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Effect of Non-edible Oil Cakes and Liquid Organic Manure on Growth, Yield and Soil Nutrient Status of Field Bean (*Dolichos lablab* L.)

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ABSTRACT: A field experiment was conducted to study the "Effect of non-edible oil cakes and liquid organic manure on growth, yield and soil nutrient status of Field bean (*Dolichos lab lab* L.)" at Organic Farming Research Centre, Zonal Agricultural and Horticultural Research (ZAHRS), Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Navile, Shivamogga, during *Kharif* 2021. The experiment was laid out in randomized complete block design with nine treatments comprising of two kinds of non edible oil cakes (castor cake and pongamia cake) and two kinds of liquid organic manures (panchagavya and jeevamrutha) were replicated thrice. The experimental results revealed that, application of castor cake along with 3% foliar spray of Panchagavya significantly recorded higher pod yield (34.3 q/ha), higher pod yield per plant (336.4g/plant), pods per plant (34.3), more number of branches (13.6) and higher plant height (93.6 cm) which in turn was on par with the application of pongamia cake along with 3% foliar spray whereas significantly lower pod yield was recorded in control treatment (T1) without any application of oil cakes and nutrient spray. The study shows that combined application of non-edible oil cakes and foliar spray of liquid organic manure especially with 3% panchagavya spray than 3% Jeevamrutha spray has performed better in organic field bean production than mere supply of nutrients only through non edible oil cakes or liquid organic spray alone. Among pulse production system, pulses usually demand more nutrient requirement at flowering and pod setting stages which demands slow release manures for crop yield. Among the manures non edible oil cakes comprising pongamia and castor cake found to be more effective for slow release of nutrients and its availability over a prolonged period. Hence the present research was undertaken.

Keywords: Non edible oil cake, Pongamia cake, Castor cake, Panchagavya, Jeeevamrutha.

INTRODUCTION

India is self sufficient in food grain production and vegetable production due to intensive cropping with increased application of chemical fertilizers and irrigated conditions. But, this chemical based agricultural practices which use high analysis fertilizers in indiscriminate manner lead to imbalance and several other challenges *viz*, declined productivity, degradation of soil, pollution hazards, decline of organic matter, increase in salinity and sodicity, deteoration in the quality of crop produce also loss of vital soil fauna and flora and resulted in loss of secondary and micronutrients and increase in pests and diseases (Singh *et al.*, 2004). Organic farming is a sustainable system that avoids the use of synthetic fertilizers, pesticides and raises the crop with the use of organic cultivation practices. Organic manuring of farm land is an age old traditional practice evolved by our fore fathers wherein only organic manures or natural inputs available on the farm were used to reduce the cost of production against chemical inputs. Organic agriculture is a production

system that sustains the soil health, ecosystems and people. Substitution of chemicals by the organic means is very important for sustainable agriculture production to improve the quality of produce, maintenance of soil fertility and health of environment. It has been estimated that the soil organic carbon content in India has drastically reduced from 1.2 per cent in 1970s to 0.60 per cent in 2000 (Devsenapathy 2008) and declining further. Use of organics in crop production is gaining much popularity. It helps to enhance and maintain soil organic carbon status for sustained crop yield and also India is blessed with rich natural heritage of soil, climate and biodiversity has a vast potential for organic farming (Debashis Dash and Amardeep 2018). Combined application of bulky organic manures along with liquid organic manures like panchagavya and jeevamrutha *etc.*, is a more synchronized system and can release the nutrients as per the need of crop to sustain higher productivity (Shwetha and Babalad 2008). Hence, the present investigation on field bean was undertaken by making use of pongamia cake and castor cake along with liquid organic manures to find out the suitable organic nutrient management options for pod yield.

Field bean popularly known as Dolichos bean belonging to the family leguminosae, is one of the important vegetable crop which is valued for proteins, minerals and energy. The crop is gaining popularity among vegetable growers due to higher remuneration and steady market demand. Field bean is remarkably adaptable to wide areas under diverse climatic conditions such as arid, semi arid, sub- tropical and humid regions and also in many types of soils and pH varying from 4.4 to 7.8. Being a legume, it can fix atmospheric nitrogen to the extent of 170 kg/ha besides leaving enough crop residues to enrich the soils with organic matter. Application of nitrogen especially in branching, flowering and pod setting stage is highly responsive in dolichos bean (Sammauria *et al.*, 2009), Right dose of phosphorus application improves green pod yield of dolichos bean (Turuko and Mohammed, 2014), Balanced potash application improves enzymatic activities and enhances translocation in dolichos bean (Devlin and Wiham, 1986). Application of FYM (7.5 t/ha) along with vermin-compost (2 t/ha) yielded higher dry pod yield in field bean (Ullasa *et al.,* 2018). *Gliricidia sepium* green leaf manuring @ 10 t ha^{-1} with 120 kg N ha^{-1} to preceding rice crop could have beneficial as residual fertility to succeeding mustard crop in terms of growth, biological yield and nutrient uptake (Ashwin Kumar Meena *et al.,* 2021). Use of non edible oil cakes provided essential plant nutrients for crop production in addition to organic carbon content (Tasosa *et al.,* 2001). There is a tremendous scope to increase the current productivity level by using different non edible oil cakes along with organic liquid manures which maintain long term soil fertility by optimizing biological activity in the soil.

MATERIAL AND METHODS

A Field experiment was conducted on Field bean at Organic Farming Research Centre, Zonal Agricultural and Horticultural Research Station (ZAHRS), Navile, KSNUAHS, Shivamogga, during *Kharif* 2021 to study the effect of non - edible oil cakes and liquid organic manures on growth, yield of field bean, soil microflora and on soil properties. The soil of experimental site was sandy loam in texture with a neutral pH of 6.45 and normal in electrical conductivity (0.027 ds/m), low in organic carbon (0.40%) and low available Nitrogen (160 Kg/ha) and medium in Phosphorus (P_2O_5 30 Kg/ha) and Potassium content (140 K_2O Kg/ha). The experiment was laid out in randomized block design with nine treatments and replicated thrice with a plot size of 4.5 × 4.2 m^2. The Field bean variety HA-3 seeds were sown on 9.7.2021 in 60×30 cm plant spacing. In the experiment field, well rotten recommended dose of FYM (5 ton) was applied to all the treatments whereas, the recommended dose of N was supplied through different non edible oil cakes with a RDF 25:50:25 Kg/ha for field bean crop as basal dose though organic source.

The treatment combinations were as follows:

T1-Control (without any oil cakes and nutrient spray)
T2-Pongamia cake
T3-Castor cake
T4-Pongamiacake + Foliarspray (3% Panchagavya)
T5-Castor cake + Foliar spray (3% Panchagavya)
T6-Pongamia cake + Foliar spray (3%Jevamrutha)
T7-Castor cake + Foliar spray (3%Jevamrutha)
T8 - 3% Panchagavya (only foliar spray)
T9- 3% Jeevamrutha (only foliar spray)

The observations were recorded on five randomly selected plants from each plot on different growth characters (Table 1). Soil samples were collected from all the plots before and after the experiment at 0-30 cm depth and analyzed for pH, Organic carbon, available nitrogen, available phosphorus and available potassium content by using standard procedures. Also the growth, yield and soil microbial load parameters were recorded using standard procedures. The data was analyzed by adopting the standard procedure of OPSTAT software. Wherever the results were found significant, critical differences (CD) were computed at 5 percent level of probability to draw statistical conclusions. The pongamia cake used in the experiment contains 4% N, 0.8% P and 1.2% K and castor cake contains 4.3% N, 1.8% P and 1.3% K respectively. The two foliar spray of fermented liquid organics were taken at branching, flowering and pod setting stages of field bean crop.

RESULTS AND DISCUSSION

A. Effect of organic nutrient management practices using non –edible oil cakes and liquid organic manures on growth of field bean

Among the different nutrient management practices, the application of castor cake along with the foliar spray of

panchagavya (T5) has recorded significantly higher plant height at harvest (93.6 cm) and more number of branches per plant (13.6) as compared to rest of the treatments (Table 1) which was also on par with the application of pongamia cake along with 3% foliar spray of panchagavya (T4) (92.3 cm and 13.0) whereas significantly lowest pant height and number of branches were recorded in control. Quantity and quality of growth attributes observed by plant largely depends not only on presence of ideal soil conditions, it's genetic potentiality and the environment acting through it's internal physiological and biochemical process but also greatly influenced by the availability of soil nutrients to the crop. This was attributed to panchagavya, a potential source to play a great role for promoting growth and providing immunity in plant system besides, as a source of nutrients and microorganisms. Bio-chemical properties of panchagavya revealed that it possesses almost all the major nutrients like N, P, K and micronutrients necessary for plant and growth hormones like IAA and GA required for crop growth (Selvaraj *et al.*, 2007). The organic manures have slow release of nitrogen due to it's slow mineralization which induces the availability of nutrients commensurate with the growth and development of plants which results in higher growth parameters (Channabasanagowda *et al*., 2008). Apart from nutrient supply, Panchagavya was a proven biofertilizers *viz.*, *Azospirillium, Azotobacter, Phosphobacter, Pseudomonas* that play an important role in stimulation of plant growth by secreting IAA and GA (Sanjutha *et al.*, 2008). Several other workers reported that panchagavya was an efficient biostimulant that enhances the physiological growth of the plant and Jeevamrutha promotes immense biological activity in soil and enhance the availability of essential nutrients to crop as reported by Nileema *et al.*, (2011).

B. Effect of organic nutrient management practices using non –edible oil cakes and liquid organic manures on yield of field bean

Among the different treatments, the application of castor cake along with the foliar spray of 3% panchagavya (T5) has recorded significantly higher pod yield (34.3 q/ha) as compared to rest of the treatments. However, it was on par with treatment T4 which received pongamia cake along with 3% panchagavya spray (31.6 q/ha) whereas significantly lower pod yield was recorded with control (T1) (20.60 q/ha).

Table 1: Growth and yield parameters of field bean to organic nutrient management Practices using non-edible oil cakes and liquid organic manures.

Treatments	Treatment details	Plant height (cm)	Number of branches /plant	Pods/ plant	Pod yield/ plant (g)	Pod yield (q/ha)
T1	Control (without any oil cakes and nutrient spray)	51.6	6.3	24.3	243.3	20.6
T2	Pongamia cake	79.0	11.3	28.6	279.0	25.1
T3	Castor cake	81.6	11.6	29.3	287.4	25.8
T4	Pongamiacake + Foliar spray(3% Panchagavya)	92.3	13.0	32.6	310.3	31.6
T5	Castor cake + Foliar spray(3% Panchagavya	93.6	13.6	34.3	336.4	34.3
T6	Pongamiacake + Foliar spray (3%Jeevamrutha)	85.0	12.6	29.3	294.4	29.1
T7	Castor cake + Foliar spray (3%Jeevamrutha)	88.0	12.6	30.6	300.0	29.7
T8	3% Panchagavya	75.0	10.3	28.0	274.9	23.6
T9	3% Jeevamrutha	70.3	10.0	27.0	271.7	23.3
	S. Em±	2.65	0.43	1.19	9.99	0.95
	CD @ (5%)	8.02	1.32	3.59	30.22	2.88

The lowest pod yield per plant was recorded in T1 (243.3 g/plant). More nutrient supply and higher nutrient uptake of plants treated with the castor cake and pongamia cake might be the reason for better exhibit of yield attributing characters and yield, while N promoted the vegetative growth, P might have probably influenced root growth in a positive manner which could have helped better absorption and transformation of nutrients from source to sink capacity of plants. Better root growth would have helped to divert photo assimilates to more economic yield. Higher uptake of nutrients would have helped to produce more vegetative growth and more number of flowers per plant. By this way, the effective conversion of carbohydrates (reserved material) to productive (economic) part might have increased the yield attributing characters and yield as reported by Singh and Maurya (1972).

Higher and ready availability of nutrients at the right time might be the reason for higher nutrient uptake and simultaneously increased the yield and yield attributing characters in the plots where castor cake and pongamia cake were incorporated along with 3% foliar spray of panchagavya and jeevamrutha.

The higher yield attributes were observed in treatment T5 and this treatment has also recorded significantly higher pod yield (34.3 q/ha) as compared to rest of the

nutrients and is on par with the treatment receiving pongamia cake along with 3% foliar spray of panchagavya. Hence, yield maximization includes all the processes associated with uptake of nutrients, translocation, partitioning, assimilation and mobilization of nutrients at different growth stages of crop (Divyashree *et al.,* 2018). Use of organic manures not only benefit the environment but also provide better resilience and coping ability to short drought spells during the crop growing period (Joglekar and Kukarni 2004).

C. Impact on soil microbial population

The highest population of soil microflora at all growth stages was observed in T5 treatment which has received the castor cake along with 3% foliar spray of panchagavya. Panchagavya is an organic liquid fertilizer, which stimulates the growth and boosts the immunity in all type of plants. It has all macro and micro nutrients along with growth hormones (IAA & GA) needed for plant growth. Panchagavya helps in proper growth and reproduction of beneficial soil microorganisms resulting vigorous plant growth. Microbial flora of soil plays an important role in soil health. The microorganisms present in the rhizosphere environment around the roots influence the plant growth and crop yield. The beneficial microorganisms from Panchagavya and their establishment in the soil improved the sustainability of agriculture. Beaulah (2001) found that the beneficial micro-organisms from panchagavya and their establishment in the soil improved the sustainability of agriculture as the microorganisms presenting the rhizosphere environment around the roots influence the plant growth and crop yield. It may be due to presence of plant growth promoting substance in cattle dung and other nutrients which provide substrate for growth of microbes. The non edible oil cakes resulted in higher production of root exudates and increasing the beneficial microbial population in rhizosphere of pulses (Jayanthi *et al.,* 2014).

Table 2: Soil microflora (cfu g^{-1} of soil) as influenced by non-edible oil cakes and liquid organic manures in field bean.

Micro flora	Bacteria (No. X 10^5)			Fungi (No. X 10^4)			Actinomycetes (No. X 10^3)			N-fixers (No. X 10^3)			PSM (No. X 10^3)		
Initial	5.67			2.33			3.00			3.67			4.33		
Treatments DAS	**30 DAS**	**60 DAS**	**At Harvest**	**30 DAS**	**60 DAS**	**At Harvest**	**30 DAS**	**60 DAS**	**At Harvest**	**30 DAS**	**60 DAS**	**At Harvest**	**30 DAS**	**60 DAS**	**At Harvest**
T1	11.00	27.00	19.00	3.00	6.00	4.67	5.67	18.33	6.33	5.00	17.00	14.00	7.67	9.33	2.67
T2	13.33	31.00	23.33	5.33	9.67	6.33	8.00	22.67	9.33	12.67	21.33	17.33	9.67	12.00	6.33
T3	15.00	32.67	24.67	6.00	10.33	7.67	8.33	24.00	10.00	13.33	22.67	19.00	10.33	12.33	7.00
T4	20.33	36.67	29.00	8.33	12.33	9.00	10.67	28.33	12.33	15.00	27.00	24.33	12.67	15.67	9.33
T5	22.00	37.33	30.33	8.67	13.00	10.33	11.33	29.00	13.00	15.33	28.33	26.00	14.00	16.33	9.67
T6	17.67	32.00	25.33	7.67	10.67	8.33	8.67	24.67	10.67	14.00	23.33	21.67	11.67	13.67	8.00
T7	18.33	33.33	26.00	7.67	17.67	8.67	9.33	25.33	11.33	14.67	24.00	22.33	12.33	14.33	9.67
T8	13.33	32.37	23.00	4.33	9.00	6.00	7.33	22.67	9.67	11.67	21.67	17.33	9.00	12.00	5.33
T9	11.00	30.33	21.33	4.00	8.00	5.33	6.67	20.67	8.33	11.00	19.33	14.00	8.00	11.00	4.00
SEm±	**0.91**	**0.45**	**0.44**	**0.55**	**0.45**	**0.41**	**0.38**	**0.43**	**0.24**	**0.39**	**0.31**	**0.32**	**0.30**	**0.47**	**0.33**
CD @5(%)	**2.73**	**1.35**	**1.32**	**1.64**	**1.35**	**1.22**	**1.15**	**1.30**	**0.73**	**1.17**	**0.93**	**0.95**	**0.90**	**1.41**	**1.02**

Cfu: Colony forming Unit. Among the treatments studied, maximum soil microbial population (cfu g^{-1} of soil) was observed in the treatment (T5) which received (Castor Cake) + Foliar spray (3% Panchagavya) whereas lowest soil microbial population was recorded in treatment (T1) which is Control (without any oil cakes and nutrient spray). The microbial population was maximum during the 60 days after sowing (Table 2).

Impact on soil nutrient status: Significant variation was observed among the treatments during post harvest nutrient status of the soil. This might be due to organic manure application which has improved the availability of nutrients through slow mineralization and slow release of nutrients which inturn results in availability of required amount of nutrients through the growing period of crop (Dudhat *et al.,* 1997). Different organic nutrient management practices significantly influence the pH, EC, OC, N, P_2O_5 and K_2O status. Significantly higher organic carbon content was recorded in T5 (0.76%) and was followed byT4, T3, T6 and lower organic carbon content was recorded in T1 (0.43%) as in Table 3. After the harvest of the crop, the soil nitrogen status was found to be significantly higher in T5 (365.64 Kg/ha) as compared to other treatments and it is on par with the treatment T4 (318.8Kg/ha) followed by T3 (272.73Kg/ha) and T2 (251.79 Kg/ha). Due to the application of different types of cakes the soil organic matter content has improved after the decomposition of non edible oil cakes, which has released nutrients slowly to the soil (Srinivasulu *et al.,* 2000) and has helped in improving the nutrient availability, soil structure and soil biological activities.

The available P was found to be significantly higher in T5 (60.39 Kg/ha) and is found to be on par with T4 (59.68 Kg/ha), T2 (55.39 Kg/ha) and T3 (53.00 Kg/ha). The available potassium status found to be significantly higher in T5 (322.06 Kg/ha) and is followed by T6 (274.73 Kg/ha) and T4 (208.89 Kg/ha) as compared to the initial soil K status. The solubility action of organic acids produced during the decomposition of organic materials resulting in more release of P and K nutrients (Shanmugam and Veeraputhran 2001).

Application of panchagavya increases soil fertility by improving organic Matter, micro and macro nutrient in soil and increase the beneficial microbial population of the soil. It also increases the nutrient uptake capacity of the plant due to more solubilization in the soil. Panchagavya has shown its effect on maintaining soil aggregate stability and increasing soil porosity. It also helps in maintaining the neutral pH level of the soil.

Table 3: Nutrient status of soil as influenced by different nutrient management practices.

Treatments	Treatment details	pH (1:2.5)	Ec (ds/m)	OC (%)	N (Kg/ha)	P_2O_5 (Kg/ha)	K_2O (Kg/ha)
T1	Control (without any oil cakes and nutrient spray)	6.18	0.172	0.43	193.89	46.09	108.11
T2	Pongamia cake	6.28	0.143	0.48	251.79	55.39	143.22
T3	Castor cake	6.44	0.206	0.56	272.73	53.00	121.14
T4	Pongamiacake + Foliar spray(3% Panchagavya)	6.35	0.151	0.68	318.8	59.68	208.89
T5	Castor cake + Foliar spray(3% Panchagavya)	6.31	0.253	0.76	365.64	60.39	322.06
T6	Pongamiacake + Foliar spray (3% Jeevamrutha)	6.68	0.290	0.50	262.98	50.72	274.73
T7	Castor cake + Foliar spray(3%Jeevamrutha)	6.74	0.248	0.42	252.89	49.61	195.82
T8	3% Panchagavya	6.49	0.2	0.47	221.60	45.96	128.88
T9	3% Jeevamrutha	6.48	0.269	0.41	212.39	56.74	112.13
	S. Em±	0.057	0.012	0.057	18.10	2.89	9.049
	CD @ (5%)	0.17	0.037	0.17	54.75	8.73	27.36
	Initial soil analysis	**6.45**	**0.057**	**0.40**	**160**	**30**	**142**

CONCLUSION

The study revealed that among organic field bean nutrient management practices either basal application of N equivalent doses of castor cake or pongamia cake along with 3% foliar application of panchagavya at flowering and pod setting stages found to be beneficial in getting higher pod yield in field bean crop.

FUTURE SCOPE

Oil cakes, a known agri waste, are the byproduct of oil processing and are rich source of micro and macro nutrients (NPK) and therefore may be utilized as plant nutrients. The edible oil cakes mostly have been used as a cattle feed, however, nonedible oil cakes do not find many application. Very little research work has been carried out in this field. Hence there is need to evaluate long term effect of non edible oil cakes on soil nutrient status and productivity in different cropping system. Also there is scope for enrich non edible oilcakes with different bio fertilizers.

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Conflict of Interest. None.

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