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

ABSTRACT

To assess how different organic nutrient regimes, in combination with biofertilizer applications, influence nodule formation, yields, and the nutritional quality of the mung bean crop a field experiment was conducted during *the summer* season of 2024 at Research Farm, School of Agriculture, OM Sterling Global University, Hisar. Seven treatment combinations comprising organic manures and biofertilizers were tested in randomized block design in three replications.The results revealed that the nodules studies*viz.*,higher number of root nodules per plant (11.33; 22.33; 19.72; 13.44) and dry weight of nodules per plant (11.47; 22.86; 19.79; 13.30. mg);yield studies*viz.*,seed yield (1,197 kg ha^{-1}), stover yield (2342 kg ha^{-1}), biological yield (3539 kg ha^{-1}) and harvest index (33.84 %);quality parameters *viz.*,protein content (20.08 %) andprotein yield (240.32 kg ha^{-1})were significantly maximum in the treatment of Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB (T_7) among all the other treatments. Whereas, significantly minimum for all above parameters were recorded under control.

Key words:Mung bean, Organic Manures, Biofertilizers, Nodules, Yield Studies and Quality

1. INTRODUCTION

Grain legumes are an important foods worldwide, particularly in tropical developing countries. Among the pulses, mung bean [*Vigna radiata* (L.) Wilczek] is widely grown in Asia, and is noted for its short cycle, good adaptation to high temperatures and water stress and production of grains with good nutritional characteristics. Mung bean has the capacity to fix atmospheric nitrogen via its association with the rhizobia, which can possibly increase the grain. However, the contribution of biological nitrogen fixation (BNF) to the development of mung bean has been found to show considerable variability, with values ranging between 17 and 80 kg ha^{-1} of N.In India mung bean cultivated in an area of 4.75 million hectares, contributing 2.46 million tonnes of production with productivity of 516 kg/ha in the country (DES, 2019). Fertilizers alone cannot sustain land productivity in modern farming. The long-term and excessive use of chemical fertilizers has resulted in soil health deterioration and decreased productivity [Yadav et al., 2007]. Maintaining environmental safety and agricultural sustainability is critical in today's agricultural production system without reducing productivity. Excessive use of the chemical is not only harmful to crop plants over time, but it also makes soil ecologically fragile, reducing productivity and having an economic impact. Long-term use of inorganic fertilizers such as ammonium sulfide and sulfur-coated urea has resulted in soil acidification, decreased soil aggregate stability, decreased soil respiration, pollution of underground water, and a decrease in earthworm population. Soil properties have deteriorated as a result of the widespread use of inorganic fertilizers to increase yield and protect crop varieties. The use of chemical fertilizers has had a negative impact on humans, soil organisms, and the environment. Using organic source of nutrients (manure and compost) which act as a soil conditioner help in improving the soil physical, chemical and biological health, but due to the slow release of these nutrients unable to fulfil their nutrient demand in a single season of crops[Akhtar et al., 2011]. To overcome such deficiencies and maintain the soil fertility we need to find some alternative option to supply the nutrients and maintain the soil health. For this we integrated different sources of nutrients like organic manures and biofertilizers to enhance the availability and help the crop to uptake more nutrients. In Agriculture manures such as farmyard manure, vermicompost, poultry manure, *etc*. are used as sources of nutrients. These manures assist in maximizing crop output and desired quality while also ensuring balanced nutrient proportions, closing the current large gap between nutrient removal and supply, and improving response efficiency. Among the organic manures, farmyard manure (FYM) is a popular organic fertilizer used in agriculture. It is rich in essential nutrients like nitrogen, phosphorus and potassium, and is known to improve soil health, leading to increased growth, yield, and quality of crops. FYM from different sources, including cow dung, poultry manure, and sheep manure, can significantly improve the growth, yield, and quality of green gram. The application of these organic fertilizers can improve soil health, leading to improved crop performance. Therefore, it is important for farmers to consider the use of FYM as a sustainable and environmentally friendly alternative to chemical fertilizers. Cow dung FYM is one of the most used sources of organic fertilizer in agriculture. It is rich in nutrients like N, P, and K, as well as micronutrients like zinc, copper, and iron. [Mangaraj et al., 2022].Vermicompost has been found to have valuable impacts when utilized as an aggregate or halfway substitute for mineral manure and as soil revisions in field studies. Moreover, some concentrate on shows that vermicomposting leachates or vermicompost water-removes, utilized as substrate corrections, additionally advance the development and yield boundaries of harvests [Ram Swaroop and Ramawatar,2012].Organic concoctions like Jeevamrutha which is a microbial culture prepared from the on-farm inputs like cow dung, urine, jaggery and pulses flour has been found a suitable formulation in natural farming to meet the nutritional demands of the crops. Jeevamrutha is a traditional fermented liquid organic concoction commonly used as soil microbial enhancer in natural farming. Organic amendments also increase the efficiency of bio-fertilizers. Such bio-fertilizers are cheaper, eco-friendly and based on renewable energy sources has gained momentum in recent years to supplement the parts of chemical fertilizers. The rhizosphere is inhabited by actively growing microbial population that immensely affects the root and plant metabolic activities. Rhizobium and PSB are beneficial for root nodule formation collectively known as rhizobia, as potential microbial inoculants have been convincingly emphasized in recent years for its nitrogen and phosphorus fixing ability. Hence,considering these above facts, the present study was conducted to assess the effect of organic manures and biofertilizers on nodulation, yield studies and quality of mung bean (Vigna radiata).

2. MATERIALS AND METHODS

The present study was carried out during the *summer* season of 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.Jeevamruthasolution 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 nodules studies *viz.*,number of nodules per plant and dry weight of nodules per plant (mg);yield studies *viz.*, seed yield (kg ha^{-1}), stover yield (kg ha^{-1}), biological yield (kg ha^{-1})and harvest index (%); quality studies*viz.*, 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. Thelowest 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] found that the direct interaction between number of root nodules and higher N fixation, application of organics and liquid manures recorded higher number of nodules and effective root nodules which resulted in manifestation of higher growth characters of chickpea. These results are in agreement with the findings [Singh and Prasad, 2008; Kumaravelu and Kadambian, 2009]. Singh et al. [2017] also, reported thatthe higher values of these growth parameters with this fertility level might be due to supply of all the essential mineral nutrients in a balanced amount. These results were in conformity with the findings [Chaudharyet al., 2011; Tiwari et al., 2012]. Patel and Gangwar[2023] reported that application of biofertilizers like rhizobium and PSB helped in increased nitrogen fixation and phosphorous solubilization, respectively, which assisted in increased root development and nodule formation. Additionally, application of farmyard manure, vermicompost and poultry manure aided in increased nutrient availability, which aided in increased nodule formation. The outcomes matched with the findings [Kumawat et al., 2010; 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 biofertilizersis 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 result of a complex interaction of physiological and biochemical processes that alter the anatomy and morphology of growing plants. According to Natarajan [2002] foliar spraying Jeevamrutha was beneficial in the majority of crops. The present trend of increase in yield studies with application of organics and bio fertilizers were also observed by [Patel et al., 2013; Shariff et al., 2017]. Application of jeevamrutha at 1000 L ha^{-1} and panchagavya at 7.5% recorded significantly higher yield attributes like number of pods $plant^{-1}$, number of seeds pod^{-1}, seed weight g $plant^{-1}$ and ultimately higher grain yield and haulm yield of cowpea as compared to control [Sutar et al., 2019]. Similar results was also observed by Shwetha [2008] who reported 25–35% increase in seed yield of soybean with the application of beejamrut, jeevamrutha and panchagavya along with different organic manures. Devakumar et al. [2008] reported the beneficial effects of jeevamrutha which was attributed to high microbial population and enzymes which in turn might have availability and uptake of nutrients and growth hormones which ultimately have resulted in better yield of crops.

3.3 Quality Parameters

Protein content and protein yield in mung beans were significantly influenced by both organic manures and biofertilizersare presented in Table4. 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 (221.83kg 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.Increase in protein yield might be due to increase in nitrogen content and seed yield by soil application of jeevamrutha. Similar finding was reported by Chaudhary et al., 2022; Patil and Udmale, 2016] for the higher protein and oil content in seed of soybean by the application of FYM + vermicompost (50% each) + jeevamrutha (2 times *i.e.,* at 30 and 45 DAS).

4. CONCLUSION

Treatment T_7 (Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB) was found most suitable in terms of higher number of root nodules per plant, dry weight of nodules per plant, seed yield, stover yield, biological yield, harvest index,protein content and protein yield among all treatments, it can be concluded that among the treatment tested, treatment T_7 (Jeevamrutha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB) may be grown for better nodules, yield studies and quality parameters.

REFERENCES

1. Akhtar M, Naee A, Akhter J, Bokhari SA, Ishaque W. Improvement in nutrient uptake and yield of wheat by combined use of urea and compost. Soil Environment, 2011; **30**(1), 45-49.
2. Anonymous, 2020. Pulses Revolution - From Food to Nutritional Security. Ministry of Agriculture and Farmers Welfare (DAC and FW), GOI.
3. Chaudhary S, Priya M, Jha UC, Pratap A, HanumanthaRao B, Singh I. “Approaches toward developing heat and drought tolerance in mungbean,” in Developing climate resilient grain and forage legumes. Eds.U.C. Jha, H. Nayyar, S.K. Agrawal and K.H.M. Siddique (Singapore: Springer), 2022; 205–234. doi: 10.1007/978-981- 16-9848-4_10.
4. Cochran WC, Cox GM. Experimental designs, Asia Publishing House, Bombay, 1959.
5. Devakumar N, Rao GGE, Shubha S, Khan I, Nagaraj; Gowda SB. Activities of Organic Farming Research Centre. Navile, Shimoga University of Agriculture Sciences, Bengaluru, 2008; p 12.
6. DES 2019. Advance Estimates of Food Grains, Oilseeds & Other Commercial Crops. Directorate of Economics and Statistics, Department of Agriculture and 62 Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India.(https://eands.dacnet.nic.in/Advance_Estimates.htm.).
7. Green gram outlook (2019), Agricultural Market Intelli gence Centre, PJTSAU. Retrieved from https:// pjtsau.edu.in/files/AgriMkt/2019/sep/Greengram.
8. Kumaravelu G, Kadamban D. Panchagavya and its effect on the growth of the mung bean cultivar K-851. *International Journal of Plant Science*, 2009; **4**:409-414.
9. Kumawat N, Sharma OP, Kumar R. Effect of organic manures, PSB and phosphorus fertilization on yield and economics of mung bean [*Vigna radiata (L.*) Wilczek]. *EnvironEcol*, 2010; **27**(1):5-7.
10. Mangaraj S, Paikaray RK, Maitra S, Pradhan SR, Garnayak LM, Satapathy M, Swain B, Jena S, Nayak B, Shankar T, Alorabi M. Integrated nutrient management improves the growth and yield of rice and greengram in a rice-greengram cropping system under the coastal plain agro- climatic condition. Plants. 2022; **11**(1):142.
11. Natarajan K, Panchgavya- A Manual. Other India Press, Mapusa, Goa, 2002; 13–27.
12. Patel M, Gangwar B. Effect of Organic Nutrient Management on Growth and Yield of Green Gram (*Vigna radiata L.,*) under Semi-arid Region. *International Journal of Plant& Soil Science*, 2023; **35**(19): 514-523.
13. Patel MM, Patel DM, Patel KM. Effect of Panchagavya on growth and yield of Cowpea (*Vigna unguiculata (L*.)). AGRES- *An International e- Journal*, 2013; **2**(3): 313-317.
14. Patel SP, Malve SH, Chavda, MH, Vala YB. Effect of panchagavya and jeevamrutha on growth, yield attributes and yield of summer pearl millet. *The Pharma Innovation Journal*, 2019; **10**(12): 105-109.
15. Patil HM, Udmale KB. Response of different organic inputs on growth and yield of soybean on Inceptisol. *Schor. J Agri. Sci*, 2016; **6**(5): 139-144.
16. Shariff AF, Sajjan AS, Babalad HB, Nagaraj LB, Palankar SG. Effect of organics on seed yield and quality of mung bean (*Vigna radiata L.*). *Legume Research*: *An International Journal*, 2017; **40**(2): 388-392.
17. Shwetha BN. 2008. Effect of nutrient management through the organics in soybean-wheat cropping system’. M Sc. thesis, University of Agriculture Science Dharwad, Karnataka (India).
18. Singh M, Deokaran JSM, Bhatt BP. Effect of integrated nutrient management on production potential and quality of summer mung bean (*Vigna radiata L.*). *J Krishi Vigyan*, 2017; **5**(2): 39-45.
19. Singh, R. and Prasad, K. Effect of vermicompost, rhizobium and DAP on growth, yield and nutrient uptake of Chickpea. *Journal of Food Legumes*, 2008; **21**:112-114.

20. Sutar R, Sujith GM, Kumar DN. Growth and yield of Cowpea [*Vigna unguiculata (L.) Walp*] as influenced by jeevamrutha and panchagavya application. *Legume Res.* 2019; (42): 824-828.
21. Tiwari A, Tiwari J, Mishra SP. Genetic divergence analysis in mungbean [*Vigna radiata* (L.) Wilczek]. *International Journal of Food, Agriculture and Veterinary Sciences*. 2012; **2**:64-70.
22. Yadav AK, Varghese K, Abraham T. Response of biofertilizers, poultry manure and different levels of phosphorus on nodulation and yield of green gram (*Vigna radiataL.*) Cv.k-851. Agric Sci Dig. 2007; **27**(3):213-215.
23. Yadav JK, Sharma M, Yadav RN, Yadav SK, Yadav S. Effect of different organic manures on growth and yield of Chickpea (*Cicer arietinum L.*). *Journal of Pharmacognosy and Phytochemistry*, 2017; **6**(5): 1857-1860.

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 (%) andprotein 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	20.08	240.32

and 45 DAS + Rhizobium +PSB		
SE (m) ±	**0.05**	**1.06**
CD at 5 %	**1.17**	**3.30**

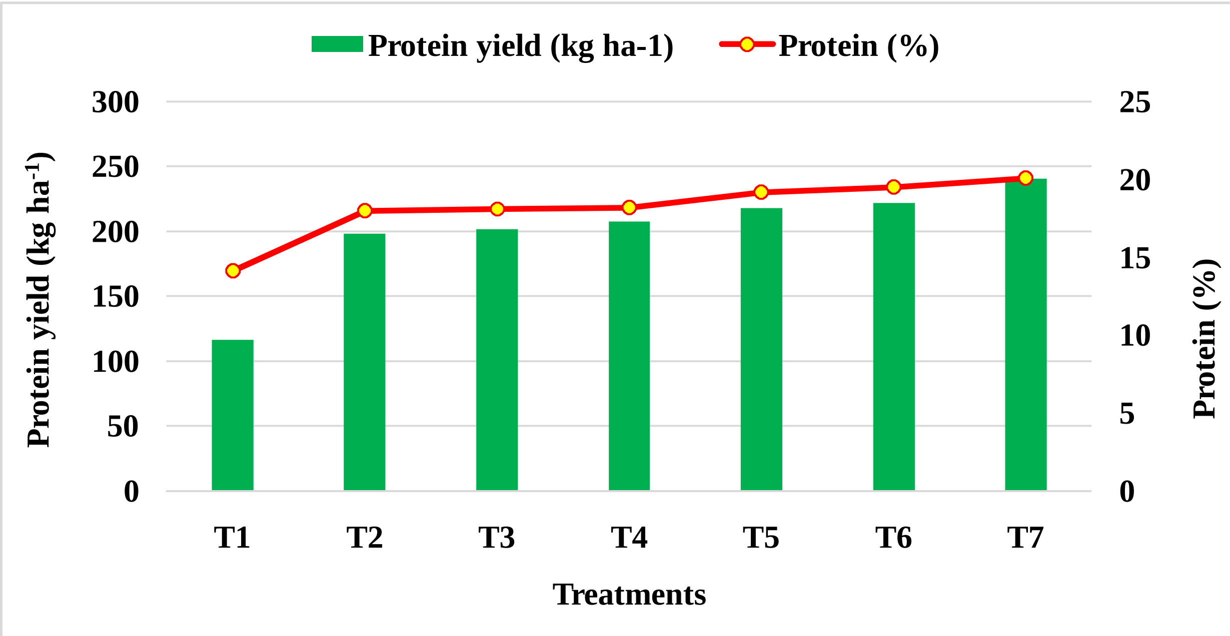

Fig.1: **Effect of organic manures and biofertilizers on protein and protein yield of mung bean crop.**

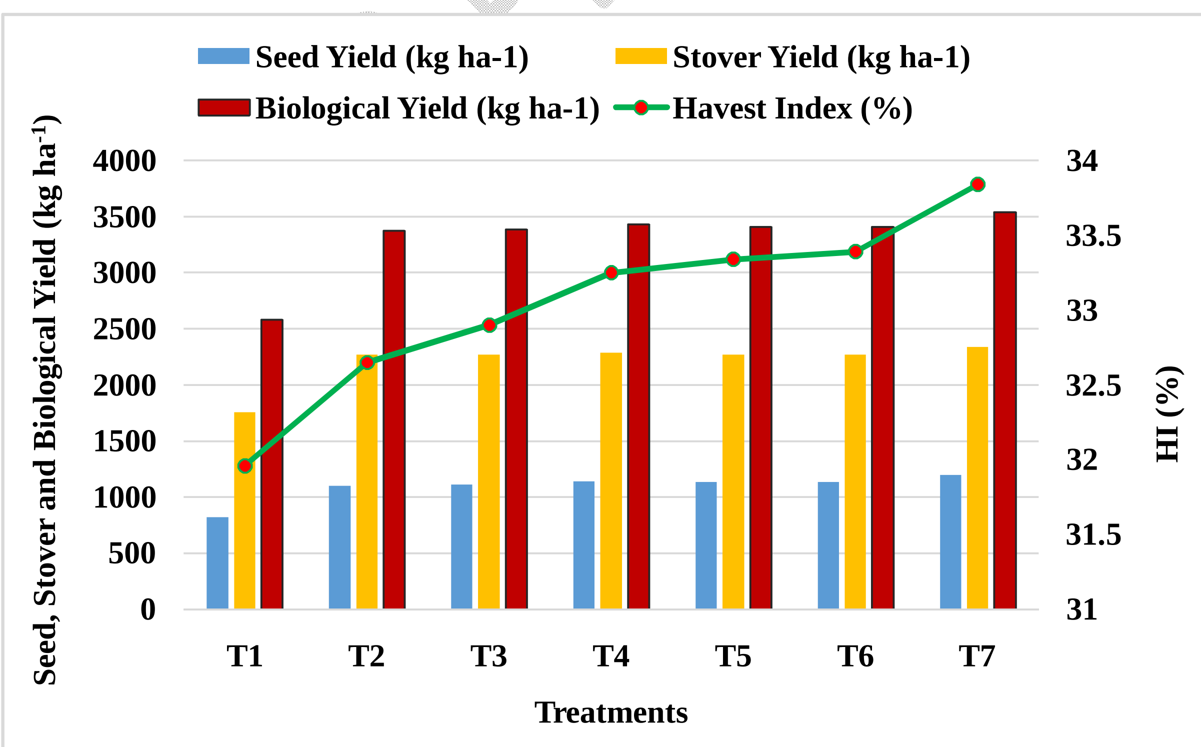

Fig. 2: Effect of organic manures and biofertilizers on yield studies of mung