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Response of inorganic and organic fertilizers on yield of Black Gram (*Vigna mungo* L.)

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Abstract

The present experiment entitled on “Response of inorganic and organic fertilizers on yield of Black Gram (*Vigna mungo* L.)” was conducted at Research farm of Department of Agronomy, School of Agriculture Science, Technology & Research, Sardar Patel University, Balaghat (M.P.) during *Rabi* season of year 2023-24. The investigation was aimed to assess the productivity of Black gram under the application of different inorganic and organic fertilizers management and their subsequent effect on plant growth parameters, yield attributes and yield as well as economics and quality of the seed. Based on this experiment it is concluded that the application of 100% RDF proves the best treatment. Among the INM treatment, application of T₄ (30:60:30 Kg. NPK ha⁻¹) recorded the maximum and significantly higher grain yield (11.72 q/ha), gross returns (Rs.22325.00/ ha), net returns (Rs.73153.00/ ha) and highest B: C ratio of 2.16. Hence, it can be concluded that the application of 30:60:30 Kg. NPK ha⁻¹ obtained B:C ratio >2.16, can be used as a remunerative strategy and can be adopted in Eastern Plateau and the hills Region of India.

Keywords: Inorganic, organic fertilizers, branches, grains, pod, seed index, straw yield

Introduction

Black gram (*Vigna mungo* L.) is an excellent source of high quality protein. Black gram is a bean belonging to the family of *Leguminosae*. It is originated in India. Common Name of Black gram is urd, urd bean. Black gram fixes the biological nitrogen, so it can be grown as a green manure crop. Legumes are a critical part of a good soil structure with many nutrients being stored in their root system. It is primarily a rainy season crop but with the development of early maturing varieties, it has also proved to be an ideal crop for spring and summer seasons. Black gram are grown and needs plenty of water and warmth, full sun, and rich soil. Plants produce more flowers at higher temperatures with longer day lengths than they need to produce fruit. It can be boiled or eaten whole and contains about 25 per cent protein. It also contains high quality of lysine (4600 mg/g N) and tryptophan (60 mg/g N) and consumed as whole grain as well as in the form of dal for table purposes. Black gram is supposed to be easily digestible, hence, it is preferred by patients. The sprouted seeds of Black gram are rich in ascorbic acid (vitamin C), riboflavin and thiamine. In India, Black gram are grown in 4.46 million ha area with a total production of 1.9 million tonnes and productivity of 506.98 kg/ha out of which 1.92 million ha area with a production of 1.75 million tonnes and productivity of 839 kg/ha. (Directorate of Economics and Statistics 2022) [4].

Incorporation of organic sources i.e. FYM, vermicompost, poultry manure and compost along with NPK fertilizer is effective in alleviating the nutrient deficiency in soil, improving physical properties of soil and its organic carbon status. Managing organic source of plant nutrients with mineral fertilizer and their incorporation into the soil in a cropping system has certain favourable and augmenting effects on soil physical and biological properties for sustainability and high productivity of crops.

Judicious combination of organic manures and inorganic fertilizers can maintain the soil fertility and its productivity at higher level. Studies under All India Co-ordinated Research Project on long term fertilizer experiments have indicated that manuring with FYM, vermicompost, poultry manure and compost during *rabi* proved significantly beneficial to the succeeding *rabi* crops

resulting in the saving of N fertilizers. Sustaining soil quality is the most appropriate method to ensure sufficient food to support life. Maintenance of soil organic carbon in soil is considered essential for long-term sustainable agriculture. Soil organic matter is the most important attribute of soil quality. Soil organic matter being a storehouse of all essential plant nutrients, plays pivotal role in crop production and soil organic matter together with physical properties has been proposed as indicator of soil quality.

In this region, due to the erratic rainfall and rise in summer temperature, there is decline in standard yield potential of the crops. Due to imbalanced fertilization and very less use of the organic manure there is continuous mining of the nutrients, which results in deterioration of soil health. Long-term fertilizer experiments have shown that the combined use of organic manures and inorganic fertilizers can maintain high productivity and sustainable crop production. Recent studies have indicated that a periodic addition of large quantities of crop residues to the soil maintain the nitrogen and organic matter at adequate level even without using legume in the rotation.

The basic concept of inorganic and organic fertilizers or integrated plant nutrition management (IPNM) is the adjustment of plant nutrient supply to an optimum level for sustaining the desired crop productivity. inorganic and organic fertilizers management is the combined application of chemical fertilizers along with organic resource materials like, organic manures, green manures, bi-fertilizers and other organic decomposable materials for crop production. The basic concepts of IPNS is the maintenance or adjustment of soil fertility and supply of plant nutrients to an optimum level for sustaining desired crop productivity through optimization of benefits from all possible sources of plant nutrients in an integrated manner. Nutrient managements are the process of managing the amount, source, timing and method of nutrients application. With the goal of optimizing from productivity while minimizing nutrients losses that could create environment problem. It includes developing nutrients budgets that consist of knowing the amount of nutrients needed by the crop, accounting for all the potential sources of nutrient, and then apply manures, compost, irrigation water or inorganic fertilizers to meet the nutrients need of the crop. In spite of being widely adapted crop in India, its productivity is very low. Crop productivity could be achieved with the help of agrochemicals. The green revolution brought impressive gains in food production but due to intensive use of agro-chemicals soil biodiversity is being affected. There is now tremendous pressure on growers to use integrated nutrient management approach to increase productivity and sustain soil health. Organic amendment offers an alternative or supplementing control tactic to increase production.

Materials and Methods

The experiment was carried out at the Research farm of the Department of Agronomy, School of Agriculture Science, Technology & Research, Sardar Patel University, Balaghat (M.P.) during *Rabi* season of year 2023-24. The experiment was conducted in a randomized complete block design with three replications. The experiment consisted of 10 treatments i.e., 9 different inorganic and organic fertilizers treatments and 1 control treatment, thus making 10 treatments. An appropriate sample provides an estimate or a sample value which is as close as possible to the value that would have been obtained, had all plant in the plot been measured the plot value. The difference between the sample value and plot constitutes sampling error. Thus, a good sampling technique gives a small sampling error.

Error of sample estimates generally decreases with the size of sampling and number of sampling unit per plot and the sampling design. However, an increase in either the size or the number of sampling unit almost always increases cost. Therefore, the choices of an appropriate sampling technique are primarily concerned with maintaining the proper balance between the sizes of the sampling unit and design to achieve the maximum precision at minimum cost. Single plot as a sampling unit and five plants are appropriate number of plants according to requirement for experimental plot as a sample size and random sampling techniques (Gomez and Gomez, 1984)^[1] were adopted for recording growth and yield attributes of test crops.

Table 1: Treatment Details

T ₁	Control
T ₂	10:20:10 Kg. NPK ha ⁻¹
T ₃	20:40:20 Kg. NPK ha ⁻¹
T ₄	30:60:30 Kg. NPK ha ⁻¹
T ₅	FYM @10 MT ha ⁻¹
T ₆	FYM @ 5.0 MT ha ⁻¹
T ₇	Vermicompost 5.0 Mt ha ⁻¹
T ₈	Vermicompost 2.5 MT ha ⁻¹
T ₉	Leaf mould @ 10 Mt ha ⁻¹
T ₁₀	Leaf mould @ 5.0Mt ha ⁻¹

Results and Discussion

Plant growth attributes like plant height (cm) is considered to be an important factor to judge the vigor in Black gram. The vegetative growth is an essential prerequisite for higher yield. Those differences among the various levels of inorganic and organic fertilizers management were found significant for plant height (cm) at 40 DAS and Harvest of Black gram plant. Result revealed from table that differences among the various levels of inorganic and organic fertilizers management were found significant for number of leaves per plant at 40 DAS and Harvest maximum number of leaves per plant recorded under the treatment T₄ (30:60:30 Kg. NPK ha⁻¹) (11.21).

Result revealed from table that differences among the various levels of inorganic and organic fertilizers management were found significant for number of branches per plant at 40 DAS and Harvest maximum number of branches per plant recorded under the treatment (6.84) T₄ (30:60:30 Kg. NPK ha⁻¹). Result revealed from table that differences among the various levels of inorganic and organic fertilizers management were found significant for Number of root nodules per plant maximum number of nodules per plant recorded under the treatment T₄ (30:60:30 Kg. NPK ha⁻¹). Similar findings were also recorded by Vitnor *et al.* (2015)^[8], Mishra *et al.* (2016)^[3].

Days Taken 50% to flowering showed that effect of inorganic and organic fertilizers management showed significant result. Minimum Days Taken 50% to flowering was recorded under treatment T₄ (30:60:30 Kg. NPK ha⁻¹) followed by (T₃ and T₅). Analysis data for length of pod showed that effect of inorganic and organic fertilizers management showed significant result. Maximum length of pod per hectare with treatment T₄ (30:60:30 Kg. NPK ha⁻¹).

Analysis data for seed yield per plant (g) and Seed yield per Plot (kg) showed that effect of inorganic and organic fertilizers management showed significant result. Maximum seed yield per plant and Seed yield per Plot (kg) with treatment T₄ (30:60:30 Kg. NPK ha⁻¹) followed by T₅ (FYM @10 MT ha⁻¹). Analysis data for Seed yield (q/ha.) evidence that effect of inorganic and organic fertilizers management showed significant result. Maximum Seed yield (11.72 q/ha.) with treatment T₄ (30:60:30

Kg. NPK ha⁻¹) followed by T₅ (FYM @10 MT ha⁻¹). (10.74 q/ha). Higher seed yield of Black gram was obtained mainly due to improvement in yield components.

Analysis data for stover yield (q/ha.) showed that effect of inorganic and organic fertilizers management showed significant result. Maximum stover yield (24.28 q/ha.) with treatment T₄ (30:60:30 Kg. NPK ha⁻¹) followed by T₅ (FYM @10 MT ha⁻¹) (14.43 q/ha).

Analysis data for harvest index (%) showed that effect of inorganic and organic fertilizers management showed significant result. Maximum harvest index (42.20%) with treatment T₄ (30:60:30 Kg. NPK ha⁻¹). Analysis data for Test Weight (g) showed that effect of inorganic and organic fertilizers management showed significant result. Maximum Test Weight (42.20 g) with treatment T₄ (30:60:30 Kg. NPK ha⁻¹). Similar findings were also recorded by Meena *et al.* (2016)^[2], Shariff *et al.* (2022)^[6].

Statistically inorganic and organic fertilizers management found significant result. Maximum Protein percentage (23.45%) was recorded by treatment T₄ (30:60:30 Kg. NPK ha⁻¹). Similar findings were also recorded by Singh *et al.* (2008)^[7], Shariff *et al.* (2022)^[6].

The economics in terms of gross and net returns for inorganic and organic fertilizers management were worked out and presented here in the different treatment combinations were registered more or less a good value of benefit: cost ratio. This indicated that the sowing of field pea with proper inorganic and organic fertilizers management doses is economical.

The application of Biofertilizer at the rate of 30:50:30 kg per hectare and f inorganic and organic fertilizers management levels at the T₄ (30:60:30 Kg. NPK ha⁻¹) achieve the higher yield of 11.72 q/ha and recorded the highest benefit: cost ratio of 2.16 with net realization of 73153.00 Rs/ha. Similar findings were also recorded by Patel *et al.* (2016)^[5], Meena *et al.* (2016)^[2].

Table 2: Response of inorganic and organic fertilizers on yield potential of Black Gram (*Vigna mungo* L.)

Treatments	Plant height (cm)	Numbers of branches/plants	Number of pods plant ⁻¹	Number of seeds pod ⁻¹	Test weight (g)	Seed yield (q ha ⁻¹)	Stover yield (q ha ⁻¹)	Harvest index (%)	Protein content (%)	B:C Ratio
Control	44.52	3.62	12.47	8.73	34.04	5.37	8.56	25.24	20.30	0.75
10:20:10 Kg. NPK ha ⁻¹	57.33	5.60	14.12	10.67	35.08	7.12	13.43	38.63	22.78	1.78
20:40:20 Kg. NPK ha ⁻¹	59.65	5.98	14.33	10.95	35.19	10.11	14.10	39.89	22.85	1.93
30:60:30 Kg. NPK ha ⁻¹	60.63	6.84	16.69	11.27	35.88	11.72	24.28	42.20	23.45	2.16
FYM @10 MT ha ⁻¹	59.96	6.26	14.87	11.07	35.54	10.74	14.43	40.83	22.93	2.08
FYM @ 5.0 MT ha ⁻¹	52.38	4.95	13.07	9.68	34.39	6.09	11.77	34.33	22.48	1.15
Vermicompost 5.0 Mt ha ⁻¹	52.84	5.11	13.38	9.92	34.47	6.56	12.56	34.37	22.49	1.26
Vermicompost 2.5 MT ha ⁻¹	53.64	5.20	13.95	10.23	34.87	6.57	13.01	35.24	22.50	1.38
Leaf mould @ 10 Mt ha ⁻¹	51.67	4.16	12.59	9.21	34.12	5.72	10.56	33.40	22.17	0.88
Leaf mould @ 5.0Mt ha ⁻¹	51.78	4.26	12.87	9.42	34.28	5.89	11.74	34.14	22.19	0.94
S.E.m. ±	1.83	0.38	0.55	0.33	0.36	1.47	1.41	2.81	0.50	0.17
C.D. 5%	5.33	1.12	1.62	0.94	1.05	4.37	4.19	8.36	1.47	0.49

Conclusion

Based on this experiment, it is concluded that the application of 100% RDF proves the best treatment. Among the INM treatments, the application of T₄ (30:60:30 Kg. NPK ha⁻¹) recorded the maximum and significantly higher grain yield (11.72 q/ha), gross returns (22325.00/ ha), net returns (73153.00/ ha), and the highest B: C ratio of 2.16. Hence, it can be concluded that the application of 30:60:30 Kg. NPK ha⁻¹ obtained B:C ratio >2.16, can be used as a remunerative strategy and can be adopted in Eastern Plateau and the hills Region of India.

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