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Effect of Organic Manures and Biofertilizers on Nodulation, Yield Performance, and Quality Attributes of Mung Bean (*Vigna radiata*)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment carried out during the *Zaid 2024* at the Research Farm, School of Agriculture, OM Sterling Global University, Hisar (Haryana) India, to study the effects of different organic nutrient regimes combined with biofertilizer applications on nodule formation, yield, and nutritional quality of mung bean crops. Seven treatments involving organic manures and biofertilizers were tested in a randomized block design with three replications. The results showed a significantly

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higher number of root nodules per plant (11.33, 22.33, 19.72, and 13.44) and dry weight of nodules per plant (11.47, 22.86, 19.79, and 13.30 mg) at 30, 45, 60 DAS and at harvest, respectively. Yield results included seed yield (1,197 kg/ha), stover yield (2,342 kg/ha), biological yield (3,539 kg/ha), and harvest index (33.84%). Quality measures such as protein content (20.08%) and protein yield (240.32 kg/ha) were highest in the treatment with Jeevamrutha at 3000 l/ha applied in three splits (at sowing, 30 DAS, and 45 DAS) combined with Rhizobium and PSB (T_7), while the lowest results for these parameters were observed in the control treatment.

Keywords: Mung bean; organic manures; biofertilizers; nodules; yield performance; quality attributes.

1. INTRODUCTION

Grain legumes are essential foods globally, especially in tropical and developing countries. Among pulses, mung bean [*Vigna radiata* (L.) Wilczek] is widely cultivated across Asia, valued for its short growth cycle, high tolerance to heat and drought, and nutrient-rich grains. Mung bean also can fix atmospheric nitrogen through its symbiosis with rhizobia, potentially enhancing grain production. However, biological nitrogen fixation (BNF) in mung bean has shown considerable variability, with values ranging from 17 to 80 kg N/ha (Hayat et al., 2008). In India, mung bean is grown on approximately 4.75 million hectares, yielding 2.46 million tonnes with an average productivity of 516 kg/ha (DES, 2019).

In modern agriculture, fertilizers alone cannot sustain soil productivity. Long-term overuse of chemical fertilizers has degraded soil health and reduced productivity (Yadav et al., 2007). Sustainable agricultural practices are critical to ensuring productivity without compromising environmental safety. Overuse of chemicals not only harms crops over time but also destabilizes soil ecology, reducing productivity and affecting economic returns. Prolonged use of inorganic fertilizers, such as ammonium sulfate and sulfur-coated urea, has led to soil acidification, weakened soil structure, decreased soil respiration, water pollution, and a decline in earthworm populations. This deterioration in soil properties, attributed to the widespread use of chemical fertilizers, adversely affects humans, soil organisms, and the environment.

Organic nutrient sources like manure and compost serve as soil conditioners, enhancing soil physical, chemical, and biological health. However, due to their slow nutrient release, they may not fully meet crop nutrient demands within a single growing season (Akhtar et al., 2011). To address these limitations and maintain soil fertility, it is necessary to integrate alternative nutrient sources such as organic manures and biofertilizers, which support nutrient availability and uptake by crops. In agriculture, farmyard manure (FYM), vermicompost, and poultry manure are common organic inputs that aid in maximizing crop yield and quality. These manures ensure balanced nutrient ratios, reduce nutrient depletion, and enhance nutrient response efficiency. Among organic manures, FYM is widely used for its richness in essential nutrients like nitrogen, phosphorus, and potassium, which improve soil health, crop growth, yield, and quality. Sources of FYM, including cow dung, poultry manure, and sheep manure, have proven beneficial in enhancing the growth, yield, and quality of mung bean.

Cow dung FYM, one of the most popular organic manures, provides essential nutrients such as nitrogen, phosphorus, potassium, and micronutrients like zinc, copper, and iron (Mangaraj et al., 2022). Vermicompost, another valuable organic amendment, has shown positive effects when used as a supplement or partial substitute for mineral fertilizers, promoting crop growth and yield (Ram Swaroop and Ramawatar, 2012). Additionally, traditional organic solutions like *Jeevamrutha*, a fermented microbial culture made from cow dung, urine, jaggery, and pulse flour, offer a viable alternative to meet crop nutritional needs in natural farming. *Jeevamrutha* is commonly applied as a microbial soil enhancer in organic agriculture. Such organic amendments can also boost biofertilizer effectiveness. Biofertilizers, which are affordable, eco-friendly, and based on renewable resources, have gained popularity as partial substitutes for chemical fertilizers. The rhizosphere, home to an active microbial community, significantly influences root and plant metabolic functions. Microbial inoculants like *Rhizobium* and phosphate-solubilizing bacteria (PSB) play key roles in root nodule formation and have been highlighted in recent years for their nitrogen and phosphorus-fixing properties.

Given these considerations, the present study aims to assess the impact of organic manures and biofertilizers on nodulation, yield performance, and the quality attributes of mung bean (*Vigna radiata*).

2. MATERIALS AND METHODS

The present study was carried out during the *zaid* 2024 at Research Farm, School of Agriculture, OM Sterling Global University, Hisar. Situated in the subtropics at 29°10′ N latitude and 75°46′ E longitudes at an elevation of 215.2 meters above mean sea level in Haryana, India. The place has a typical semi-arid climate with severe cold during winter and hot, dry desiccating winds during summer. The meteorological data recorded during crop season of 2024 indicated that the weekly highest and lowest maximum mean temperature were recorded 37.1 ºC and 14.2 in 3rd and 17th and highest and lowest minimum mean temperature were recorded 4.9 ºC and 18.8 in 3rd and 17th meteorological standard weeks, respectively. The weekly mean lowest and highest wind velocity was 1.6 km hr^{-1} and 5.5 km hr^{-1} in 7th and 8th standard weeks, respectively. The weekly mean minimum and maximum relative humidity was recorded 55.5 % and 99.6% in morning during 3rd and 15th standard weeks and 18.1 % and 79 % in evening during 15th and 5th standard weeks, respectively. Weekly mean maximum and minimum sunshine of 9.1 hrs and 1.7 hrs per day were recorded on 17th and 5th weeks, respectively. The data show that the total amount of rainfall received during the crop growing period was 9.0 mm. The soil of the experimental field was sandy loam in texture, low in organic carbon and available nitrogen, medium in available phosphorus and high in available potassium. The experiment consisting of seven treatment combinations *viz*., T_1 (Control), T_2 [Farmyard Manure (FYM) @ 10 t/ ha], T_3 [Vermicompost (VC) @ 5 t/ ha] T_4 [Poultry Manure (PM) @ 5 t/ha] T_5 (50% FYM @ 5 t/ha + 50% VC @ 2.5 t/ha +Rizobium+PSB) T_6 (50% FYM @ 5 t/ ha + 50% PM @ 2.5 t/ha + Rizobium+PSB) T_7 (Jeevaamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS+ Rizobium+PSB) comprising of organic manures and biofertilizer were tested in randomized block design in three replications. During the experiment, the standard package of practices was considered for mung bean crop. The plot size maintained was 3.6 m*2.0 m and high yielding MH1142 variety was taken for the study. The plant to plant spacing was 10 cm and row to row spacing was 30 cm. The farmyard manure, poultry manure and vermicompost doses were calculated according to the treatment for each plot. FYM, poultry manure and vermicompost were applied 15 days before sowing and incorporated five days before sowing in respective plots as per treatment specification. Jeevamrutha solution was prepared by thoroughly mixing cow dung (fresh) (10 kg) + cow urine (10 liters) + jaggery (2 kg)+ pulse flour (cow pea) (2 kg) + sajiv soil (1 kg) + water (200 liters) in a container and stirred well. Allowed the mixture to ferment for 7 days under tree shade. The mixture was stirred twice (morning and evening) every day in a clockwise direction. The container was kept under a well-ventilated open shed. The mouth of container was tied with thin cotton cloth to enable proper aeration in the container and after preparation applied as per treatments. Rhizobium and PSB inoculation: 25 g of jaggery was boiled in one half liter water and then cooled, 50 g of culture was mixed in jaggery solution. The required quantity of seed was thoroughly mixed with the paste of culture to inoculate them with Rhizobium/PSB, then the seeds were allowed to dry in shade and after dried applied as per treatments. Weeding, hoeing and plant protection measures were carried out as per recommendations at appropriate times. Data were recorded on number of nodules per plant; dry weight of nodules per plant (mg); seed yield (kg ha^{-1}), stover yield (kg ha^{-1}), biological yield (kg ha^{-1}); harvest index (%); protein content in grain (%), protein yield (kg ha^{-1}) as per the standard procedure. Data collected during the study were statistically analyzed by using the technique of analysis of variance (ANOVA) described by (Cochran and Cox, 1959).

3. RESULTS AND DISCUSSION

3.1 Nodules Studies

The number of root nodules per plant at 30, 45, 60 DAS and at harvest influenced by various organic manures and biofertilizers treatments are presented in Table 1. An application treatment of Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB (T_7) recorded significantly higher number of root nodules per plant (11.33; 22.33; 19.72; 13.44) as compared to others treatments *viz.,* T_6 (50% FYM @ 5 t/ha+50% PM @ 2.5 t/ha + Rhizobium +PSB) (10.20), (21.13), (18.73) and (11.93); T_5 (50% FYM @ 5 t/ha + 50% VC @ 2.5 t/ha + Rhizobium +PSB) (10.73), (20.00), (18.67) and (11.53); T_4 [Poultry Manure (PM) @ 5 t/ ha]

(9.53), (19.33), (18.20) and (10.87); T_3 [Vermicompost (VC) @ 5 t/ ha] (9.27), (18.93), (17.73) and (11.20); T_2 [Farmyard Manure (FYM) @ 10 t/ ha] (8.87), (16.77), (17.20) and (11.20); T_1 (control) (7.47), (16.40), (14.93) and (9.00) at 30, 45, 60 DAS and at harvest, respectively. The significantly lower number of root nodules per plant was recorded in treatment T_1 (control) at all growth stages of mung bean crop. The dry weight of nodules per plant (mg) at 30, 45, 60 DAS and at harvest influenced by various organic manures and biofertilizers treatments are presented in Table 2. An application treatment of Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB (T_7) recorded significantly higher dry weight of nodules per plant (11.47 mg); (22.86 mg); (19.79 mg); (13.30 mg), respectively as compared to others treatments *viz.,* T_6 (50% FYM @ 5 t/ha+50% PM @ 2.5 t/ha + Rhizobium +PSB) (10.73 mg), (20.00 mg), (17.60 mg) and (11.26 mg); T_5 (50% FYM @ 5 t/ha + 50% VC @ 2.5 t/ha + Rhizobium +PSB) (10.13 mg), (19.80 mg), (17.13 mg) and (10.80 mg); T_4 [Poultry Manure (PM) @ 5 t/ ha] (10.00 mg), (19.47 mg), (16.13 mg) and (10.53 mg); T_3 [Vermicompost (VC) @ 5 t/ ha] (9.47 mg), (19.00 mg), (15.60 mg) and (10.13 mg); T_2 [Farmyard Manure (FYM) @ 10 t/ ha] (8.40 mg), (18.47 mg), (14.33 mg) and (8.93 mg); T_1 (control) (6.47 mg), (6.47 mg), (12.33 mg) and (7.00 mg) at 30, 45, 60 DAS and at harvest, respectively. The lowest number of root dry weight of nodules per plant was recorded in treatment T_1 (control) at all growth stages of mung bean crop. Yadav et al. (2017) observed that the direct interaction between the number of root nodules and enhanced nitrogen fixation led to a higher number of effective nodules when organic inputs and liquid manures were applied, resulting in improved growth characteristics in chickpea. These findings align with the results of Singh and Prasad (2008) and Kumaravelu and Kadambian (2009). Singh et al. (2017) also reported that the higher values of these growth parameters at this fertility level were likely due to the balanced supply of essential mineral nutrients. These results are consistent with the work of Chaudhary et al. (2011) and Tiwari et al. (2012). Additionally, Patel and Gangwar (2023) highlighted that the use of biofertilizers such as Rhizobium and PSB improved nitrogen fixation and phosphorus solubilization, respectively, which contributed to increased root development and nodule formation. The application of farmyard manure, vermicompost, and poultry manure further enhanced nutrient availability, promoting greater nodule formation. These outcomes are in agreement with the findings of Kumawat et al. (2010) and Singh et al. (2017).

3.2 Yield Studies

Seed yield was significantly influenced by different organic manures and biofertilizers is presented in Table 3. Among the treatments, treatment T_7 recorded significantly maximum seed yield (1,197 kg ha^{-1}) as compared to other treatments *viz.*, T_6 (50% FYM @ 5 t/ha+50% PM @ 2.5 t/ha + Rhizobium +PSB) (1136 kg ha^{-1}); T_5 (50% FYM @ 5 t/ha + 50% VC @ 2.5 t/ha + Rhizobium +PSB) (1135 kg ha^{-1}); T_4 [Poultry Manure (PM) @ 5 t/ ha] (1141 kg ha^{-1}); T_3 [Vermicompost (VC) @ 5 t/ ha] (1114 kg ha^{-1}); T_2 [Farmyard Manure (FYM) @ 10 t/ ha] (1101 kg ha^{-1}); T_1 (control) (824 kg ha^{-1}), respectively. Whereas significantly lower seed yield was recorded under control (T_1). Stover yield was significantly influenced by different organic manures and biofertilizers is presented in Table 3. Among the treatments, treatment T_7 (Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB) recorded significantly higher stover yield (2342 kg ha^{-1}) as compared to other treatments *viz.*, T_6 (50% FYM @ 5 t/ha+50% PM @ 2.5 t/ha + Rhizobium +PSB) (2269 kg ha^{-1}); T_4 [Poultry Manure (PM) @ 5 t/ ha] (2291 kg ha^{-1}); T_3 [Vermicompost (VC) @ 5 t/ ha] (2273 kg ha^{-1}); T_2 [Farmyard Manure (FYM) @ 10 t/ ha] (2272 kg ha^{-1}); T_5 (50% FYM @ 5 t/ha + 50% VC @ 2.5 t/ha + Rhizobium +PSB) (2271 kg ha^{-1}); T_1 (control) (1755 kg ha^{-1}), respectively. Whereas, significantly lower stover yield was recorded in treatment control. Biological yield was significantly influenced by different organic manures and biofertilizers is presented in Table 3. Among the treatments, treatment T_7 (Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB) recorded significantly higher biological yield (3539 kg ha^{-1}) as compared to other treatments *viz.*, T_4 [Poultry Manure (PM) @ 5 t/ ha] (3432 kg ha^{-1}); T_5 (50% FYM @ 5 t/ha + 50% VC @ 2.5 t/ha + Rhizobium +PSB) (3406 kg ha^{-1}); T_6 (50% FYM @ 5 t/ha+50% PM @ 2.5 t/ha + Rhizobium +PSB) (3405 kg ha^{-1}); T_3 [Vermicompost (VC) @ 5 t/ ha] (3386 kg ha^{-1}); T_2 [Farmyard Manure (FYM) @ 10 t/ ha] (3374 kg ha^{-1}); T_1 (control) (2580 kg ha^{-1}), respectively. Whereas, significantly lower biological yield was recorded in treatment control (T_1). Differences in harvest index were significantly influenced by different organic manures and biofertilizers is presented in Table 3. Among the treatments, maximum harvest index (33.84 %) was recorded in treatment T_7 (Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB). as compared to other treatments *viz.*, T_6 (50% FYM @ 5 t/ha+50% PM @ 2.5 t/ha + Rhizobium +PSB) (33.39 %); T_5 (50% FYM @ 5 t/ha + 50% VC @ 2.5 t/ha + Rhizobium +PSB) (33.34%); T_4 [Poultry Manure (PM) @ 5 t/ ha] (33.25 %); T_3 [Vermicompost (VC) @ 5 t/ ha] (32.90 %); T_2 [Farmyard Manure (FYM) @ 10 t/ ha] (32.65 %); T_1 (control) (31.96 %), respectively. significantly minimum HI was recorded in treatment control (T_1). Due to the cumulative effect of yield attributes, like number of pods $plant^{-1}$, number of seeds pod^{-1} and slight improvement in test weight which were the important yield attributes having significant positive correlation with yield studies. Crop yield is the outcome of a complex interaction outcome of physiological and biochemical processes that influence the anatomy and morphology of growing plants. According to Natarajan (2002), foliar spraying with Jeevamrutha has been beneficial for most crops. The current trend of increased yield associated with the application of organic inputs and biofertilizers has also been reported by Patel et al. (2013) and Shariff et al. (2017). Application of Jeevamrutha at 1000 L/ha and Panchagavya at 7.5% resulted in significantly higher yield attributes, such as the number of pods per plant, number of seeds per pod, seed weight per plant, and, ultimately, higher grain and haulm yields in cowpea, compared to the control (Sutar et al., 2019). Similar results were reported by Shwetha (2008), who observed a 25–35% increase in soybean seed yield with the application of Beejamrut, Jeevamrutha, and Panchagavya, along with various organic manures. Devakumar et al. (2008) attributed the beneficial effects of Jeevamrutha to its high microbial population and enzymes, which likely enhanced nutrient availability and uptake, along with growth hormones that ultimately resulted in improved crop yields.

3.3 Quality Parameters

Protein content and protein yield in mung beans were significantly influenced by both organic manures and biofertilizers are presented in Table 4. Protein content (20.08%) and protein yield (240.32 kg ha^{-1}) with application treatment of T_7 (Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB) was significantly higher as compared to other treatments *viz.,* T_6 (50% FYM @ 5 t/ha+50% PM @ 2.5 t/ha + Rhizobium +PSB) (19.52 %) and (221.83 kg ha^{-1}); T_5 (50% FYM @ 5 t/ha + 50% VC @ 2.5 t/ha + Rhizobium +PSB) (19.17 %) and (217.54 kg ha^{-1}); T_4 [Poultry Manure (PM) @ 5 t/ ha] (18.19 %) and (207.47 kg ha^{-1}); T_3 [Vermicompost (VC) @ 5 t/ ha] (18.09 %) and (201.40 kg ha^{-1}); T_2 [Farmyard Manure (FYM) @ 10 t/ ha] (17.98 %) and (198.02 kg ha^{-1}); T_1 (control) (14.13 %) and (116.42 kg ha^{-1}) at 30, 45, 60 DAS and at harvest respectively. The significantly lower number of protein content (14.13 %) and protein yield (116.42 kg ha^{-1}) were recorded under treatment T_1 (control) at all growth stages of mung bean crop. The increase in protein yield may be attributed to the enhanced nitrogen content and seed yield resulting from the soil application of Jeevamrutha. A similar finding was reported by Chaudhary et al. (2022) and Patil and Udmale (2016), who observed higher protein and oil content in soybean seeds with the application of FYM + vermicompost (50% each) + Jeevamrutha (applied twice, at 30 and 45 DAS).

Table 1. Effect of organic manures and biofertilizers on number of nodules per plant at all growth stages of mung bean crop

Treatments	Number of nodules per plant			
	At 30 DAS	At 45 DAS	At 60 DAS	At harvest
T_1: Control	7.47	16.40	14.93	9.00
T_2: Farmyard Manure (FYM) @ 10 t/ ha	8.87	16.77	17.20	11.20
T_3: Vermicompost (VC) @ 5 t/ ha	9.27	18.93	17.73	11.20
T_4: Poultry Manure (PM) @ 5 t/ ha	9.53	19.33	18.20	10.87
T_5: 50% FYM @ 5 t/ha + 50 % VC @ 2.5 t/ha +Rizobium+PSB	10.73	20.00	18.67	11.53
T_6: 50 % FYM @ 5 t/ha+50 % PM @ 2.5 t/ha + Rhizobium +PSB	10.20	21.13	18.73	11.93
T_7: Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB	11.33	22.33	19.72	13.44
SE (m) ±	**0.16**	**0.26**	**0.31**	**0.45**
CD at 5 %	**0.49**	**0.80**	**0.96**	**1.39**

Table 2. Effect of organic manures and biofertilizers on dry weight of nodules per plant (mg) at all growth stages of mung bean crop

Treatments	Dry weight of nodules per plant (mg)			
	At 30 DAS	At 45 DAS	At 60 DAS	At harvest
T_1: Control	6.47	16.13	12.33	7.00
T_2: Farmyard Manure (FYM) @ 10 t/ ha	8.40	18.47	14.33	8.93
T_3: Vermicompost (VC) @ 5 t/ ha	9.47	19.00	15.60	10.13
T_4: Poultry Manure (PM) @ 5 t/ ha	10.00	19.47	16.13	10.53
T_5: 50% FYM @ 5 t/ha + 50% VC @ 2.5 t/ha +Rizobium+PSB	10.13	19.80	17.13	10.80
T_6: 50% FYM @ 5 t/ha+50% PM @ 2.5 t/ha + Rhizobium +PSB	10.73	20.00	17.60	11.26
T_7: Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB	11.47	22.86	19.79	13.30
SE (m) ±	**0.31**	**0.20**	**0.29**	**0.26**
CD at 5 %	**0.97**	**0.62**	**0.91**	**0.81**

Table 3. Effect of organic manures and biofertilizers on yield studies of mung bean crop

Treatments	Yield Studies			
	Grain Yield (kg ha^{-1})	Straw Yield (kg ha^{-1})	Biological Yield (kg ha^{-1})	Harvest Index (%)
T_1: Control	824	1755	2580	31.96
T_2: Farmyard Manure (FYM) @ 10 t/ ha	1101	2272	3374	32.65
T_3: Vermicompost (VC) @ 5 t/ ha	1114	2273	3386	32.90
T_4: Poultry Manure (PM) @ 5 t/ ha	1141	2291	3432	33.25
T_5: 50 % FYM @ 5t/ha + 50 % VC @ 2.5 t/ha +Rizobium+PSB	1135	2271	3406	33.34
T_6: 50 % FYM @ 5 t/ha+50 % PM @ 2.5 t/ha + Rhizobium +PSB	1136	2269	3405	33.39
T_7: Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB	1197	2342	3539	33.84
SE (m) ±	**6.69**	**15.34**	**19.61**	**0.14**
CD at 5 %	**20.85**	**47.80**	**61.00**	**0.42**

Table 4. Effect of organic manures and biofertilizers on protein (%) and protein yield (kg ha^{-1}) of mung bean crop

Treatments	Protein (%)	Protein Yield (kg ha^{-1})
T_1: Control	14.13	116.42
T_2: Farmyard Manure (FYM) @ 10 t/ ha	17.98	198.02
T_3: Vermicompost (VC) @ 5 t/ ha	18.09	201.40
T_4: Poultry Manure (PM) @ 5 t/ ha	18.19	207.47
T_5: 50 % FYM @ 5 t/ha + 50 % VC @ 2.5 t/ha +Rizobium+PSB	19.17	217.54
T_6: 50 % FYM @ 5 t/ha+50 % PM @ 2.5 t/ha + Rhizobium +PSB	19.52	221.83
T_7: Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB	20.08	240.32
SE (m) ±	**0.05**	**1.06**
CD at 5 %	**1.17**	**3.30**

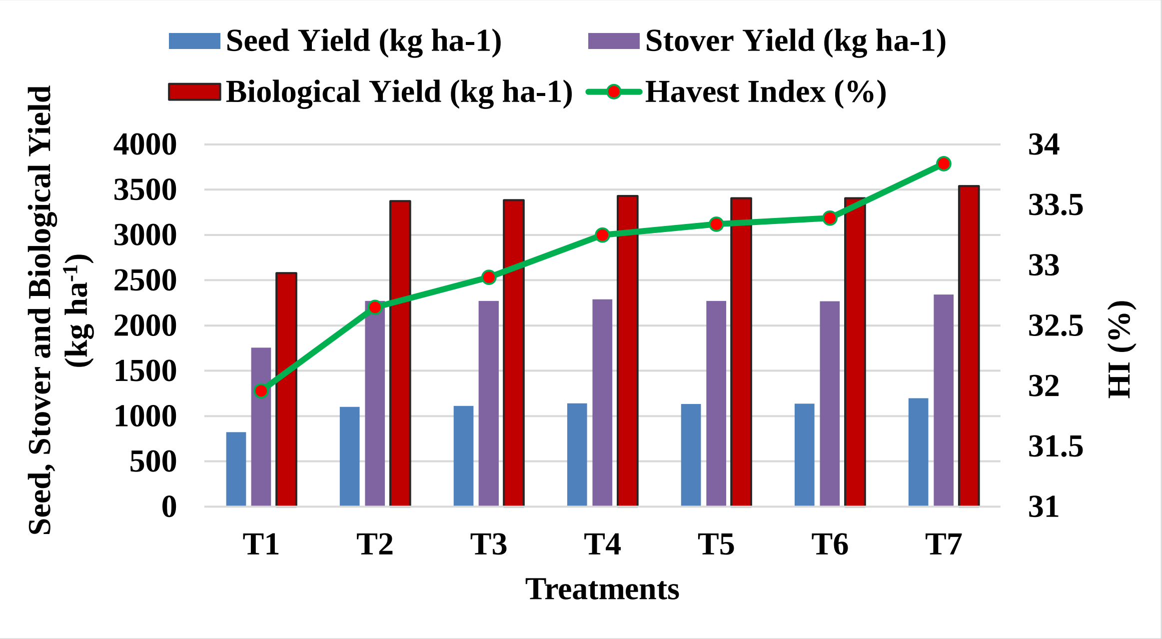

Fig. 1. Effect of organic manures and biofertilizers on yield studies of mung

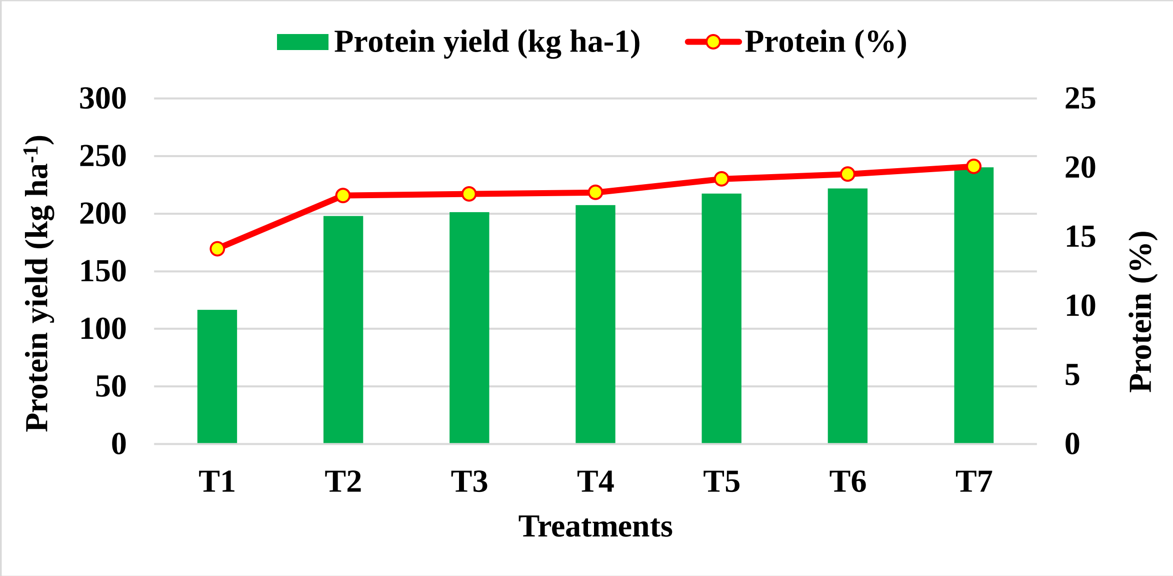

Fig. 2. Effect of organic manures and biofertilizers on protein and protein yield of mung bean crop

4. CONCLUSION

Jeevamrutha @ 3000 l/ha applied in three splits at sowing, 30 DAS, and 45 DAS, combined with Rhizobium and PSB found to be the most effective in terms of higher root nodule count, dry weight of nodules, seed yield, stover yield, biological yield, harvest index, protein content, and protein yield compared to other treatments and combinations. Therefore, it can be concluded that among treatments and combinations tested, application of Jeevamrutha @ 3000 l/ha resulted best for promoting better nodulation, yield, and quality attributes in Mung Bean.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

1. Research papers
2. M. Sc. and PhD Thesis
3. MS Office

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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