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Performance of Organic manure with *Rhizobium* inoculation on growth and yield of Mungbean (*Vigna radiata* L.)

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ABSTRACT

A field experiment was carried out at the Organic Farm of Shri Guru Ram Rai University during the kharif season of 2022 using RBD with three replications to investigate the effects of various organic manures and in combination with *Rhizobium* on growth, yield of mungbean, *Rhizobium* inoculation + 100 % Vermicompost + 100% FYM significantly increased plant height, number of branches, fresh and dry weight of nodules. The same treatment combination also proved most effective in improving the yield and yield attributing parameters viz., number of pods per plant, grain and straw and harvest index and also proved most effective in improving the physiological attributing parameters viz., nitrogen's activity.

Key words: *FYM, Vermicompost, Rhizobium inoculation, Growth and yield attributes, Physiological attributes*

Introduction

Pulses are important not only for their value as human food, but also because of high protein content for livestock. It has been important component of Indian agriculture enabling the land to restore fertility by fixing atmospheric nitrogen, so as to produce reasonable yields of succeeding crops and to meet out the demand of dietary requirement regarding proteins, carbohydrates and other nutrient sources. On an average, pulses contain 22-24 per cent protein as against 8-10 per cent in cereals. A good amount of lysine is present in the pulses. Pulses vary in maturity periods, hence, are useful in different cropping systems. Greengram locally called as moog or mug (*Vigna radiata* L.) belongs to the family Leguminaceae, which fixes atmospheric nitrogen and improves soil fertility by adding 20-25 kg N ha^{-1} (Karmakar *et al.*, (2013). Pulse production is very low and become challenging problem against the requirement of increasing population of our country. It has the capacity to fix atmospheric nitrogen. It's one of the important kharif pulse crops of India which can be grown as catch crop between Rabi and kharif -seasons. A seed of mungbean is highly nutritious containing 24–28% protein, 1.0–1.5% fat, 3.5–4.5% fiber, 4.5–5.5% ash and 59–65% carbohydrates on dry weight basis and provide 334–344 kcal energy. Mungbean protein is considered to be easily digestible. Greengram, scientifically known as *Vigna radiata*, is a plant species in the legume family and is commonly called mungbean or moong in India. In-

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dia is its primary origin and is mainly cultivated in East Asia, South East Asia and Indian subcontinent. It is the third important pulse crop in the country, which occupies nearly 16 per cent of the total pulse area in India. It contains protein-rich seeds with 20-25% protein, and sometimes plants are cut and ploughed into the soil as green manure to enrich the soil with nitrogen.India is the major producer of green gram in the world, and it is grown in almost all the states. It is grown on about 42.38 lakh hectares with a total production of 30.9 lakh tones with a productivity of 729.1 kg/ha and contributes 12% to the total pulse production in the year 2020-21. In Kharif 2021-22, greengram production was 20.5 lakh tones (1st advance estimates) in an area of 35.25 lakh hectares (agricoop.nic). In Andhra Pradesh, greengram was cultivated in an area of 1.05 lakh ha with a production of 0.82 lakh tones, contributing 2.65% of production to country (Final Estimates, 2020-21). According to 2nd ANGRAU (2021) advance estimates during 2021-22, greengram was grown in 1.04 lakh hectares with a production of 0.84 lakh tones and productivity was 808 kg/ha. Nitrogen requirement of pulse crops is very low than other crops because nitrogen needed only for establishment of plant after that plants fulfill their requirement through symbiotic nitrogen fixation. Phosphorus is an important plant nutrient for greengram. Indian soils are poor to medium in available phosphorus. Only about 30 per cent of the applied phosphorus is available for crops and remaining part converted into insoluble phosphorus. In mungbean, roots have symbiotic rhizobia bacteria which help in fixing atmospheric nitrogen into the soil (Anjum *et al.,* 2006). For increasing the growth and yield of mungbean, starter dose of nitrogen is essential. Vermicompost for enhancing crop productivity and improving soil health is gaining popularity among the farming community. The possibility of utilizing different plant biomass (weed biomass, crop residue etc.) into quality organic manure. Improvement in soil health and crop productivity, following vermicompost application, has been earlier reported by many workers Rajkhowa *et al.* (2003); Rajkhowa *et al.* (2000).

Materials and Methods

The field research was carried out in experimental field of Shri Guru Ram Rai University, Patel Nagar, and Dehradun, India during kharif season in 2022 to study the Performance of Organic manure with *Rhizobium* inoculation on growth and yield by organically produced Mungbean (*Vigna radiate* L.) under different organic manure and in combination with *Rhizobium*. The geographical situation of the farm lies in the north-Gangetic alluvial plain at 25º 18' north latitudes 83º03' East longitude and at an altitude of 128.93 meters above the mean sea level. The following therapies were used: T_1: Local control T_2: (100%) vermicompost, Vermicompost (50%) in T_3. T_4: Inoculation with *Rhizobium* T_5: Inoculation of *Rhizobium* + (100%) vermicompost T_6: Inoculation of *Rhizobium* + (50%) vermicompost T_7: FYM (100%), T_8: FYM (100%) + (100%) vermicompost. T_9: FYM (100%) + (50%) vermicompost. T_{10}: Vermicompost and *Rhizobium* inoculation (100%) T_{11}: FYM (100%) + inoculation of *Rhizobium* + (100%) vermicompost T_{12}: FYM (100%) + Vermicompost (50%) + *Rhizobium* inoculation. The recommended dose of FYM to chickpea is 12 tonnes per ha^{-1}andVermi Compost is 8 tonnes per ha^{-1}. The experiment was laid out in randomized block design with three replications. The soil of the experimental plot was sandy loam. The land was primarily ploughed followed by two harrowing. The field was given a pre-sowing irrigation before field preparation to obtained proper germination and establishment of the crop. Mungbean variety 'PDM-139' was sown after pre sowing irrigation using 8 kg/acre seed rate. FYM and Vermicompost was applied in the field as per the treatment details before sowing and mixed in soil. Accordingly, seeds were inoculated with *Rhizobium*. Plant height (cm), number of branches, number of nodules per plant and fresh and dry weight of nodules (mg) was measured at harvest. The height of five randomly selected and tagged plants in second row of each plot was measured from ground surface to apex leaf and then average was taken. Five plants were randomly selected from each plot at 20 and 40 DAS and uprooted carefully such that nodules were not lost by detaching in the soil. After washing the roots carefully, total number of nodules present on the roots were detached from the roots and counted and then averaged. The nodules so detached were freshly weighed in the weighing balance after which the nodules were dried in sun for 2 days and then dried in oven at 70°C temperature. After complete drying of the nodules, dry weight was taken. Number of pods in sampled five plants was counted. The average number were computed and expressed as number of pods per plant. A representative sample

of 1000-grains of mungbean was sundried at 15% moisture level from each plot and weighed in gram. Grain yield after threshing, cleaning and sun drying were taken and finally recorded in quintal per hectare. After picking the pods, the remaining portion of the plant was harvested. The stover yield was calculated after the plant was completely dried. For obtaining the final straw yield, weight of straw of the observational plants were also added in the corresponding figures. The yield was then converted into quintal per hectare. The harvest index was calculated as the ratio of economic yield (grain) to biological yield (grain + straw). The soil of the experimental area was sandy loam with moderately alkaline pH; low in organic carbon (0.32%) and available N (188.30 kg ha^{-1}), available P (34.50 kg ha^{-1}) and available K (87.00 kg ha^{-1}) during kharif season 2022 respectively.

Results and Discussion

Plant height: Application of combination of rhizobium and different level of organic fertilizers significantly influenced the plant height. It is evident from the data given in (Table 1) treatment T_{11}, *Rhizobium* inoculation + Vermicompost (100%) + FYM (100%) showed significantly higher plant height (49.59cm) and was at par with treatments T_2 (47.17cm), T_4 (46.53 cm) and T_6 (45.09 cm) and T_{10} (43.05 cm). Similar result was also reported by Kumar and Singh (2010), Wagadre *et al*. (2010), Joshi *et al*. (2022), Patra and Sinha (2012), and Jat *et al*. (2012).

Number of branches: Application of combination of rhizobium and different level of organic fertilizers significantly influenced the Number of branches. It is evident from the data given in (Table 1) treatment T_{11}, *Rhizobium* + Vermicompost (100%) + FYM (100%) showed significantly higher number of branches (10.86) and was at par with treatments T_2 (10.23), T_4 (9.83) and T_6(9.73) and T_{10} (10.21) respectively. The consequences of the current investigation are additionally in concurrence with the investigation of Kumar and Singh (2010), Wagadre *et al*. (2010), Joshi *et al.* (2022), Patra and Sinha (2012), and Jat *et al*. (2012).

Number of nodules per plant: Application of combination of rhizobium and different level of organic fertilizers significantly influenced the Number of Nodules. It is evident from the data given in (Table 1) treatment T_{11} (27.06) *Rhizobium* inoculation + FYM (100%) + Vermicompost (100%) recorded highest number of nodules and at par with T_{10}(24.69) at 45 Days. Similar result was also reported by Kumar and Singh (2010), Wagadre *et al.* (2010), N. Joshi *et al.* (2022), Patra and Sinha (2012), and Jat *et al*. (2012).

Fresh Weight of Nodules: Application of combination of rhizobium and different level of organic fertilizers significantly influenced the Fresh weight of Nodules. It is evident from the data given in (Table 1) treatment T_{11} (122.34 mg) *Rhizobium* + FYM (100%) + Vermicompost (100%) recorded highest

Table 1. Effect of organic manure and in combination with *Rhizobium* on growth of kharif mungbean

Treatment	Plant height (cm)	Number of No. of branches	Number of nodules per plant at 45 DAS	Fresh weight of nodules (mg) at 45 DAS	Dry weight of nodules (mg) at 45 DAS	Nitrogenase activity (µ mole)
T1	43.59	.8.67	14.67	66.32	20.67	241.13
T2	47.17	10.23	19.53	102.49	39.63	321.05
T3	42.09	9.15	18.17	82.15	33.67	298.66
T4	46.53	9.83	21.83	98.69	35.33	350.82
T5	39.06	8.83	22.07	99.77	24.57	362.76
T6	45.09	9.73	22.45	101.49	33.67	369.01
T7	40.66	9.05	18.43	83.32	25.06	302.93
T8	46.57	9.19	21.67	97.78	34.36	356.19
T9	41.08	9.24	21.73	98.24	22.39	357.17
T10	43.05	10.21	24.69	111.62	36.73	405.83
T11	49.59	10.86	27.06	122.34	42.73	444.78
T12	47.81	9.11	22.67	88.67	30.87	372.63
SE (m) ±	2.21	0.473	1.027	1.914	0.967	25.407
CD @ 5%	6.56	3.953	3.032	8.117	2.856	29.535

Fresh weight of nodules as compared to T_{10} (111.62mg) *Rhizobium* inoculation + FYM (100%) . Similar result was also reported by Kumar and Singh (2010), Wagadre *et al.* (2010), N. Joshi *et al.* (2022), Patra and Sinha (2012), and Jat *et al*. (2012).

Dry Weight of Nodules: Application of combination of rhizobium and different level of organic fertilizers significantly influenced Dry weight of Nodules. It is evident from the data given in (Table 1) treatment T_{11} (42.73 mg) *Rhizobium* inoculation + FYM (100%) + Vermicompost (100%) recorded highest Dry weight of nodules at 45 days as compared with T_{10} (36.73 mg) *Rhizobium* inoculation + FYM (100%). Similar result was also reported by Kumar and Singh (2010), Wagadre *et al*. (2010), N. Joshi *et al*. (2022), Patra and Sinha (2012), and Jat *et al.* (2012).

Nitrogenase activity: Application of combination of rhizobium and different level of organic fertilizers significantly influenced on Nitrogenase activity a. It is evident from the data given in (Table 1) treatment T_{11} (444.78 µ mole) *Rhizobium* inoculation + FYM (100%) + Vermicompost (100%) recorded the greatest levels of Nitrogenase activity as compared with T_{10} (405.83 µ mole) *Rhizobium* inoculation + FYM (100%). Similar result was also reported by Bhavya *et al*. (2017).

Number of pods per plant: Application of combination of rhizobium and different level of organic fertilizers significantly influenced the Number of pods per plant. It is evident from the data given in (Table 2) treatment T_{11} t (36.33), but it was compared to treatments T_{12} (28.66) and T_{10} (26.33). Similar results were also reported by Ahmed *et al.* (1981).

Table 2. Effect of organic manure and in combination with *Rhizobium* on yield of kharif mungbean

Treatment	Number of pods per plant	Seed yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
T1	25.33	10.33	29.66	23.84
T2	32.66	12.09	35.02	25.19
T3	26.33	10.60	34.01	24.95
T4	25.66	10.61	31.33	25.19
T5	27.33	10.33	32.33	24.23
T6	23.67	11.33	30.67	20.29
T7	30.61	12.03	34.67	26.21
T8	33.33	11.08	31.67	23.58
T9	28.33	10.66	30.14	26.37
T10	26.33	10.78	30.33	25.98
T11	36.33	12.32	35.87	27.75
T12	28.66	11.64	33.33	24.19
CD @ 5%	4.649	0.827	3.922	1.728
SE (m) ±	2.853	1.109	1.329	3.197

Seed Yield, Straw Yield (q/ha) and Harvest index (%): Application of combination of rhizobium and different level of organic fertilizers significantly influenced the seed yield, straw yield and harvest index. Application of *Rhizobium* inoculation + FYM (100%) + Vermicompost (100%) T_{11} (Table 2) showed highest grain yield and at par with T_{12}. Application of *Rhizobium* inoculation + FYM (100%) + Vermicompost (100%) T_{11} (Table 2) showed highest straw yield as compared with T_{12}. Application of *Rhizobium* inoculation + FYM (100%) + Vermicompost (100%) T_{11} (Table 2) showed highest harvest index as compared with with T_{12}. This result is also in close conformity with the findings of (Canci and Toker, 2009).

Conclusion

From the result obtained with the following experiment it may concluded that application of *Rhizobium* inoculation ,100 %Vermicompost and 100% FYM showed positive influence on plant height, number of branches, fresh and dry weight of nodules. The same treatment combination also proved most effective in improving the yield and yield attributing parameters viz., number of pods per plant, grain and straw and harvest index and also proved most effective in improving the physiological attributing parameters viz., nitrogenase activity.

Conflict of Interest- None

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