1792.33	408.33	1390.33	6.17	20.3
T_5: Application of vermicompost+ghanajeevamrutha based on 50% RDP	1923.67	491.33	1432.33	7.10	20.9
T_6: Application of FYM+ghanajeevamrutha based on 50% RDP	1837.00	411.00	1426.00	6.93	20.7
T_7: Application of FYM+vermicompost based on 100% RDP+ *Rhizobium*+PSB	2497.33	659.33	1838.00	9.83	22.0
T_8: Application of vermicompost+ghanajeevamrutha based on 100% RDP+*Rhizobium*+PSB	2740.00	701.33	2038.67	10.25	22.7
T_9: Application of FYM+ghanajeevamrutha based on 100% RDP+ *Rhizobium*+PSB	2570.00	680.00	1890.00	10.03	22.6
T_{10}: Application of FYM+vermicompost based on 50% RDP+ *Rhizobium*+PSB	2017.33	537.00	1480.33	7.16	21.0
T_{11}: Application of vermicompost+ghanajeevamrutha based on 50% RDP+*Rhizobium*+PSB	2224.33	592.67	1631.67	7.67	21.4
T_{12}: Application of FYM+ghanajeevamrutha based on 50% RDP+ *Rhizobium*+PSB	2105.33	573.00	1532.33	7.47	21.2
SEm±	67.66	30.54	60.81	0.34	0.85
CD (p=0.05)	198.44	89.60	178.37	1.01	NS

Note: FYM- Farm yard manure, RDP- Recommended dose of phosphorus (50 Kg ha^{-1}) and PSB- Phosphorus solubilizing bacteria

insoluble P through the production of organic acids and has some augmenting effect on the native *Rhizobium* population besides playing a vital role in nodule formation in black gram (Wagadre *et al.,* 2010).

Black gram quality parameters

The combinations of vermicompost+ghanajeevamrutha, FYM+ghanajeevamrutha, FYM+vermicompost based on 100% RDP along with *Rhizobium*+PSB treatments recorded higher quality parameters *i.e.,* seed index (10.25%) and protein content (22.7%) when compared to other treatments. There was higher availability of nitrogen which is the major constituent of amino acids, which act as a building block of protein (lysine) (Luikham *et al*., 2005). There was a supply of available essential nutrients, growth-promoting hormones, growth-regulating substances and synthesizing phytohormones such as GA, IAA, IBA *etc*. through organics and effective regulation of metabolic functions resulting in the better synthesis of proteins and consequent improvement in quality of the produce. These results conformed to Shariff *et al.* (2015).

CONCLUSION

When organics are applied, nutrients will be released slowly and also nutrient losses will be minimized due to increased absorption of nutrients as a result of increased cation exchange capacity that was increased with organic matter application. Thus, plant nutrients will be available for a long period inadequate quantity thereby facilitating the plant to absorb the required amountof nutrients as per its demand resulting in better growth, development and yield. The addition of organic matter also improves the soil physical properties such as structure, porosity, water holding capacity and decreases bulk density and the chemical properties such as soil organic carbon and available nutrients will also be improved. All these promote soil health, crop growth and the yield on a sustained basis (Dhakal *et al*., 2016).

Conflict of interest: None.

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