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Effect of Different Doses of Panchgavya on Productivity of Moth Bean [*Vigna aconitifolia* (Jacq.) Marechal]

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ABSTRACT

Background: The panchgavya, an liquid organic manure has the potential to play the role in promoting growth and providing immunity in the plant system, resulting in increased overall yields. Hence, the present study was carried out to assess the fertilization effect of panchgavya on growth, yield and qualitative traits of moth bean in semi-arid environment.

Methods: A field experiment was conducted at Agronomy Research Farm, Sri Karan Narendra Agriculture University, Jobner, Rajasthan to study the effect of different levels of Panchgavya (2.5%, 5% and 7.5% each at 20 DAS (days after sowing), 35 DAS and 20 DAS + 35 DAS, respectively) on growth and yield of mothbean. The field experiment was laid out in a randomized block design with three replications comprising of 10 treatments.

Result: Application of 5% Panchgavya at 20 DAS + 35 DAS in mothbean resulted in significantly higher grain yield and net return in comparison to control. Thus, the study recommended the correct concentration of Panchgavya (5%) for enhancing moth bean productivity in the Rajasthan and similar eco-regions elsewhere for nutritional security.

Key words: Growth, Panchgavya, Plant growth promoter, Quality, Yield.

INTRODUCTION

Mothbean [*Vigna aconitifolia* (Jacq.) Marechal] is an important pulse crop of the desert region and is well suited to arid and semi-arid areas of India and some other countries of Asia. It is drought tolerant, can be grown on relatively poor soils and fixes nitrogen thereby improving soil fertility. It requires minimum annual rainfall of 200 mm. It can very well withstand drought conditions and is probably the most drought resistant crop among the grain legumes. The crop has spreading growth habit forming a mat like covering on the soil surface. It thus helps greatly in the conservation of soil, water and serves as a very efficient and suitable cover crop for checking soil erosion.

But in this present-day situation organic farming is alternative to conventional system, utilizing the locally available farm inputs and reducing the cost of cultivation. Panchgavya, an organic product is the potential source for promoting growth and providing immunity in plant system. Panchgavya is a bio promoter with a combination of five products obtained from the cow *viz*., dung, urine, milk, curd and ghee. Panchgavya acts as growth promoter (75%) and immunity booster (25%) and exactly fills the missing link to sustain the organic farming without any yield loss (Vedivel, 2007). Biochemical properties of panchagavya revealed that it contains almost all the major nutrients like N, P, K and micronutrients necessary for plant and growth hormones like Indole acetic acid (IAA) and Gibberellic acid (GA) required for crop growth as well as the predominance of fermentative microorganisms like yeast, azotobacter, phoshobacteria and lactobacillus (Selvaraj, 2003). Information on performance of Panchgavya on growth and productivity of mothbean is meagre and hence, the present investigation was undertaken.

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MATERIALS AND METHODS

The present field experiment was carried out during the rainy (*Kharif*-2019) season at the Agronomy Research Farm, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India. The experimental site is located at 26° 05′ N latitude and 75° 28′ E longitude and an altitude of 427 meters above mean sea level in the Jaipur district of Rajasthan. This region lies in agroclimatic zone III-A (Semi-Arid Eastern Plain) of Rajasthan. The relative humidity fluctuates between 42 to 87 per cent. The maximum and minimum temperature ranged between 30.5 to 36.8°C and 19.5 to 24.9°C,

respectively. The total amount of rainfall received during moth bean crop growth in 2019 was 376.9 mm and this was well distributed during the crop growth period. The soil of top 15 cm depth of experimental site was loamy sand, saline in reaction, low in OC and available N, medium in available P and exchangeable K. The details of the treatments *viz*, control, panchgavya 2.5% at 20 DAS, panchgavya 2.5% at 35 DAS, panchgavya 2.5% at 20 DAS + 35 DAS, panchgavya 5% at 20 DAS, panchgavya 5% at 35 DAS, panchgavya 5% at 20 DAS + 35 DAS, panchgavya 7.5% at 20 DAS, panchgavya 7.5% at 35 DAS and panchgavya 7.5% at 20 DAS + 35 DAS. Panchgavya solutions were prepared as per treatment application, for example, 2.5% of panchgavya solution was prepared by adding 2.5 litres of panchgavya to every 100 litres of water. After dilution of the panchgavya solution, it was filtered before using for spraying. The spray solution of panchgavya was sprayed at 20 DAS @ 400 litres ha^{-1} and at 35 DAS @ 500 litres ha^{-1} by using a knap shake sprayer. The impacts on moth bean yields were assessed for different levels of panchgavya (2.5%, 5% and 7.5% each at 20 DAS (days after sowing), 35 DAS and 20 DAS + 35 DAS, respectively). The twice foliar spray of panchgavya at 20 DAS (days after sowing) and 35 DAS to assess their impact on change in growth, N, P and K concentration in seed and finally yield of moth bean.

The moth bean variety "RMO-435" was released in 2001 from ARS Bikaner. It is one of the most popular of variety among farmers and is cultivated throughout the arid and semi-arid regions of India. It is an early maturing erect type variety and matures in 62-65 days. Moth bean was sown on 30 cm between the rows and 10 cm spacing within the plants. The soil samples were kept in the oven for drying at 65°C for 24-72 hours to obtain a constant weight. Since most analytical methods require grinding of a dry sample, therefore, mechanical grinding of seed and straw materials was carried out with stainless mills usually to pass a 60-mesh sieve. Afterwards, grinded seed and straw materials were used for further chemical analysis using the following formulas (Kumar 2019):

N uptake in seed/straw (kg ha^{-1}) =

% N in seed/straw × Seed/straw yield (kg ha^{-1})

Soil samples were analyzed in the laboratory for their chemical properties as per their standard protocol including following formula:

Organic carbon in soil (%) =

$$\frac{(\text{Blank reading - Sample reading}) \times 0.003 \times 100}{2 \times \text{Weight of soil sample taken}} \times 100 \quad \text{....(Eq.1)}$$

Preparation of panchgavya

Panchagavya was prepared as per the method described by Suresh Kumar *et al.* (2011).

Method of preparation of panchgavya

In an earthen container, first mix fresh cow dung 7 kg and cow ghee 1 kg thoroughly and keep it for 3 days. Mix it twice daily (morning/evening) at least for 15 minutes.

↓

Add 10 litres of cow urine and 10 litres of water and mix thoroughly. Keep it for 15 days with regular mixing in the morning and evening hours.

↓

Add 3 litres of cow milk, 2 kg cow curd and also 500 g jaggery as an additive and mix them completely.

↓

This solution should be kept for 12 days and should be stirred twice daily (morning/evening) at least for 15 minutes each time to facilitates aerobic microbial activity.

↓

Panchgavya stock solution will be ready after proper sieving through a fine cloth.

RESULTS AND DISCUSSION

Crop growth

Data presented in Table 1 and Fig 1 indicated that significantly higher values of growth parameters were obtained from application of panchgavya 5% at 20 DAS + 35 DAS as compared to control. The said treatment produced significantly taller plants (35.5 and 37.4 cm),

Table 1: Effect of different levels of panchgavya on growth parameters of moth bean.

Treatment	Plant height (cm)		Branches /plant	Chlorophyll content (mg/g)
	50 DAS	At harvest	At harvest	40 DAS
Control	23.2	24.4	3.5	1.2
Panchgavya 2.5% at 20 DAS	25.4	26.7	3.8	1.3
Panchgavya 2.5% at 35 DAS	26.0	27.4	3.9	1.4
Panchgavya 2.5% at 20 DAS + 35 DAS	32.9	34.6	4.9	1.8
Panchgavya 5% at 20 DAS	30.2	31.8	4.5	1.6
Panchgavya 5% at 35 DAS	30.6	32.2	4.6	1.6
Panchgavya 5% at 20 DAS + 35 DAS	35.5	37.4	5.3	2.0
Panchgavya 7.5% at 20 DAS	27.9	28.6	4.1	1.5
Panchgavya 7.5% at 35 DAS	27.8	29.3	4.2	1.5
Panchgavya 7.5% at 20 DAS + 35 DAS	33.3	35.0	5.0	1.8
SEm±	0.7	0.7	0.1	0.0
CD (p=0.05)	2.0	2.2	0.3	0.1

accumulated more dry matter (86.4 and 104.0 g m^{-1} row length) at 50 DAS and harvest over control. Other growth parameters included total number of branches/plant (5.3), total chlorophyll content (2.0 mg g^{-1}), CGR (6.4 g/m^2/day), RGR (33.1 mg/g/day) and leaf area index (4.1) were also significantly highest under the treatment of 5% panchgavya at 20 DAS + 35 DAS (Fig 2). Application of panchgavya 7.5% at 20 DAS + 35 DAS was at par with treatment panchgavya 2.5% at 20 DAS + 35 DAS. This might be due to the fact that application of liquid manure improves overall growth of moth bean. Yadav and Tripathi (2013) reported that foliar-applied panchgavya had a significant effect on all growth parameters of green gram. The results indicated the need for adding panchgavya to the soil which increased the availability of nutrients over a long period and have a positive effect on the height of the plant. Balanced nutrition might have resulted in better development and robust growth. Nitrogen is one of the most important factors affecting the leaf area index which might have helped in enhancing photosynthesis and productivity of the crop. The positive effect of panchgavya on the leaf area index might be due to the fact that panchagavya as reported by Yadav and Lourduraj, 2006 is a source of macro and micronutrients, vitamin and growth hormones like gibberellins which enhanced leaf area resulting in higher photo assimilates. Increase in total chlorophyll in green leaves with foliar application of panchgavya has also been reported by Tejada and Gonzalez (2003) and Yadav and Lourduraj (2006).

Critical perusal of data presented in Table 2 indicated that application of panchgavya 5% at 20 DAS +35 DAS significantly increased pods $plant^{-1}$ (28.7), seeds pod^{-1} (5.7) and test weight (30.3g) over other treatments. Application of panchgavya 7.5% at 20 DAS + 35 DAS was at par with that of application of panchgavya 2.5% at 20 DAS + 35 DAS. Significantly higher seed and straw yield was recorded with foliar spray of panchgavya 5% at 20 DAS and 35 DAS (919 and 2108 kg ha^{-1}) over 2.5% and 7.5% panchgavya application. Selvaraj (2003) observed a 36% increased yield of french bean with the application of vermicompost + panchgavya. Natarajan (2002) reported an increased yield of crop plants with panchgavya application due to enhancement in the biological efficiency of crop plants. Scorching has appeared in the leaves of moth bean at higher concentrations (7.5%, panchgavya) which led to decreased rate of photosynthetic activity which ultimately resulted in a reduction in moth bean yield Similar findings have been reported in black gram by Somasudaram *et al.,* 2003.

Quality parameters

Total N uptake and protein content

Application of panchgavya 7.5% at 20+35 DAS resulted in significant improvement in nutrient content of mothbean but was at par with 2.5% panchgavya at 20+35 DAS (Fig 3). The maximum total nitrogen uptake (77.9 kg/ha) was recorded with the application of panchgavya 5% at 20 DAS + 35 DAS and the minimum was recorded under control.

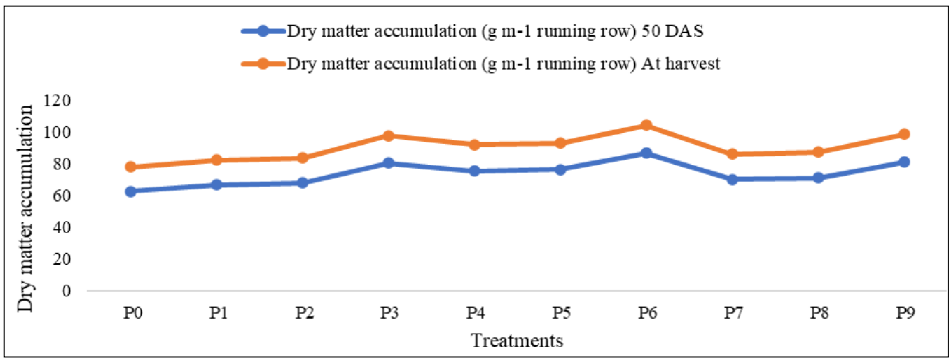

Fig 1: Effect of different levels of panchgavya on dry matter accumulation of moth bean.

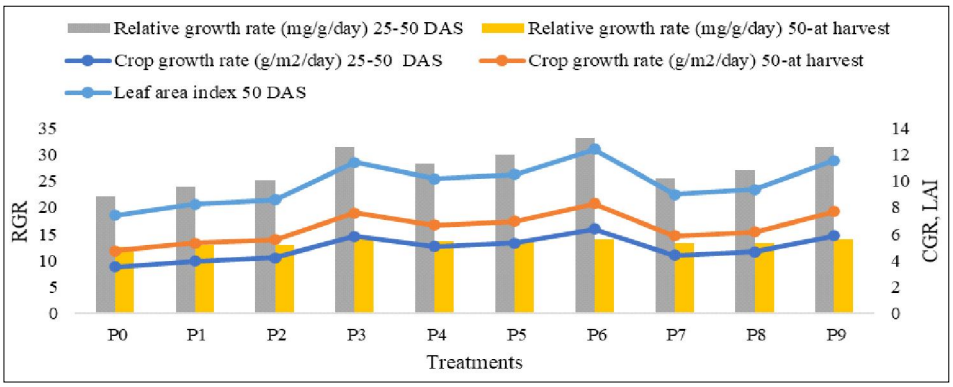

Fig 2: Effect of different levels of panchgavya on CGR, RGR and LAI of moth bean.

Table 2: Effect of panchgavya on yield attributes and yield.

Treatment	Pods plant^{-1}	Seeds pod^{-1}	Test weight (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
Control	18.8	4.4	23.7	601	1361
Panchgavya 2.5% at 20 DAS	20.5	4.7	25.0	657	1502
Panchgavya 2.5% at 35 DAS	21.0	4.7	25.4	673	1520
Panchgavya 2.5% at 20 DAS + 35 DAS	26.6	5.4	28.7	846	1954
Panchgavya 5% at 20 DAS	24.4	5.1	27.2	781	1798
Panchgavya 5% at 35 DAS	24.7	5.1	27.4	792	1816
Panchgavya 5% at 20 DAS + 35 DAS	28.7	5.7	30.3	919	2108
Panchgavya 7.5% at 20 DAS	21.9	4.8	25.9	703	1638
Panchgavya 7.5% at 35 DAS	22.5	4.9	26.3	720	1659
Panchgavya 7.5% at 20 DAS + 35 DAS	26.9	5.4	29.0	848	1971
SEm±	0.5	0.1	0.3	18.0	43.7
CD (p=0.05)	1.6	0.9	0.8	53	130

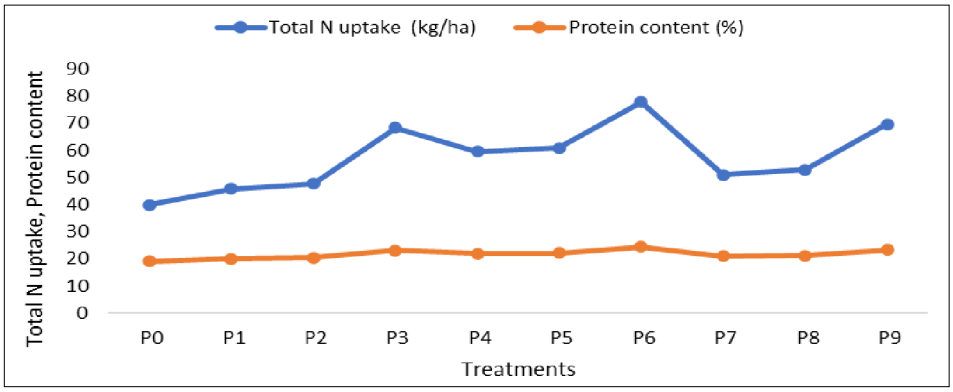

Fig 3: Effect of levels of panchgavya and stage of crop at application on nitrogen and protein content of moth bean.

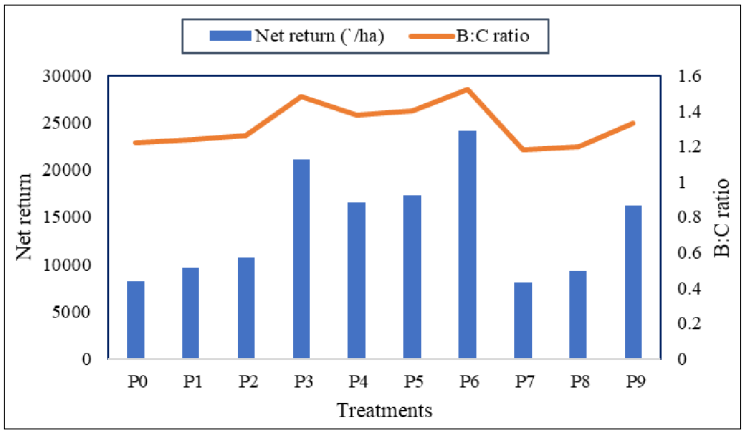

Fig 4: Effect of levels of panchgavya and stage of crop at application on net return and B:C ratio of mothbean nitrogen and protein content of moth bean.

Similarly, application of panchagavya 5% at 20 DAS + 35 DAS resulted in higher protein content (24.5%) followed by that of application of panchagavya 7.5% at 20 + 35 DAS (23.4%) and the minimum was recorded with the control (19.1%).

Panchgavya contains N (527 ppm), P_2O_5 (371 ppm), K_2O (371 ppm), S (49 ppm), Fe (114 ppm) and Zn (72 ppm) besides reducing sugars (glucose). Chemolithotrophs and autotropic nitrifiers (ammonifiers and nitrifiers) present in panchgavya which colonize in the leaves of mothbean and increase the ammonia uptake and increase the total N supply which help in increased nutrient content, uptake and increased protein content in seed and stover of mothbean. Similar results were also reported by Beaulah (2002) who found that the secondary and micronutrients (Ca, S and Fe) and macronutrients (NPK) contents of leaves and pods of

annual moringa were superior under poultry manure + neem cake + panchgavya treatments. Higher nutrient uptake and nutrient use efficiency in both main and ratoon crops of annual moringa were also observed. Likewise, application of panchgavya spray with organic manure had also higher the quality parameters *viz.*, crude fibers, protein, ascorbic acid, carotene content and shelf life.

Economics

Net returns in mothbean was influenced significantly due to various treatments of panchagvya. Results presented in Fig 4 indicated that the higher net return (₹24091/ha) and B:C ratio (1.5) were obtained with application of panchgavya 5% at 20 DAS+35 DAS which could be due to the higher seed yield during the growing season. Among the different treatments, application of panchagvya 7.5% at 20+35 DAS resulted in significantly better net return and benefit cost ratio over absolute control but found at par with application of panchagvya 2.5% at 20+35 DAS. The lowest B:C ratio of 1.2 was recorded under control. Further, the benefit cost ratio varied due to application of lower and higher level of panchagvya because effectiveness of panchagvya at 2.5% and 7.5% was less in increasing yield attributes and yield as compared to panchgavya 5%. Similar results were also reported in blackgram by Somasudaram *et al.* (2003) and in groundnut by Kumawat *et al.,* (2009).

CONCLUSION

High and low concentration of panchgavya is one of the major abiotic constraints limiting productivity of moth bean under semi-arid agroecosystem. In order to increase yield of moth bean, use of the organic sources for fulfilling nutrient requirement to sustain crop productivity and safeguard soil-human-environment health is recommended. Thus, it can be inferred that the correct concentration of panchgavya (5%) for enhancing moth bean productivity in the Rajasthan (India) and similar eco-regions elsewhere for advancing nutritional security. Twice foliar spray of 5% at 20 DAS and 35 DAS gave significantly, higher seed yield (919 kg/ha), net return (₹ 24091/ha) and B:C ratio (1.5) over the treatments where no foliar spray was done.

Conflict of interest: None.

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