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Effect of organic and inorganic fertilizer on the growth and yield of green gram (*Vigna radiata* L.)

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Abstract

The present experiment was conducted at the Crop Research Center (CRC), School of Agriculture, ITM University, Gwalior (M.P.) during the *kharif* season of 2019 with nine treatment combinations comprising three levels of RDF scheduling (0%, 50% and 100%) and three levels of Vermicompost (0, 1.0 and 2.0 t/ha) in Factorial Randomized Block design with three replications. The maximum yield (691.6 kg ha⁻¹) was recorded with 100% RDF which was 44.1 and 25.0 per cent significantly higher to control (0% RDF) and 50% RDF treatments. Application of 1.0 and 2.0 t vermin compost recorded 40.8 and 67.8 per cent higher seed yield over control. Under different treatment combination of organic and inorganic fertilizers, seed yield of greengram was observed 371.4 to 840.8 kg ha⁻¹ and maximum seed yield (840.8 kg ha⁻¹) was recorded with F₃ x VC₃ (100% RDF with 2.0 t VC ha⁻¹) which was significantly higher over rest of the treatment combinations. The maximum gross and net return was obtained with F₃ (100% RDF), VC₃ (2.0 t VC ha⁻¹) and its combination (F₃ x VC₃) and these were higher than all other treatments.

Keywords: Green gram, Net return, RDF, seed yield, vermicompost

Introduction

Green gram [*Vigna radiata* (L.)] is an important pulse crop and an excellent source of high quality protein. It consists of about 25% protein which is almost 2.5-3.0 times more than the cereals. The total area covered under green gram in India was 34.50 lakh hectares with a total production of 15.91 lakh tonnes. The highest yield was recorded by the state of Punjab (845 kg ha⁻¹) followed by Jharkhand (704 kg ha⁻¹) and Andhra Pradesh (696 kg ha⁻¹). In Madhya Pradesh during Twelfth Plan (2012-2017) the total area covered under green gram 2.51 lakh ha with 1.16 lakh tones total production and productivity was 464 kg ha⁻¹ (Anonymous, 2016-17). At present, the average productivity is 612 kg ha⁻¹ grown, cultivated in 434.00 million hectare all over M.P with a total production of 265.75 million ton (Sources GOI Department of Agricultural and Corporation 2019-20). Average yield of pulse are very low in India compared to other countries due to poor spread of improved varieties and technologies, abrupt climatic changes, substandard methods of cultivation, poor crop stand, imbalanced nutrition and vulnerability to pests and disease. The integrated plant nutrient system helps in improving and maintenance of soil fertility for sustaining crop productivity. Use of organic manures alone or in combination with chemical fertilizers will help to improve physicochemical properties of the soils, efficient utilization of applied fertilizers for improving seed quality and quantity. Organic manures provide a good substrate for the growth of microorganisms and maintain a favourable nutritional balance and soil physical properties (Amruta *et al.*, 2015) [1]. Mungbean yield can be improved by the balanced use of fertilizers and also by managing the organic manures properly. Considering the above facts, present investigation was carried to find out the combined effect of organic manure and inorganic fertilizers on productivity and economics of green gram.

Method and Materials

The present experiment was conducted at the Crop Research Center (CRC), School of Agriculture, ITM University, Gwalior (M.P.) during the *kharif* season of 2019. The experiment was laid out in a Factorial Randomized Block design with nine treatment combinations comprising three levels of RDF scheduling (0%, 50% and 100%) and three levels of Vermicompost (0, 1.0 and 2.0 t/ha) were tested with 3 replications. The soil of experimental field was sandy clay loam in texture and was slightly alkaline in reaction and low in organic

carbon, available nitrogen and medium in available Phosphorus and potassium content. Green gram bean (variety. Maya) was sown at 30 cm row spacing on July 25th 2019. All the fertilizers and nutrients were applied as per the treatments. Other agronomic practices were performed in all the treatments as per recommended package of practices.

Results and Discussion

Growth and yield attributes parameters

The results (Table-1) revealed that the application of different levels of inorganic fertilizers and vermicompost significantly increased all growth parameters and yield attributes parameter and their trend of increase was towards positive direction.

Table 1: Growth and yield attributes parameters of chickpea as influenced by different levels of organic and inorganic fertilizers

Treatments	Growth and yield attributes parameters				
	Plant height (cm)	Number of branches plant ⁻¹	Number of Pods plant ⁻¹	Number of seed pod ⁻¹	Test weight (g)
Inorganic fertilizers (F) doses					
F ₁ : 0% RDF	59.64	7.79	19.11	6.35	25.56
F ₂ : 50% RDF	66.57	8.49	26.76	7.18	26.79
F ₃ : 100% RDF	70.37	9.18	28.76	8.61	29.39
S.E m.±	0.83	0.12	0.32	0.10	0.40
C.D. (5%)	2.44	0.36	0.95	0.28	1.16
Vermi Compost (VC) – Levels					
VC ₁ : 0.0 t ha ⁻¹	62.95	7.22	21.08	5.87	24.65
VC ₂ : 1.0 t ha ⁻¹	65.61	8.70	24.24	7.61	27.27
VC ₃ : 2.0 t ha ⁻¹	68.01	9.53	29.32	8.67	29.81
S.E m.±	0.83	0.12	0.32	0.10	0.40
C.D. (5%)	2.44	0.36	0.95	0.28	1.16
Interaction (F XVC)	NS	NS	S*	S*	NS

Effect of inorganic fertilizers

Under different doses of inorganic fertilizers, maximum value of growth and yield attributes parameter was recorded with 100% RDF ha⁻¹ which was significantly superior over rest of the inorganic fertilizers levels. The probable reason may be that adequate supply of all the nutrients, resulted in greater accumulation of carbohydrates, amino acids and their translocation to the productive organs, which, in turn improved all the growth and yield attributing characters. The findings corroborates with the findings of Pandey *et al.* (2019)^[8], Singh *et al.* (2019)^[12].

The application of 100% RDF to the green gram increased availability of major nutrients to plant due to enhanced early root growth and cell multiplication leading to more absorption of other nutrients from deeper layers of soil ultimately resulting in increased plant growth attributes and finally increased crop growth rate. This is further supported that soil of the experimental field was low in available nitrogen, medium in available phosphorus and potassium and this might be the cause in more response of the crop to the application of 100% RDF. The results are in close agreement with the findings of Yadav *et al.* (2019)^[14], and Subrata *et al.* (2020)^[13].

Effect of vermicompost

It is revealed from the results that the increasing level of vermicompost increased the growth and yield attributes parameter significantly and maximum values was noted in 2.0 t V.C. ha⁻¹, which was significant superior to control and 1.0 t V.C. ha⁻¹ level. Vermicompost helps in enhancing the activity of microorganism in soils resulting in enhanced solubility of nutrients and their consequent availability to plants by reducing soil pH at micro sites and chelating action of organic acids produced by them. The increased yield attributing characters might be due the increased supply of almost all plant essential nutrients by translocation of the photosynthates accumulated under the influence of the sources of organic nutrients. Similar findings have also been reported by Kumar *et al.* (2003)^[7] and Pankaj *et al.* (2019)^[9]. Edwards and Bates (1992)^[4] also found that earthworms significantly increases the yield attributes parameters of green gram.

Nodulation parameters

It is clear from the results (Table-2) that the application of different levels of inorganic fertilizers and vermicompost increased nodule number and their dry weight, root length and their biomass significantly.

Table 2: Root nodulation parameters in chickpea as influenced by different levels of organic and inorganic fertilizers

Treatments	Nodulation parameters		Root parameters	
	Nodule number	Nodule Dry Weight (mg plant ⁻¹)	Root Length (cm)	Root biomass (g plant ⁻¹)
Inorganic fertilizers (F) doses				
F ₁ : 0% RDF	10.57	5.05	11.07	2.51
F ₂ : 50% RDF	13.01	5.65	12.15	2.75
F ₃ : 100% RDF	13.74	6.54	13.23	3.04
S.E m.±	0.24	0.13	0.19	0.10
C.D. (5%)	0.70	0.38	0.57	0.28
Vermi Compost (VC) – Levels				
VC ₁ : 0.0 t ha ⁻¹	10.94	4.62	10.93	2.37
VC ₂ : 1.0 t ha ⁻¹	12.04	5.85	12.37	2.81
VC ₃ : 2.0 t ha ⁻¹	14.33	6.77	13.15	3.11
S.E m.±	0.24	0.13	0.19	0.10
C.D. (5%)	0.70	0.38	0.57	0.28
Interaction (F XVC)	S*	NS	NS	NS

Effect of inorganic fertilizers

It is clear from the results that the under different doses of inorganic fertilizers, maximum nodulation parameters (i.e. nodule number, nodule dry weight, root length and biomass) was recorded with 100% RDF ha⁻¹ which was significantly superior over 0% and 50% RDF ha⁻¹, treatments. The improvement in nodules per plant and consequently their dry weight may be due to adequate supply of available nutrients through inorganic fertilizers might be due to adequate supply of nutrients to plants which helps in stimulation the Rhizobium bacteria for nodule formation and dry weight and played an important physiological role by enhancing cell multiplication, elongation, expansion and chlorophyll biosynthesis, which is turn increased the assimilate production to be used for root development also. These results confirmed the findings Ghanshyam *et al.* (2010) [5] and Bhatt *et al.* (2012) [3].

Effect of vermicompost

Under different levels of vermi compost, nodule dry weight was found in the range of 4.62 to 6.77 mg per plant. maximum nodulation parameters (i.e. nodule number, nodule dry weight, root length and biomass) was recorded with 2.0 t VC ha⁻¹ which was statistically superior over other two levels of vermi compost and minimum under control. Grappelli *et al.* (1985) [6] concluded the enhancement of root initiation, root elongation, root biomass and rooting percentage by vermicompost.

Yield and economical parameter

Effect of inorganic fertilizers

Seed yield of greengram was observed in the range of 479.8 to 691.6 kg ha⁻¹ with different levels of inorganic fertilizers. Application of different doses of RDF had significantly increased the seed yield of greengram. The maximum seed yield (691.6 kg ha⁻¹) was recorded with the application of 100% RDF ha⁻¹ which was significantly higher over rest 0 and 50% RDF treatments. It is apparent from the result that the application of 100% RDF ha⁻¹ recorded 44.1 and 25.0 per cent significantly higher seed yield over to control (0% RDF) and 50% RDF treatments. Application of 50% RDF also recorded 15.3 per cent significantly higher seed yield over to control. It is clear from the data that the crop sown different doses of inorganic fertilizers showed significantly superior harvest index compared to control.

The increased yield attributes and yield might be due the increased supply of the major nutrients (NPK) by translocation of the photosynthates accumulated under the

influence of the sources of inorganic nutrients. Further, the translocation and accumulation of photosynthates in the economic sinks, resulted in increased grain, straw and biological yields. Increased yield attributes and yield by various workers have been reported by Rajkhowa *et al.* (2002) [10] and Sawmi and Sawmi (2019).

Effect of vermicompost

Under different levels of vermin compost, maximum seed yield (708.1 kg ha⁻¹) was recorded with 2.0 t V.C. ha⁻¹ which was significantly superior over control and 1.0 t V.C. ha⁻¹ treatments. Application of 1.0 and 2.0 t V.C. recorded 40.8 and 67.8 per cent higher seed yield over control. Beneficial effect of Vermicompost may be due to adequate nutrient supply from its decomposition, enhanced mobilization of nutrients from the soil, activation of beneficial soil biological activities through which nutrient availability was increased as well as improved physical condition of soil which provided the plant a good food hold to grow and develop. Increase in yield upto 36% to 48% due to the application of vermicompost over control has been also reported by Bhadu *et al.* (2018) [2].

Interaction effects

The interaction effect due to organic and inorganic fertilizers levels on seed and biological yield was found statistically significant and Maximum value (was recorded with F₃ x VC₃ (100% RDF with 2.0 t VC ha⁻¹) which was significantly higher over rest of the treatment combinations. Under present study, application of 100% RDF with 1.0 t VC ha⁻¹ (F₃ x VC₂) was the next treatment combinations in respect of highest seed and biological yield. However, minimum both yields were noted in control of both nutrients (F₁ x VC₁).

The maximum harvest index was recorded under the application of 100% RDF with combined application of Vermicompost @ 2 t/ ha. It may be due to the better availability of nutrients in soil and source- sink relationship, resulting in higher production of photosynthetic and increased translocation to reproductive parts and increase the yield thus resulting higher harvest index. The probable reason may be that the optimum NPK levels resulted in greater accumulation of carbohydrates, protein and their translocation to the productive organs, which in turn, improved all growth and yield attributing characters, result in more grain yield. Besides this, the addition of Vermicompost provided adequate balanced quantity of sulphur and micronutrients to the plant which results in more economic yield. The findings confirm the results of Sharma *et al.* (2010) and Pandey *et al.* (2019) [11,8].

Table 3: Yield and economics of Greengram under different treatments of organic and inorganic fertilizers and its combinations

Treatments	Yield parameters		Economical parameters	
			Net Return (Rs./ha)	B:C Ratio
Inorganic fertilizers (F) doses				
F ₁ : 0% RDF	479.8	38.43	13138	1.84
F ₂ : 50% RDF	553.1	40.10	16206	1.95
F ₃ : 100% RDF	691.6	41.12	23186	2.27
S.E m.±	6.8	0.21	-	-
C.D. (5%)	19.8	0.62	-	-
Vermi Compost (VC) – Levels				
VC ₁ : 0.0 t ha ⁻¹	422.1	38.41	9676	1.62
VC ₂ : 1.0 t ha ⁻¹	594.2	40.21	17002	1.91
VC ₃ : 2.0 t ha ⁻¹	708.1	41.03	20836	1.96
S.E m.±	6.8	0.21	-	-
C.D. (5%)	19.8	0.6	-	-
Interaction				

F ₁ x VC ₁	371.4	37.79	6634	1.42
F ₁ x VC ₂	478.6	38.39	10066	1.54
F ₁ x VC ₃	589.5	39.12	13720	1.63
F ₂ x VC ₁	410.4	38.34	7644	1.45
F ₂ x VC ₂	554.7	40.44	13302	1.67
F ₂ x VC ₃	694.1	41.50	18666	1.81
F ₃ x VC ₁	484.6	39.10	10766	1.59
F ₃ x VC ₂	749.3	41.81	23648	2.11
F ₃ x VC ₃	840.8	42.45	26138	2.08
S.E m.±	11.7	0.37	-	-
C.D. (5%)	34.3	1.08	-	-

Economics

The maximum net return was obtained with F₃ (100% RDF ha⁻¹), VC₃ (2.0 t VC ha⁻¹) and its combination (F₃ x VC₃) and these were higher than all other treatments. Under different levels of inorganic fertilizers, maximum B:C ratio (2.27) was obtained from F₃ (100% RDF ha⁻¹), followed by F₂ (50% RDF ha⁻¹), with 1.95 B:C ratio. Under different levels of vermicompost, maximum B:C ratio (1.96) was obtained from VC₃ (2.0 t VC), followed by VC₂ (1.0 t VC) with 1.91 B:C ratio. Under different treatment combination (interactions) of organic and inorganic fertilizers, maximum B:C ratio (2.11) was obtained from F₃ x VC₂ followed by F₃ x VC₃ with 2.08 B:C ratio. Whereas minimum B:C ratio (1.62) under combination of control of both treatment. The findings confirm the results of Sharma *et al.* (2010)^[11].

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