Eco. Env. & Cons. 29 (4) : 2023; pp. (1611-1615)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2023.v29i04.025

Effect of Organic, Inorganic and Biofertilizers on growth and yield of Blackgram (*Vigna mungo L.*)

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(Received 13 April, 2023; Accepted 15 June, 2023)

ABSTRACT

A field experiment entitled "Effect of Organic, Inorganic and Biofertilizer on growth and yield of Blackgram (*Vigna mungo* L.) was conducted during Kharif season of 2022 at the experimental farm of School of Agriculture, Lovely Professional University. The experiment was laid out in a Randomized Block Design with eleven treatments and three replications. The layout plan is as follows :T_1-Control, T_2-50% RDF, T_3-100% RDF, T_4-50% RDF+5t FYM/ ha, T_5-50% RDF+7.5t FYM/ha, T_6-100% RDF+5t FYM/ha, T_7-100% RDF+7.5t FYM/ha, T_8-50% RDF+5t FYM/ha + Rhizobium, T_9-50% RDF+7.5t FYM/ha +Rhizobium, T_{10}-100% RDF+5t FYM/ha + Rhizobium, T_{11}-100% RDF+7.5t FYM/ha +Rhizobium. Among the eleven treatments, T_{11}-100% RDF+7.5t FYM/ha + Rhizobium showed significant impact on all the growth and yield parameters (Plant height, Number of branches/plant, Dry matter accumulation, Number of pods/plant, Number of grains/pod, Seed yield, Stover yield, Harvest index) followed by T_{10}- 100% RDF+5t FYM/ha + Rhizobium.

Key words: *Black gram, RDF, Biofertilizer, Growth, Yield*

Introduction

Black gram (*Vigna mungo* L.) is one of the most important pulse crop grown throughout the country. In tropical and sub-tropical areas, where diets are generally lacking in protein, legumes are considered to be the most essential source of protein. Pulses contain approximately three times as much high-quality protein as grains. In addition, they supply a significant amount of minerals and vitamins to the diet. Black gram contains a lot of protein. On a dry weight basis, it comprises roughly 26% protein, 1.2 percent fat, and 56.6 percent carbohydrates. It is also high in calcium and iron. Apart from that, black gram is a good source of forage. It also has a lot of vegetative growth and covers the ground so thoroughly that it prevents weeds from growing. It also prevents soil erosion by covering the ground so effectively. It is wonderful silage and green manure crop as well. Black gram is a drought-tolerant and warm-weather crop that has found favour in the tropics drier parts, where other food crops have failed. Legume is a poor performer. It has the ability to fix around 22.10 kg of nitrogen from the atmosphere every year. Through its root nodules, it can cover an area of one hectare. It is also shade tolerant, making it suitable for use as an outdoor plant. Maize, millet, sorghum, sugarcane and cotton can all be intercropped.

Africa, Myanmar and Thailand are the main producers of black gram. The states of Madhya Pradesh, Maharashtra, Uttar Pradesh, Andhra Pradesh, Rajasthan, Karnataka, and Bihar produce the most black gram in India (agricoop.nic.in).

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Non-availability of quality seeds of improved and short-duration varieties, growing pulses in marginal and less fertile soil with low inputs and without pest and disease management, growing pulses under moisture stress, unscientific post-harvest practices and storage under unfavourable conditions are all factors that contribute to India's low pulse yields when compared to global productivity. As a result, the usage of inorganic and bio-fertilizers has the potential to improve this crop's production potential. During the previous four decades, India has made amazing strides in fertilizer output and consumption.

However, the use of renewable energy, such as chemical fertilizers, will be a significant limiting factor in agricultural productivity in the future. Chemical fertilizers are not accessible at a reasonable price to farmers due to rising energy costs. Furthermore, the unbalanced and continual use of chemical fertilizers has a negative impact on the physical, chemical and biological aspects of soil, compromising agricultural production sustainability, as well as creating hazards to human health and environmental pollution. Chemical fertilizers are playing crucial role to meet the nutrient requirements of the crop. Persistent nutrient depletion is posing a greater threat to the sustainable agriculture. As a result, there is a need to reduce the use of chemical fertilizers while increasing the use of organics in order to maintain yield and quality levels.

Organic manure has a profound effect on improving soil physical, chemical and biological properties and enhancing the productivity of crops. Farmyard manure is a valuable source of organic matter and nutrients. The beneficial impact of FYM in combination with approved fertilizer doses may be related to the influence of organic matter on enhancing soil physical, chemical, and biological qualities favourable to improved plant development. Adequate manuring not only increases yield but also preserves soil health and production (Lourduraj, 1999). It is well known that addition of organic manure (FYM) not only increase the crop yield but also improved the soil structure by providing binding effect to soil aggregates. It is also increase CEC, water holding capacity, maintain buffering capacity and enhance phosphate solubility of soil. Application of FYM decreased soil bulk density and increased porosity thus provide favorable environment for plant growth. It increased the activity of hetero-trophic bacteria, fungi in soil, responsible for conversion of unavailable form of nutrient to available form and mitigates the micro-nutrient deficiencies.

Bio-fertilizers are the source of microbial inoculates, which have brought hopes for many countries both economically and environmentally. As a result, in developing nations such as India, bio-fertilizers may reduce the problem of high fertilizer costs and thereby save the country's economy (Gupta *et al*., 2003).

Bio-fertilizers have an essential role in enhancing nitrogen and phosphorus availability. The safest method of providing nitrogen to black gram among several bio-fertilizers is through the well-known symbiotic nitrogen fixation process. Therefore, introduction of efficient strain of Rhizobium found in root nodules of leguminous species leads associative symbiotic relationship with host plant. Inoculation of seed with Rhizobium give host plant drought tolerance and disease resistance benefits apart from nitrogen fixation.

The basic concept of integrated nutrient management is the supply of required plant nutrient for sustaining the desired crop productivity with deleterious effect on soil health environment. Integrated nutrient management intended for four major goals to be achieved: to maintain soil productivity, to ensure sustainable productivity, to prevent degradation of the environment and to reduce the expenditure on the cost of chemical fertilizers.

Objective of the research

In order to gain further knowledge towards the effect of organic, inorganic and biofertilizer on growth and yield of blackgram, the following experiment is being conducted.

Materials and Methods

A research experiment was conducted in the Agriculture farm of School of Agriculture, Lovely Professional University during July in 2022. The experiment aimed to investigate the effect of organic, inorganic and biofertilizer on growth and yield of blackgram (*Vigna mungo* L.).

Experimental details

A research trial was conducted in a randomized block design with three replications and eleven treatments. The variety used was Mash 114 and the spacing followed was 30×10cm. Plot size was

5m×4m (20 m^2).

Measurement of growth parameters

Growth parameters i.e., Plant height (cm), Number of branches/plant, Dry matter accumulation, Yield parameters like Number of pods/plant, Number of grains/pod, Seed yield (kg/ha), Stover yield (kg/ha), Harvest index (%) and the economics of treatments were calculated on Cost of cultivation (Rs/ha), Gross returns (Rs/ha), Net returns (Rs/ha) and B:C ratio.

Statistical Analysis

The average values of all the parameters were measured for all the treatments and statistical analysis has been conducted using OPSTAT software.

Results and Discussion

Growth parameters

Plant height

Data in the Table 1 shows that maximum plant height T_{11}, 54.20 and 71.10 cm at 30 and 60 DAS respectively and the minimum has been recorded in T_1 with 28.80, 43.50 at 30 and 60 DAS.

Number of branches/plant

As shown in the Table 1 the number of branches/plant at 30 DAS (2.83) and 60 DAS (7.00) has recorded significantly high in treatment T_{11} (100%RDF+7.5t FYM/ha+ Rhizobium). The lowest number of branches has been recorded in the treatment T_1 (Control) 1.26 and 5.50 at 30 and 60 DAS respectively.

Dry matter accumulation

A critical review of Table 1 shows that the highest value of dry matter accumulation has been recorded in the treatment T_{11} 4.48, 16.63 at 30 and 60 DAS respectively and the lowest value of dry matter accumulation has been recorded in T_1 with 2.95, 12.00 at 30 and 60 DAS respectively.

Yield Parameters

Number of pods/plant

A perusal data in the Table 2 shows that the maximum number of pods/plant was recorded in the treatment T_{11} 32.23 followed by T_{10} 31.77 at harvest and the minimum number of pods/plant has been recorded in the treatment T_1 22.60 respectively.

Number of grains/pod

Number of grains/pod has been recorded at harvest and as shown in the Table 2 the maximium number of grains/pod has shown in T_{11} 5.93 followed by T_{10} 5.90 and the minimum number of grains/pod has been recorded in the treatment T_1 3.23 respectively.

Grain yield (kg/ha)

All the eleven treatments showed significant increase in grain yield compared to control (T_1). According to data shown in the Table 2 the highest grain yield was recorded in the treatment T_{11} (100%RDF+7.5tFYMha^{-1} + Rhizobium) (962.83 kg/

Table 1. Effect of organic, inorganic and biofertilizers on growth parameters of Black gram

Tr No.	Treatments	Plant height		Number of branches/plant		Dry matter accumulation	
		30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
T1	Control	28.80	43.50	1.26	5.50	2.95	12.00
T2	50% RDF	30.76	48.53	1.40	5.73	3.01	13.06
T3	100% RDF	35.50	54.03	1.43	5.90	3.25	13.90
T4	50% RDF+5t FYM ha^{-1}	31.53	50.20	1.33	5.53	3.11	13.50
T5	50% RDF+7.5t FYM ha^{-1}	37.20	55.50	1.56	6.00	3.43	14.53
T6	100% RDF+5t FYM ha^{-1}	42.46	59.23	2.08	6.26	3.50	15.10
T7	100% RDF+7.5t FYM ha^{-1}	47.90	62.36	2.11	6.46	4.03	15.56
T8	50% RDF+5t FYM ha^{-1}+Rhizobium	32.83	52.40	1.60	5.93	3.18	14.10
T9	50%RDF+7.5tFYM ha^{-1}+Rhizobium	38.43	57.03	2.06	6.06	3.60	14.96
T10	100%RDF+5t FYM ha^{-1}+Rhizobium	53.33	70.36	2.76	6.90	4.48	16.50
T11	100%RDF+7.5tFYMha^{-1}+Rhizobium	54.20	71.10	2.83	7.00	4.48	16.73
	S.Em±	0.54	0.79	0.08	0.07	0.08	0.33
	C.D. (P=0.05)	1.62	2.37	0.26	0.21	0.24	1.00

ha) followed by T_{10} (100%RDF + 7.5t FYMha^{-1} + Rhizobium) (952.83 kg/ha) and the lowest grain yield was recorded in the treatment T_1 (Control) (421.13 kg/ha) respectively.

Stover yield (kg/ha)

A perusal data in the Table 2 shows that the maximum stover yield was recorded in the treatment T_{11}2114.11 kg/ha followed by T_{10} 2098.46 kg/ha at harvest and the minimum stover yield has been recorded in the treatment T_1 1182.14 kg/ha respectively.

Harvest index (%)

Analysis of Table 2 shows that the data of harvest index found statistically non-significant among all the eleven treatments.

Economics

Gross Returns (Rs.)

Economic analysis in Table 3 revealed that maximum gross returns (Rs.69889.11 ha^{-1}) was recorded with application of 100% RDF+7.5t FYM ha^{-1}+Rhizobium, which was at par with 100% RDF+5t FYM ha^{-1}+ Rhizobium (Rs.69182.16 ha^{-1}). Minimum gross returns of Rs.31354.22 ha^{-1} was observed in the controlled plots.

Net returns (Rs)

Economic analysis in Table 3 revealed that maximum net returns (Rs.43693.29 ha^{-1}) was recorded with application of 100% RDF+7.5t FYM ha^{-1} + Rhizobium, which was at par with 100% RDF+5t FYM ha^{-1} + Rhizobium (Rs.43736.34 ha^{-1}). Minimum net returns of Rs.9596.9 ha^{-1} was observed in the con-

Table 2. Effect of organic, inorganic and biofertilizer on yield parameters of Black gram

Tr No	Treatments	Number of pods per plant	Number of grains per pod	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
T1	Control	22.60	3.23	421.13	1,182.14	26.59
T2	50% RDF	23.50	3.56	671.26	1,641.89	29.04
T3	100% RDF	27.13	4.43	815.40	1,929.49	29.70
T4	50% RDF+5t FYM ha^{-1}	25.53	3.66	771.33	1,868.29	29.22
T5	50% RDF+7.5t FYM ha^{-1}	27.70	4.50	819.00	1,888.84	30.27
T6	100% RDF+5t FYM ha^{-1}	28.50	5.23	882.80	2,030.10	30.30
T7	100% RDF+7.5t FYM ha^{-1}	29.73	5.40	922.40	2,105.34	30.46
T8	50% RDF+5t FYM ha^{-1}+Rhizobium	26.30	4.30	775.10	1,760.07	30.63
T9	50%RDF+7.5tFYMha^{-1}+Rhizobium	28.16	5.11	832.36	1,874.28	30.81
T10	100%RDF+5tFYM ha^{-1}+Rhizobium	31.77	5.90	952.83	2,098.46	31.26
T11	100%RDF+7.5tFYMha^{-1}+Rhizobium	32.23	5.93	962.83	2,114.11	31.29
	S.Em±	0.53	0.10	6.57	6.36	0.55
	C.D. (P=0.05)	1.59	0.31	19.53	18.90	NS

Table 3. Effect of organic, inorganic and biofertilizers on economics of Black gram

Tr. No	Treatments	Cost of cultivation (Rs)	Gross Returns (Rs)	Net Returns (Rs)	B : C Ratio
T_1	Control	21757.32	31354.22	9596.9	1.44
T_2	50% RDF	22801.57	49228.83	26427.26	2.15
T_3	100% RDF	23845.82	59604.87	35759.05	2.49
T_4	50% RDF+5t FYM ha^{-1}	24301.57	56512.65	32211.08	2.31
T_5	50% RDF+7.5t FYM ha^{-1}	25051.57	59720.52	34218.95	2.38
T_6	100% RDF+5t FYM ha^{-1}	25345.82	64355.1	39009.28	2.53
T_7	100% RDF+7.5t FYM ha^{-1}	26095.82	67194.42	41098.6	2.57
T_8	50% RDF+5t FYM ha^{-1} + Rhizobium	24401.57	56436.81	32035.24	2.32
T_9	50% RDF+7.5t FYM ha^{-1} + Rhizobium	25151.57	60558.6	35407.03	2.40
T_{10}	100% RDF+5t FYM ha^{-1} + Rhizobium	25445.82	69182.16	43736.34	2.66
T_{11}	100% RDF+7.5t FYM ha^{-1} + Rhizobium	26195.82	69889.11	43693.29	2.71

trolled plots.

Benefit-cost ratio (B:C ratio)

Economic analysis in Table 3 revealed that highest benefit cost ratio (2.71) was recorded with application of 100% RDF+7.5t FYM ha^{-1} + Rhizobium followed by 100% RDF+5t FYM ha^{-1} + Rhizobium (2.61). Lowest benefit cost ratio of 1.44 was observed in the controlled plots.

Conclusion

The study evaluated the effect of organic, inorganic and biofertilizer on growth and yield of black Gram (*Vigna mungo* L.), the use of organic, inorganic and biofertilizer combinedly improved the growth and yield parameters of Black gram. Specifically applying 100% RDF+7.5t FYM ha^{-1} + Rhizobium showed significant increase in plant height, number of branches/plant, dry matter accumulation, number of pods/plant, number of grains/pod, grain yield, stover yield. Further studies are required to investigate the long-term effect of these sources.

Conflict of Interest

The authors have stated that they does not have any conflicts of interest.

Acknowledgement

The authors of research study are expressing their appreciation for the assistance provided by the Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara, Punjab.

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