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Impact of Organic Nutrient Management Practices on Growth and Yield of Mungbean

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ABSTRACT

A multilocation field experiment was conducted during *kharif* season (July–September) of 2019 in mungbean under organic nutrient management at Agriculture Research Sub-Station, Sumerpur, Pali and Adaptive Trial Centre, Sumerpur, Pali, Rajasthan, India. The nine organic nutrient management practices viz. T_1- Farmyard manure (FYM) as per soil health card @ 10 t ha^{-1}, T_2- Vermicompost @ 2 t ha^{-1}, T_3- T_1+Vermiwash @ 10% at 15, 30 and 45 days after sowing (DAS), T_4- T_2+Vermiwash @ 10% at 15, 30 and 45 DAS, T_5- T_1+Panchgavya @ 4% at 15, 30 and 45 DAS, T_6- T_2+Panchgavya @ 4% at 15, 30 and 45 DAS, T_7- T_1+Panchgavya @ 6% at 15, 30 and 45 DAS, T_8- T_2+Panchgavya @ 6% at 15, 30 and 45 DAS and T_9- Control in three replications in randomized complete block design (RCBD). The higher values of growth attributes like number of leaves, number of branches, height and leaf area per plant were recorded by treatment vermicompost as per soil health card+Panchgavya @ 4% at 15, 30 and 45 days after sowing (DAS) which was found significantly superior over the other treatments at both the places. It was found that Panchgavya @ 4% at 15, 30 and 45 DAS along with vermicompost @ 2 t ha^{-1} obtained higher SPAD value (39.51), seed yield (908 kg ha^{-1}) and benefit cost ratio (B:C ratio) under organic farming during *kharif* season at both the places.

KEYWORDS: FYM, moong, nutrient management, organic, panchgavya, vermicompost, vermiwash

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1. INTRODUCTION

Green gram is an excellent source of high-quality protein and contains about 25% protein having high digestibility. It has 25–26% protein, 3% vitamins and 51% carbohydrates (Deotale et al., 2005). Being leguminous in nature, mungbean needs low nitrogen but require optimum doses of other major nutrients as recommended. Organic materials hold great promise as a source of multiple nutrients and ability to improve soil characteristics (Moller, 2009). In mungbean roots have symbiotic rhizobia bacteria which help in fixing atmospheric nitrogen into the soil (Basu and Bandyopadhyay, 1990, Basu and Sharma, 1989). Synthetic fertilizers have mainly macronutrients in large quantities and cemented the soil for worsening the soil and also the negative impact on crops, livestock and human being (Moller, 2009, Shweta et al., 2021, Meena et al., 2020b). Soil and fertilizer management is very complex and dynamic in nature. In the recent years, micronutrients such as zinc and iron have improved productivity of pulse crops considerably in many pockets (Meena and Lal, 2015). We are increasingly forced to meet up growing food needs from increase in yield from existing or even shrinking land areas (Anonymous, 2005). For sustainable agriculture, emphasis should be on the use of organic fertilizer for growing crops (Tejada et al., 2009).

Organic manures are great sources of nitrogen and other essential plant nutrients. The use of organics in crop production is nothing new to our agriculture and many organics like farmyard manure, compost, neem cake, vermicompost, poultry manure etc. are used as a substitute for chemical fertilizers to supply plant nutrients in traditional farming which also helps to sustain soil organic carbon and maintain favourable soil condition for crop growth.Organic manures contain both macro and micro nutrients and enhance soil fertility, and lead to increasing availability of plant nutrients through mineralization (Khan et al., 2009, Moller, 2009, Shweta et al., 2021). In recent years fermented, liquid organic fertilizers, effective microorganisms (EM) as foliar fertilizers have been introduced to modern agriculture to produce food with good quality and safety. The use of organic matter as a lost cost supplement to the artificial fertilizers may help decreasing the cost of production (Aslam et al., 2010). Panchgavya, an organic product is a potential source to play great role for promoting growth and providing immunity to plant system. Bio-chemical properties of panchgavya revealed that it possesses almost all the nutrients like N, P, K and micronutrients essential for plant nutrition and growth hormones like IAA and GA required for crop growth (Selvaraj et al., 2007, Arun and Debbarna, 2022). Vermiwash is coelomic fluid extraction contains several enzymes, plant growth hormones like cytokinins, gibberlines and vitamins along with micro and macro nutrients (Buckerfield et al., 1999, Tripathi and Bhardwaj, 2004). Varghese and Prabha (2014) stated that vermiwash is cost effective and used as bio-pesticide and ecofriendly soil conditioner. Vermicompost is nutrient rich products of a non-thermophilic biodegradation of organic materials through interactions between earthworms and microorganisms (Aira et al., 2002). Farmyard manure is known to play an important role in improving the fertility and capacity of soils through its positive effects on soil physical, volatility and biological properties and level of plant nutrition (Priyadarshini et al., 2021). Use of eco-friendly bioenhancers is another alternate way for nourishing the crops grown under organic farming besides organic manures and biofertilizers. Hence, present experiment was carried out to find the effect of different organic preparations on growth and yield of greengram under organic farming.

2. MATERIALS AND METHODS

A field experiment was carried out during *kharif* (July–September, 2019) at Agriculture Research Sub-Station, Sumerpur, Pali and Adaptive Trial Centre, Sumerpur, Pali, Rajasthan, India located at Latitude 25.1415° and Longitude 73.1010° on sandy silty clay loam soil which is low in organic carbon (0.22%) and available nitrogen (143.5 kg ha^{-1}), high in available phosphorus (44.2 kg ha^{-1}) and potassium (256 kg ha^{-1}) with soil pH 7.9. The experiment consisted of nine treatments viz., T_1- FYM as per soil health card @10 t ha^{-1} , T_2- Vermicompost @ 2 t ha^{-1} , T_3- T_1+Vermiwash @ 10% at 15, 30 and 45 DAS, T_4- T_2+Vermiwash @ 10% at 15, 30 and 45 DAS, T_5- T_1+Panchgavya @4% at 15, 30 and 45 DAS, T_6- T_2+Panchgavya @ 4% at 15, 30 and 45 DAS, T_7- T_1+Panchgavya @ 6% at 15, 30 and 45 DAS, T_8- T_2+Panchgavya @ 6% at 15, 30 and 45 DAS and T_9- Control were tested in randomized block design in three replications. Greengram variety GM-6 was sown @ 20 kg ha^{-1} seed rate at inter row spacing of 30 cm×10 cm on 29th July, 2019.

Panchgavya is a special preparation made from 5 products of deshi cow along with certain other ingredients incubated for specific duration in an open mouth plastic container (Natarajan, 2002). The nutrient composition of Panchgavya, Vermicompost, Vermiwash and Farmyard manure (FYM) was given in Table 1. Application of well decomposed FYM was done as per the treatments and mixed well with the soil. Nitrogen and phosphorus were applied at the rate of 20 kg ha^{-1} and 40 kg ha^{-1} through urea and DAP, respectively inpreviously opened furrows before sowing of seeds as per treatments. Foliar spray of panchgavya @ 4% amd 6% and vermiwash @ 10% were done at 15, 30 and 45 DAS as per treatments using knapsack sprayer during evening hours. Five plants/plot were selected in the net plot area and tagged for recording growth and yield attributes. The crop was

manually harvested, threshed and seed yield were recorded. The net return was computed using prevailing market price of inputs, seed of greengram.

Nutrients	Panchgavya	Vermicompost	Vermiwash	FYM
N (%)	0.23	2.3	0.52	0.50
P_2O_5 (%)	0.02	1.95	0.35	0.20
K_2O (%)	0.13	1.62	0.70	0.50

3. RESULTS AND DISCUSSION

3.1. Growth attributes

All growth parameters of greengram *viz.*, number of nodules/plant, dry weight of nodules, SPAD value, plant height, number of leaves plant^{-1}, number of branches plant^{-1}, leaf area plant^{-1} were influenced significantly due to use of different organic management practices (Table 1). Application of Panchgavya @ 4% at 15, 30 and 45 DAS along with vermicompost @ 2 t ha^{-1} produced significantly taller plants than control than alone application of vermicompost @ 2 t ha^{-1} or FYM @ 10 t ha^{-1} , but remained on par with application of Panchgavya @ 6% at 15, 30 and 45 DAS along with both FYM @10 t ha^{-1} and vermicompost @ 2 t ha^{-1}. Application of Panchgavya @ 4% at 15, 30 and 45 DAS along with FYM as per soil health card @ 10 t ha^{-1} recorded significantly higher number of leaves plant^{-1}, number of branches plant^{-1} and leaf area plant^{-1} over rest of the treatments. The increase in plant height might be due to application of panchgavya and vermiwash attributed to increase in availability of cytokinin of shoot which in turn play a role in cell elongation process either through cell division and cell elongation Beaulah (2002), Sanjutha et al. (2008) and Kumawat et al. (2009). Panchgavya provides almost all the plant nutrients for the growth and development of plants which resulted in more plant height (Nileema et al., 2011; Ali et al., 2011). Panchgavya might have contained microbial metabolites in appreciable amount that help in maintaining the opening of stomata for longer period both in optimum and adverse conditions during the crop growth which led to increased LAI providing stronger source for sink (Rao et al., 2010; Swarnam et al., 2016). Somasundaram and Amanullah (2007) reviewed that panchagavya shows positive effect on growth and productivity of crops. Pagar et al., (2016) reported that application of panchagavya influenced the plant height, dry matter accumulation, which in turn influences the yield.

3.2. Yield and yield attributes

Yield contributing characters, viz., pod length, number of pods plant^{-1}, dry weight pod^{-1} and seed index were significantly improved by application of organic management practices (Table 2 and Figure 1). However, number of seeds

Table 1: Effect of various organic preparations on growth characters of mungbean (mean of both places)

Treatment	Details	No. of nodules plant^{-1}	Dry weight of nodules (mg plant^{-1})	SPAD value	Height 60 DAS (cm)	Height harvest (cm)	No. of leaves plant^{-1}	No. of branches plant^{-1}	Leaf area plant^{-1} (cm^2)
T_1	FYM as per soil health card @ 10 t ha^{-1}	19.14	18.66	29.71	23.77	51.66	16.36	6.33	437.43
T_2	Vermicompost @ 2 t ha^{-1}	19.68	17.91	30.08	24.1	52.93	16.62	6.22	447.48
T_3	T1+Vermiwash @ 10% at 15, 30 and 45 DAS	21.08	21.04	33.64	25.2	53.7	19.36	7.20	499.09
T_4	T2+Vermiwash @ 10% at 15, 30 and 45 DAS	22.04	21.42	34.68	26.1	55.44	16.74	7.50	504.35
T_5	T_1+Panchgavya @ 4% at 15, 30 and 45 DAS	24.95	23.77	38.26	26.1	57.13	23.41	7.56	528.83
T_6	T_2+Panchgavya @ 4% at 15, 30 and 45 DAS	25.10	23.74	39.51	26.46	58.58	21.3	8.10	579.48
T_7	T_1+Panchgavya @ 6% at 15, 30 and 45 DAS	20.46	19.68	31.64	24.35	54.35	22.87	7.23	470.17
T_8	T_2+Panchgavya @ 6% at 15, 30 and 45 DAS	21.01	19.81	33.95	24.12	53.52	18.22	7.17	456.28
T_9	Control	14.00	12.94	26.77	22.75	45.87	15.86	6.10	339.26
SEm±		1.30	1.24	1.52	0.50	1.79	1.76	0.29	18.77
CD (p=0.05)		3.95	3.76	4.61	1.46	5.26	5.32	0.88	56.76

pod^{-1} being a varietal character showed nonsignificant effect of treatments. Application of panchgavya as foliar spray @ 4.0% at 15, 30 and 45 DAS along with vermicompost @ 2 t ha^{-1} gave significantly more pods plant^{-1}, number of seeds pod^{-1}, dry weight pod^{-1} and 100 seed weight which was found *at par* with Panchgavya @ 4% at 15, 30 and 45 DAS along with FYM as per soil health card @ 10 t ha^{-1} and vermiwash @ 10% at 15, 30 and 45 DAS along with vermicompost @ 2 t ha^{-1}. Liquid organic management practices particularly panchgavya and vermiwash contributed to enhancement of number of leaves plant^{-1} encourages better photosynthesis and production of more photosynthates which contributed toward the formulation of more pods plant^{-1}, dry weight pod^{-1} and stouted seed (bold seed). IAA and GA present in panchgavya could create stimuli in the plant system and simulated the necessary growth and development of crop (Patel et al. (2013); Sutar et al., 2019 and Pandey et al. (2019). Shariff et al. (2017) noted that cow dung in panchgavya act as a medium for the growth of beneficial microbes and cow urine provides nitrogen which is essential for crop growth and resulting in increased pod length. The treatment of nutrients and growth stimulants to plants

Table 2: Effect of various organic preparations on yield and yield attributing characters of mungbean

Treat-ment	Details	Pod length (cm)	Dry weight pod^{-1} (g)	No. of pods plant^{-1} (g)	No. of seeds pod^{-1}	Seed index (g)	Seed yield (kg ha^{-1})	B:C ratio
T_1	FYM as per soil health card @ 10 t ha^{-1}	6.89	0.54	20.15	9.67	46.49	655	1.21
T_2	Vermicompost @ 2 t ha^{-1}	7.12	0.59	20.85	10.69	47.51	667	1.31
T_3	T1+Vermiwash @ 10% at 15, 30 and 45 DAS	7.55	0.63	22.53	11.22	48.58	780	1.50
T_4	T2+Vermiwash @ 10% at 15, 30 and 45 DAS	7.89	0.69	23.10	11.37	50.01	823	1.57
T_5	T_1+Panchgavya @ 4% at 15, 30 and 45 DAS	8.04	0.7	23.34	11.42	50.10	868	1.68
T_6	T_2+Panchgavya @ 4% at 15, 30 and 45 DAS	8.19	0.76	24.1	11.57	51.21	908	1.71
T_7	T_1+Panchgavya @ 6% at 15, 30 and 45 DAS	7.43	0.60	21.5	10.44	47.58	680	1.40
T_8	T_2+Panchgavya @ 6% at 15, 30 and 45 DAS	7.31	0.61	20.97	10.56	47.76	713	1.48
T_9	Control	6.48	0.53	17.75	8.45	46.43	548	1.13
SEm±		0.33	0.02	1.22	0.29	0.21	40	
CD (p=0.05)		0.99	007	3.57	NS	NS	118	

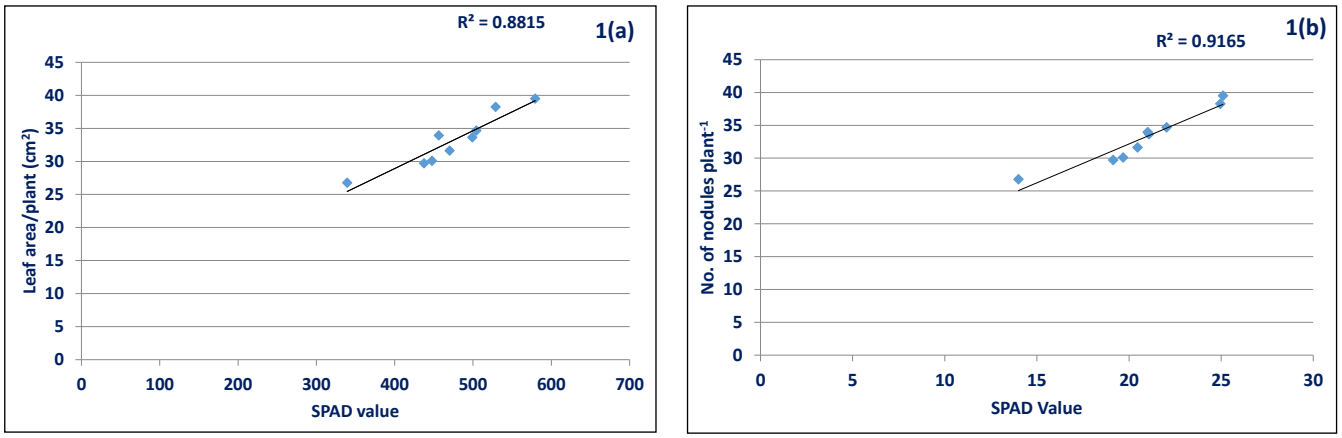

Figure 1: Study of Correlation between leaf area plant^{-1} (cm^2) and SPAD value (a) and between number of nodules plant^{-1} and SPAD value (b)

through foliar spray of Panchgavya might be the reason for enhancement in yield attributes (Somasundaram et al., 2003 and Birendra and Christopher, 2007). Seed yield of greengram was significantly influenced by the treatments. An application of Panchgavya @ 4% at 15, 30 and 45 DAS along with vermicompost @ 2 t ha^{-1} registered maximum seed yield (908 kg ha^{-1}) followed by panchgavya @ 4% at 15, 30 and 45 DAS along with FYM as per soil health card @ 10 t ha^{-1} and vermiwash @ 10% at 15, 30 and 45 DAS along with vermicompost @ 2 t ha^{-1}, accounted for 74.61, 66.92 and 58.26% higher seed yield over control treatment. Higher yield under these treatments ascribed due to improvement in plant height, number of leaves $plant^{-1}$, number of pods $plant^{-1}$, dry weight pod^{-1} and seed index which have significant positive correlation with seed yield. These findings are in line with those reported by Kannan et al., (2014) and Shariff et al. (2017). Highest BCR value of 1.71 was incurred under the treatment of Panchgavya @ 4% at 15, 30 and 45 DAS along with vermicompost @ 2 t ha^{-1} followed by panchgavya@ 4% at 15, 30 and 45 DAS along with FYM as per soil health card @ 10 t ha^{-1} of 1.68 (Table 1). Maximum BCR was noted. Gopal et al. (2017) and Choudhary et al. (2021) stated that panchgavya (4%) spray showed significantly higher number of pods, number of seeds, seed yield, straw yield and net returns in black gram.

Under these treatments was mainly on account of higher seed yield and favourable response of greengram to panchgavya and vermicompost. The results are in conformity with those reported by Patel et al. (2013).

Significant positive correlation was observed between leaf area/plant and SPAD value (R^2=0.881) and number of nodules $plant^{-1}$ and SPAD value (R^2=0.916). This shows the importance of proper nodulation for better productive performance of mungbean (Reddy and Reddy, 2001). SPAD value has positive correlation with organic sources of nutrients and in turn with leaf area $plant^{-1}$ (Menon et al., 2010).

4. CONCLUSION

The application of Panchgavya @ 4% at 15, 30 and 45 DAS along with vermicompost @ 2 t ha^{-1} and panchgavya @ 4% at 15, 30 and 45 DAS along with FYM as per soil health card @ 10 t ha^{-1} may be recommended for obtaining higher seed yield and net returns and improving biological fertility of soil for greengram raised under organic farming under *kharif* season.

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