Effect of Organic Manures and Biofertlizer on Crop Phenology and Growth parameters of Mung Bean (*Vigna radiata*)

ABSTRACT

Pulses are significant in India's agricultural economy not only for their worth as human food, but also for animals because of their high protein content. Due to pulses deep roots and great ground cover, pulses are drought tolerant and minimize soil erosion and are known as a "Marvel of Nature" because of these positive qualities. Mung bean, also known as green gram (*Vigna radiata*) is a small green, and cylindrical-shaped legume that is widely cultivated in various parts of the world, including India, China, and Southeast Asia.The present study was carried out during *summer* season of 2024 at Research Farm, School of Agriculture, OM Sterling Global University, Hisar. Seven treatment combinations comprising of organic manures and biofertilizer were tested in randomized block design in three replications.The plot size maintained was 3.6 m*2.0 m and high yielding MH 1142 variety were taken for the study.The results revealed that the growth parameters *viz.*, Plant height, dry matter accumulation, root shoot ratio on the length and weight basis and number of branches per plant, Phenology studies viz., days taken to emergence, flowering, pod initiation and maturity and grain yield were significantly higher in the treatment of Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB. Whereas, significantly minimum for all above parameters were recorded under control.

Key words: Mung bean, organic manures, bio fertilizer, phenology and growth parameters

INTRODUCTION

Mung bean, also known as green gram (*Vigna radiata*) is a small green, and cylindrical-shaped legume that is widely cultivated in various parts of the world, including India, China, and Southeast Asia. In India, the area under mung bean was 4.75-million-hectare with production of 2.46 million tonnes (516 kg ha^{-1}) during 2018-19 (Anonymous, 2018). It is a highly nutritious and versatile crop that is used for both food and fodder purposes. The plant is known for its tolerance to different climatic conditions, and it is often grown in rotation with other crops to enhance soil fertility. The mung bean seed is high in copper, phosphorus, potassium, magnesium, important vitamins, contains 20-25% protein, 1.3 % fat, 15.4 % fibre and 3.7 ash % (FAO, 2019). There is no doubt that chemical fertilizers are playing a vital role to meet the nutrient requirement of crops and thereby increasing their production. However, recently the non-judicious use of chemical fertilizers is posing both economic and ecological problems, which are often difficult to face, particularly in developing countries (Sutton *et al*., 2011). The cost of chemical fertilizers is high, but the organic manure is easily available and low cost. Therefore, smallholder farmers have shifted their attention from chemical alone agriculture to organic nutrient management strategy which utilizes organic nutrients forms (Singh *et al*., 2017). Organic matter acts as a reservoir of plant nutrients, chiefly N, P and S and it improves cation exchange capacity of soil (Brady and Weil, 2008).In Agriculture manures such as farmyard manure, vermicompost, poultry manure, *etc*. are used as source 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, FYM is rich in organic matter and it is a good source of plant nutrients. It help to buffer soils against rapid chemical changes. FYM can potentially be used as a source of energy for soil microorganisms, improvement in physical properties of soil, organic carbon and available nitrogen, phosphorus and potassium were found due to long term application of FYM and fertilizer (Babulkar *et al*., 2000). Vermicompost is created by vermicomposting of organic material through interactions between earthworm and microorganisms. The continued use of chemical fertilizers causes health and environmental hazards such as ground and surface water pollution by nitrate leaching (Eswaran and Mariselvi, 2016). Stimulation of plant growth mainly depend on the biological characteristics of vermicompost, the plant species used and the conditions of cultivation. Poultry manure (PM) has gained attention as a potential source of organic fertilizer because of its high nutrient content and relatively low cost. PM, which is rich in nitrogen, phosphorus, potassium, and other essential nutrients, has been shown to improve soil fertility, increase crop yield and enhance the quality of agricultural products. (Mutale-Joan *et al*., 2020).

Organic concoctions like Jeevamrutha/Jeevamrutha which is a microbial culture prepared from the on-farm inputs like cow dung, urine, jiggery and pulse 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. Bio-fertilizers, a component of integrated nutrient management are considered to be cost effective, eco-friendly and renewable source of non-bulky, low cost of plant nutrient supplementing chemical fertilizers in sustainable agriculture system in India. Their role assumes a special significance in present context of high costs of chemical fertilizers.

Considering these above facts, the present study was conducted to assess the effect of organic manures and biofertilizer on growth and phenology of mung bean (*vigna radiata*).

MATERIALS AND METHODS

The present study was carried out during *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 sun shine 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 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 MH 1142 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.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 growth parameters *i.e.*, plant height, dry matter accumulation, root shoot ratio on the length and weight basis and number of branches per plant, Phenology studies viz., days taken to emergence, flowering, pod initiation and maturity and grain yield 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).

RESULTS AND DISCUSSION

1. Crop Phenology

The perusal of data are presented in Table 6 and depicted in Fig.1 showed that the treatments were not influenced crop emergence during of study. However, treatments T_1, T_3, T_5 and T_7 had taken numerically more days for emergence, the crop took 6.67 days for emergence while in the other treatments *i.e.,* T_2, T_4 and T_6 crop took 6.33 days for emergence. Among the treatments, T_7 (43.67), (52.00) T_6 (43.00), (51.67); T_5 (42.33), (64.33); T_4 (42.33) (50.00), respectively significantly took more days for the flowering and pod initiation stage as compared to other treatments during the year of study. Among the treatments, T_7 (65.67); T_6 (65.33); T_5 (50.00), respectively significantly took more days for the maturity stage as compared to other treatments during the year of study. Similar results were reported by Rahman *et al.* (2009) and Singh *et al*. (2019).

2. Growth Parameters

The data are presented in Tables 1, 2, 3, 4 and 5 on different growth attributing characters of mung bean *viz.*, plant height, dry matter accumulation, root shoot ratio on length basis, root shoot ratio on weight basis and number of branches per plant, respectively. Plant height is an index of plant growth which is mainly controlled by genetic makeup of a genotype and also it can be influenced by environmental condition. Plant nutrition plays an important role even under favorable environmental condition. Among the treatments, treatment T_7 (Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS+ Rhizobium +PSB) recorded significantly taller plants height (21.07; 48.82; 58.67; 59.00 cm) as compared to other treatments at 30, 45, 60

DAS and at harvest respectively. Among the treatments, treatment T_7 (Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB) produced significantly higher dry matter accumulation (4.93; 13.83 g; 19.32; 21.41g) as compared to others treatments at 30, 45 60 DAS, and at harvest. The significantly lower dry matter accumulation (2.50; 6.96; 9.69; 10.71 g) were recorded in treatment T_1 (control) at all the growth stages of mung bean crop. There was non-significant difference in the root shoot ratio on length basis among all the treatments. However, maximum root shoot ratio on length basis (0.58) was recorded in treatment T_7 (Jeevamrtha (j) @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB) and minimum root shoot ratio on length basis (0.32) was recorded in control. Among the treatments, treatment T_7 (Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB) produced significantly higher root shoot ratio on length basis (0.65; 0.70; 0.75) as compared to others treatments at 45, 60 DAS and at harvest. The significantly lower root shoot ratio on length basis (0.33; 0.39; 0.42) were recorded in treatment T_1 (control) at 45, 60 DAS and at harvest stages of mung bean crop, respectively. Among the treatments, treatment T_7 (Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB) produced significantly higher number of branches per plant (3.67; 5.00; 5.67; 5.83) as compared to other treatments. The significantly lower number of branches per plant (217; 2.83; 3.67; 3.83) were recorded in treatment T_1 (control) at 30, 45, 60 DAS and at harvest stages of mung bean crop, respectively.Significant increase in plant height, dry matter accumulation, root shoot ratio on length and weight basis and number of branches per plant of mung bean might be due to the availability of small quantities of macronutrients, micronutrients and growth promoting substances in addition to huge beneficial microbial population in jeevamrut, thus when applied to the crop as foliar spray and through soil they trigger the necessary plant growth. Moreover, liquid bioenhancer avail favourable influence of nitrogen to produce larger cells with thinner cell walls and its contribution in cell division and cell elongation, which promoted vegetative growth and ultimately increased growth parameters and improved the metabolic and photosynthetic activity for enhancing biological efficiency of plant which helps the roots to spread into deeper layer of soil so that it can uptake more nutrients from soil cause there by accumulation of more carbohydrates and higher dry matter (Upperi *et al.*, 2009; Patel *et al.*, 2023). These results corroborate with the findings (Ramesh *et al.*, 2015; Siddappa *et al.*, 2016; Gowda *et al.*, 2018). Foliar sprays enhanced the availability of nutrients at site of photosynthesis leading to improved growth of mung plant. Liquid organics like jeevamrut, possessed good amount of nutrients enriched with beneficial microorganism and growth promoting substances along with other enzymes (Nileema *et al*., 2011). Similar result was also reported by (Gunasekar *et al*., 2018).

CONCLUSION

Treatment T_7 (Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB) was found most suitable in terms of Phenology *viz*., days taken to emergence, 50 per cent flowering,50 % pod initiation and physiological maturity; growth parameters *viz*., plant height, dry matter accumulation, number of branches per plant, root shoot ratio on length and weight basis of crop;grain yield among all treatments, it can be concluded that among the treatment tested, treatment T_7 (Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB) may be grown for better phenology and growth parameters.

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Table 1: Effect of organic manures and biofertlizer on plant height (cm) at all growth stages of mung bean crop.

Treatments	Plant height (cm)			
	At 30 DAS	At 45 DAS	At 60 DAS	At harvest
T_1: Control	15.54	39.93	46.31	47.30
T_2: Farmyard Manure (FYM) @ 10 t/ ha	16.37	44.47	53.03	54.41
T_3: Vermicompost (VC) @ 5 t/ ha	17.06	45.33	53.75	55.45

T_4: Poultry Manure (PM) @ 5 t/ ha	18.05	45.6	54.52	55.71
T_5: 50% FYM @ 5 t/ha + 50% VC @ 2.5 t/ha +Rhizobium+PSB	18.89	46.53	54.82	55.84
T_6: 50% FYM @ 5 t/ha+50% PM @ 2.5 t/ha + Rhizobium +PSB	19.77	46.77	55.82	56.66
T_7: Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS+ Rhizobium +PSB	21.07	48.82	58.67	59.00
SE (m) ±	**0.35**	**0.48**	**0.71**	**0.59**
CD at 5 %	**1.07**	**1.49**	**2.23**	**1.84**

Table 2: Effect of organic manures and biofertlizer on dry matter accumulation (g) at all growth stages of mung bean crop.

Treatments	**Dry matter accumulation (g)**			
	At 30 DAS	**At 45 DAS**	**At 60 DAS**	**At harvest**
T_1: Control	2.50	6.96	9.69	10.71
T_2: Farmyard Manure (FYM) @ 10 t/ ha	3.76	10.56	14.72	16.31
T_3: Vermicompost (VC) @ 5 t/ ha	3.91	10.93	15.34	16.97
T_4: Poultry Manure (PM) @ 5 t/ ha	4.00	11.20	15.63	17.31
T_5: 50% FYM @ 5 t/ha + 50% VC @ 2.5 t/ha +Rizobium+PSB	4.12	11.50	16.08	17.80
T_6: 50% FYM @ 5 t/ha+50% PM @ 2.5 t/ha + Rhizobium +PSB	4.20	12.04	16.81	18.63
T_7: Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB	4.93	13.83	19.32	21.41
SE (m) ±	**0.16**	**0.49**	**0.72**	**0.81**
CD at 5 %	**0.51**	**1.52**	**2.24**	**2.53**

Table 3: Effect of organic manures and biofertlizer on root shoot ratio on length basis at all growth stages of mung bean crop.

Treatments	**Root shoot ratio on length basis**			
	At 30 DAS	**At 45 DAS**	**At 60 DAS**	**At harvest**
T_1: Control	0.32	0.33	0.39	0.42
T_2: Farmyard Manure (FYM) @ 10 t/ ha	0.42	0.46	0.52	0.54

T_3: Vermicompost (VC) @ 5 t/ ha	0.47	0.49	0.55	0.57
T_4: Poultry Manure (PM) @ 5 t/ ha	0.48	0.53	0.60	0.62
T_5: 50% FYM @ 5 t/ha + 50% VC @ 2 .5 t/ha +Rhizobium+PSB	0.52	0.56	0.62	0.64
T_6: 50% FYM @ 5 t/ha + 50% PM @ 2.5 t/ha + Rhizobium +PSB	0.56	0.60	0.66	0.68
T_7: Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB	0.58	0.65	0.70	0.75
SE (m) ±	**0.09**	**0.01**	**0.01**	**0.02**
CD at 5 %	**NS**	**0.05**	**0.03**	**0.07**

Table 4: Effect of organic manures and biofertlizer on root shoot ratio on weight basis at all growth stages of mung bean crop.

Treatments	**Root shoot ratio on weight basis**			
	At 30 DAS	**At 45 DAS**	**At 60 DAS**	**At harvest**
T_1: Control	0.14	0.15	0.16	0.18
T_2: Farmyard Manure (FYM) @ 10 t/ ha	0.17	0.18	0.20	0.21
T_3: Vermicompost (VC) @ 5 t/ ha	0.18	0.22	0.23	0.24
T_4: Poultry Manure (PM) @ 5 t/ ha	0.20	0.24	0.25	0.26
T_5: 50% FYM @ 5 t/ha + 50% VC @ 2 .5 t/ha +Rizobium+PSB	0.21	0.25	0.27	0.28
T_6: 50 % FYM @ 5 t/ha+50 % PM @ 2.5 t/ha + Rhizobium +PSB	0.23	0.28	0.31	0.30
T_7: Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB	0.29	0.35	0.35	0.36
SE (m) ±	**0.02**	**0.02**	**0.01**	**0.02**
CD at 5 %	**0.05**	**0.05**	**0.02**	**0.05**

Table 5: Effect of organic manures and biofertlizer on number of branches per plant at all growth stages of mung bean crop.

Treatments	**Number of branches per plant**			
	At 30 DAS	**At 45 DAS**	**At 60 DAS**	**At harvest**
T_1: Control	2.17	2.83	3.67	3.83
T_2: Farmyard Manure (FYM) @ 10 t/ ha	2.50	3.50	4.00	4.17
T_3: Vermicompost (VC) @ 5 t/ ha	2.67	3.33	4.00	4.33

T_4: Poultry Manure (PM) @ 5 t/ ha	3.00	3.67	4.33	4.83
T_5: 50% FYM @ 5t/ha + 50% VC @ 2.5 t/ha +Rizobium+PSB	3.17	4.03	4.83	5.00
T_6: 50% FYM @ 5 t/ha+50% PM @ 2.5 t/ha + Rhizobium +PSB	3.33	4.33	5.33	5.00
T_7: Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB	3.67	5.00	5.67	5.83
SE (m) ±	**0.32**	**0.17**	**0.20**	**0.26**
CD at 5 %	**NS**	**0.52**	**0.61**	**0.79**

Table 6: Effect of organic manures and biofertlizer on phenological stages of mung bean crop.

Treatments	Days taken to			
	Emergence	**Flowering**	**Pod initiation**	**Maturity**
T_1: Control	6.67	40.33	47.67	62.33
T_2: Farmyard Manure (FYM) @ 10 t/ ha	6.33	40.67	48.67	63.00
T_3: Vermicompost (VC) @ 5 t/ ha	6.67	41.33	49.00	63.33
T_4: Poultry Manure (PM) @ 5 t/ ha	6.33	42.33	50.00	64.00
T_5: 50% FYM @ 5 t/ha + 50% VC @ 2.5 t/ha +Rizobium+PSB	6.67	42.33	50.00	64.33
T_6: 50% FYM @ 5 t/ha+50% PM @ 2.5 t/ha + Rhizobium +PSB	6.33	43.00	51.67	65.33
T_7: Jeevamrtha @ 3000 l ha^{-1} through three splits at sowing, 30 and 45 DAS + Rhizobium +PSB	6.67	43.67	52.00	65.67
SE (m) ±	**0.35**	**0.61**	**0.71**	**0.44**
CD at 5 %	**NS**	**1.90**	**2.22**	**1.38**

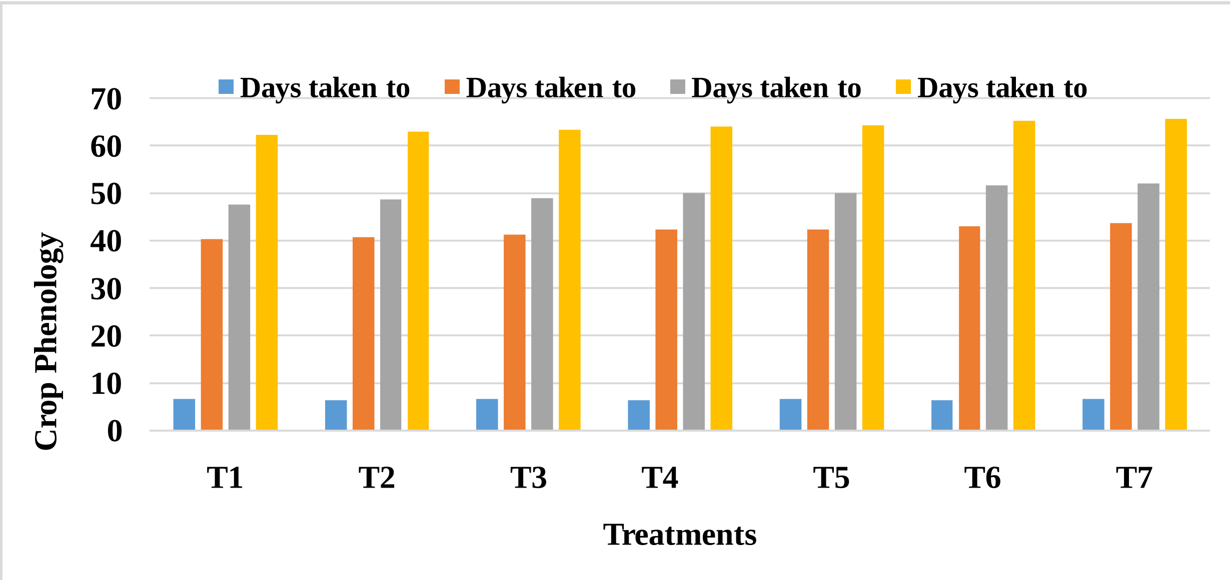

Fig. 1: Effect of organic manures and biofertlizer on phenological stages of mung bean crop