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Case Studies on Sustainable Soil Health Management Through Application of Organic Amendments In Dolichos Bean Cultivation

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Abstract

The experiment was conducted to standardize the quantity of bulky and concentrated organic manures for Dolichos Bean to substitute the inorganic fertilizers. The experiment was laid out in a randomized block design with 14 treatments in 3 replications. The treatment schedule included various levels of bulky (25 and 75 % N) and concentrated organic manures (25 and 75 % N), inorganic fertilizers along with an absolute control. The bulky organic manures used were FYM and vermicompost and the concentrated manures used were neem cake and groundnut cake. The nutrient content of bulky and concentrated organic manures used in the study were FYM (0.80, 0.41 and 0.74 % NPK), vermicompost (1.60, 2.20 and 0.67 % NPK), poultry manure (3.47, 1.33 and 3.1 NPK), neem cake (5.2, 1.0 and 1.4 % NPK) and castor cake (4.1, 1.9 and 1.4 % NPK). Quantity of organic manures required was computed on the basis of nitrogen equivalent to substitute the recommended dose of chemical fertilizer (32:72 kg NP ha^{-1}) in garden bean.Among the organic manures and concentrated oil cakes applied, 75 per cent N supplied through vermicompost @ 2.41 t ha^{-1} along with 25 per cent N supplied through neem cake @ 0.22 t ha^{-1} followed by 75 percent N supplied through poultry manure @ 0.61 t ha^{-1} along with neem cake @ 0.22 t ha^{-1} were identified.Which recorded the maximum level of soil physico-chemical properties, number of,nutrient uptake ,post harvest nutrient status of soil and yield of Garden bean.

Key words: *Dolichos Bean, bulk and concentrated organic manures, Organic Carbon, root nodules, nutrient uptake,post harvest nutrient status of soil.*

I.INTRODUCTION

For improving the soil health, bulky organic manures should be necessarily applied. FYM, vermicompost, poultry manure and pressmud are some of the commonly available organic manures which are widely used by the farmers. Organic manures which are tried in the present investigation are FYM, poultry manure, oilcakes and vermicompost. Among the varied organic inputs, Farm yard manure is considered as a repository of plant nutrients. The role of FYM is multidimensional, varying from building up of organic matter, good soil aggregation, permeability of soil and related physical properties to long lasting supply of several macro and micronutrients, besides, improving cation exchanging capacity of soil (Gupta et al., 1983).Biological nitrogen fixation (BNF) is the biological process by which the atmospheric nitrogen (N2) is converted to ammonia by an enzyme called nitrogenase. It is the major source of the biosphere nitrogen and as such has an important ecological and agronomical role, accounting for 65 % of the nitrogen used in agriculture worldwide. The most important source of fixed nitrogen is the symbiotic association between rhizobia and legumes. The nitrogen fixation is achieved by bacteria inside the cells of

de novo formed organs, the nodules, which usually develop on roots, and more occasionally on stems. This mutualistic relationship is beneficial for both partners, the plant supplying dicarboxylic acids as a carbon source to bacteria and receiving, in return, ammonium. Legume symbioses have an important role in environment-friendly agriculture. They allow plants to grow on nitrogen poor soils and reduce the need for nitrogen inputs for leguminous crops, and thus soil pollution. Nitrogen-fixing legumes also contribute to nitrogen enrichment of the soil and have been used from Antiquity as crop-rotation species to improve soil fertility. They produce high protein-containing leaves and seeds, and legumes such as soybeans, groundnuts, peas, beans, lentils, alfalfa and clover are a major source of protein for human and animal consumption. Vermicompost produced using earthworm is another rich and recognized source of macro and micro-nutrients and contributes much towards improving the fertility of soil. Vermicompost contains major and minor nutrients in available form along with enzymes, antibiotics, vitamins, beneficial microorganisms and other plant hormones and have definite advantage over other organic manures in respect of quality and shelf life of produce (Meerabai and Raj, 2001). Kale et al., (1992) found that the application of vermicompost to fields improved the physico-chemical and biological properties of soil.

II.MATERIAL AND METHODS

The seeds of Dolichos bean cv.KonkanBushanwere dibbled singly at a spacing of 30 x 60 cm apart. The first irrigation was given immediately after sowing followed by life saving irrigation and subsequent irrigations were given once in a week. Incidence of sucking pests was managed by spraying with Neem seed 3054ourte extract at 5%. Weeding was done where and when found necessary. Quantity of organic manures required was computed on the nitrogen equivalent basis. Recommended dose of N (36 kg ha^{-1}) was supplied in two different combinations like supply of 25% and 75% N through Bulky and 25% and 75%N through concentrated organic manures. The bulky organic manures used were FYM, Poultry Manure and vermicompost (VC) and the concentrated manures used were neem cake (NC) and castor cake (GC). 25 and 75 per cent N was calculated as 0.84 and 2.25 t ha^{-1} of FYM; 0.8 and 2.41 t ha^{-1} of VC; 0.25 and 0.61 t ha^{-1} of poultry manure; 0.22, and 0.78 t ha^{-1} of NC; 0.20 and 0.65 t ha^{-1} of CC to substitute the recommended dose of N (36 kg ha^{-1}). Bulky organic manures were applied as basal and concentrated cakes were top dressed in 2 split doses. First application was done at 20 days after sowing. The second was applied on 45^{th} day of sowing. Recommended dose of inorganic fertilizers were applied only in the conventional farming treatment.

A. Experimental design and treatment details

The experiment was laid out in a Randomized Block Design with three replication and 3054ourteen treatments, viz.,

T_1 - Control
T_2 - Inorganic fertilizers (36:72 kg NP ha^{-1})
T_3 - 25 % N as Farm Yard Manure (0.84 t ha^{-1}) +75 % N as Neem cake (0.78 t ha^{-1})
T_4 - 75 % N as Farm Yard Manure FYM (2.52 t ha^{-1})+ 25 % N as Neem cake(0.22 t ha^{-1})
T_5 - 25 % N as Farm Yard Manure (0.84 t ha^{-1}) + 75 % N as Castor cake (0.65 t ha^{-1})
T_6 - 75 % N as Farm Yard Manure (2.52 t ha^{-1}) +25 % N as Castor cake (0.20 t ha^{-1})
T_7 - 25 % N as Vermicompost (0.80 t ha^{-1})+75 %N as Neem cake (0.78 t ha^{-1})
T_8 - 75 % N as Vermicompost (2.41 t ha^{-1})+25 % N as Neem cake (0.22 t ha^{-1})
T_9 - 25 % N as Vermicompost (0.80 t ha^{-1}) +75 % N as Castor cake (0.65 t ha^{-1})
T_{10} - 75 % N as Vermicompost (2.41 t ha^{-1})+25 % N as Castor cake (0.20 t ha^{-1})
T_{11} - 25 % N as Poultry manure (0.25 t ha^{-1}) +75 % N as Neem cake(0.78 t ha^{-1})
T_{12} - 75 % N as Poultry manure (0.61 t ha^{-1}) +25 % N as Neem cake (0.22 t ha^{-1})
T_{13} - 25 % N as Poultry manure (0.25 t ha^{-1}) +75 % N as Castor cake (0.78 t ha^{-1})
T_{14} - 75 % N as Poultry manure (0.61 t ha^{-1}) + 25 % N as Castor cake(0.22 t ha^{-1})

III.RESULTS

A. Physico-chemical properties of soil

Perusal of data on soil physico chemical properties revealed that all the organic manures along with bio fertilizers influenced significantly when compared with control and inorganic fertilizers. (Table 1).Regarding the data on organic carbon in soil, irrespective of sources the highest content of 0.46 per cent

was recorded in all the treatments where application of bulky along with concentrated organic manures were applied. These treatments were found to be influencing this parameter at the same level. The least value (0.42 per cent) for organic carbon was recorded in control and in inorganic fertilizers treatment.

Regarding EC, the highest value (0.45 dSm^{-1}) was observed in the same treatment where 75 per cent dose of organic manures along with biofertilizers was tried. The least value for EC was recorded in control (0.40 dSm^{-1})

The data with regard to pH revealed that the lowest value for pH (7.01) was recorded in all the treatment combinations of bulky along with concentrated organic manures. The highest value for pH was recorded in T_1 (7.11).which served as control.

Application of organic manures had significantly influenced the parameter bulk density. Among the treatments, the least value for bulk density was recorded in all the treatments where bulky and concentrated organic manures (1.50 mg m^{-3}) were incorporated. The highest value (1.56 mg m^{-3}) for bulk density was recorded in control and treatment that received inorganic fertilizers.

Table.1.Effect of bulky and concentrated organic manures on physico- chemical properties of soil

Treatments	soil carbon (%)	EC (dsm^{-1})	pH	Bulk density (mg m^{-3})
T_1 - Control	0.42	0.40	7.11	1.56
T_2 - Inorganic fertilizers (36:72 NP kg ha^{-1})	0.42	0.42	7.10	1.55
T_3 - FYM @ 10 t ha^{-1} + NC @ 2.25 t ha^{-1}	0.46	0.45	7.01	1.52
T_4 - FYM @ 15 t ha^{-1} + NC @ 1.50 t ha^{-1}	0.46	0.45	7.01	1.51
T_5 - FYM @ 10 t ha^{-1} + CC @ 2.0 t ha^{-1}	0.46	0.45	7.01	1.50
T_6 - FYM @ 15 t ha^{-1} + CC @ 1.50 t ha^{-1}	0.46	0.45	7.01	1.51
T_7 – VC @ 5 t ha^{-1} + NC @ 2.25 t ha^{-1}	0.46	0.45	7.01	1.50
T_8 - VC @ 7.5 t ha^{-1} + NC @ 1.50 t ha^{-1}	0.46	0.45	7.01	1.50
T_9 - VC @ 5 t ha^{-1} + NC @ 2.0 t ha^{-1}	0.46	0.45	7.01	1.50
T_{10} - VC @ 7.5 t ha^{-1} + NC @ 1.5 t ha^{-1}	0.45	0.45	7.01	1.51
T_{11} - PM @ 7.5 t ha^{-1} + NC @ 2.25 t ha^{-1}	0.46	0.45	7.01	1.51
T_{12} - PM @ 10 t ha^{-1} + NC @ 1.5 t ha^{-1}	0.46	0.45	7.01	1.50
T_{13} - PM @ 7.5 t ha^{-1} + NC @ 2.0 t ha^{-1}	0.46	0.45	7.01	1.50
T_{14} - PM @ 10 t ha^{-1} + NC @ 1.5 t ha^{-1}	0.46	0.44	7.03	1.51
SED	-	-	-	-
CD (P=0.05)	NS	NS	NS	NS

The highest value (24.6 per cent) for water holding capacity was recorded where the treatments were imposed with bulky and concentrated organic manures. The lowest value for water holding capacity was recorded in control (24.0 per cent) as shown in Table 1.

B. Number of root nodules plant^{-1} at harvest

There were significant differences seen among all the treatments against control as for as this trait is concerned. The highest number of root nodules per plant was recorded in T_2 (25.46) closely followed by T_8 (24.50). The next best value was observed in T_{12} (24.35) and T_7 (24.26). The treatment T_1 (control) recorded a value of 21.01, which was lowest when compared to all other treatments as presented in the table 2

C. Weight of root Nodule plant^{-1} at harvest

The nodule weight per plant varied significantly among all the treatments when compared to control. The highest (190.01mg) value for this trait was recorded in the treatment T_2. This was followed by the treatments T_8 (187.30 mg), then by T_{12} (184.20 mg) and by T_7 (181.74 mg) in order. There existed significant differences between the treatments T_4 and T_3 too. The least nodule weight plant^{-1} was recorded in the treatment T_1 (146.15 mg) which was kept as control as shown in the table 2.

Table 2: Effect of bulky and concentrated organic manures on nodule number and nodule weight per plant in garden bean

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Treatments	Nodule number per plant^{-1}	Nodule weight (mg plant^{-1})
T_1 - Control	21.01	146.15
T_2 - Inorganic fertilizers (36:72 NP kg ha^{-1})	25.46	190.01
T_3 - FYM @ 10 t ha^{-1} + NC @ 2.25 t ha^{-1}	22.88	179.15
T_4 - FYM @ 15 t ha^{-1} + NC @ 1.50 t ha^{-1}	22.98	155.08
T_5 - FYM @ 10 t ha^{-1} + CC @ 2.0 t ha^{-1}	22.56	151.12
T_6 - FYM @ 15 t ha^{-1} + CC @ 1.50 t ha^{-1}	22.75	153.10
T_7 – VC @ 5 t ha^{-1} + NC @ 2.25 t ha^{-1}	24.26	181.74
T_8 - VC @ 7.5 t ha^{-1} + NC @ 1.50 t ha^{-1}	24.50	187.30
T_9 - VC @ 5 t ha^{-1} + NC @ 2.0 t ha^{-1}	23.43	173.00
T_{10} - VC @ 7.5 t ha^{-1} + NC @ 1.5 t ha^{-1}	24.08	176.61
T_{11} - PM @ 7.5 t ha^{-1} + NC @ 2.25 t ha^{-1}	24.10	178.03
T_{12} - PM @ 10 t ha^{-1} + NC @ 1.5 t ha^{-1}	24.35	184.20
T_{13} - PM @ 7.5 t ha^{-1} + NC @ 2.0 t ha^{-1}	23.13	167.91
T_{14} - PM @ 10 t ha^{-1} + NC @ 1.5 t ha^{-1}	23.29	162.58
S.ED	**0.02**	**0.93**
CD (P=0.05)	**0.04**	**1.91**

D. Pod yield per hectare

The pod yield per hectare has shown significant difference among all the treatment when compared with control (Table 3). The pod yield was highest (6.46 t ha^{-1}) in T_2 which was followed by T_8 (5.50 t ha^{-1}) and T_{12} (5.35 t ha^{-1}). The treatment T_3 and T_4 were however, on par with each other. The treatment, T_1 recorded the lowest pod yield of 2.72 tonnes per hectare.

Table 3:Effect of bulky and concentrated organic manures on yield per plot and hectare in garden bean

Treatments	Pod yield per hectare in tonnes
T_1 - Control	2.72
T_2 - Inorganic fertilizers (36:72 NP kg ha^{-1})	6.46

T_3 - FYM @ 10 t ha^{-1} + NC @ 2.25 t ha^{-1}	3.63
T_4 - FYM @ 15 t ha^{-1} + NC @ 1.50 t ha^{-1}	3.64
T_5 - FYM @ 10 t ha^{-1} + CC @ 2.0 t ha^{-1}	3.01
T_6 - FYM @ 15 t ha^{-1} + CC @ 1.50 t ha^{-1}	3.21
T_7 – VC @ 5 t ha^{-1} + NC @ 2.25 t ha^{-1}	5.26
T_8 - VC @ 7.5 t ha^{-1} + NC @ 1.50 t ha^{-1}	5.50
T_9 - VC @ 5 t ha^{-1} + NC @ 2.0 t ha^{-1}	4.43
T_{10} - VC @ 7.5 t ha^{-1} + NC @ 1.5 t ha^{-1}	5.08
T_{11} - PM @ 7.5 t ha^{-1} + NC @ 2.25 t ha^{-1}	5.10
T_{12} - PM @ 10 t ha^{-1} + NC @ 1.5 t ha^{-1}	5.35
T_{13} - PM @ 7.5 t ha^{-1} + NC @ 2.0 t ha^{-1}	4.32
T_{14} - PM @ 10 t ha^{-1} + NC @ 1.5 t ha^{-1}	4.13
S.ED	**0.02**
CD (P=0.05)	**0.05**

E.Nutrient uptake

Nitrogen uptake

There were significant differences among all the treatments in terms of uptake of Nitrogen. The treatment T_2 recorded the highest value of 114.00 kg ha^{-1} while the treatment T_1 recorded the lowest value of 76.15 kg ha^{-1}. The treatments T_3 and T_4 were statistically on par with each other as shown in (Table 28).

Phosphorus uptake

For this parameter, there existed significance differences among all the treatments when compared with the control. The highest uptake of phosphorus was observed inT_2 (26.32 kg ha^{-1}) and was followed by T_8 (25.60 kg ha^{-1}) which exhibited significant difference with T_{10}. The lowest uptake of phosphorus was observed in T_1 (13.74 kg ha^{-1}) as presented in the table 28.

Potassium uptake

Among all the treatments, there existed significance differences interns of potassium uptake when compared with the control. Uptake of potassium was highest in the treatment T_2 (104.63 kg ha^{-1}) and was lowest in the treatment T_1 (83.15 kg ha^{-1}). The treatments T_4 and T_3 however did not exhibited significant difference among themselves as shown in (Table 4)

Table 4:Effect of bulky and concentrated organic manures on nutrient uptake in garden bean

Treatments	Nutrient uptake (kg ha^{-1})		
	Nitrogen	**Phosphorus**	**Potassium**
T_1 - Control	76.15	13.74	83.15

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T_2 - Inorganic fertilizers (36:72 NP kg ha^{-1})	114.00	26.32	104.63
T_3 - FYM @ 10 t ha^{-1} + NC @ 2.25 t ha^{-1}	81.01	17.74	87.12
T_4 - FYM @ 15 t ha^{-1} + NC @ 1.50 t ha^{-1}	81.05	18.01	87.25
T_5 - FYM @ 10 t ha^{-1} + CC @ 2.0 t ha^{-1}	78.91	15.10	85.16
T_6 - FYM @ 15 t ha^{-1} + CC @ 1.50 t ha^{-1}	80.11	16.15	86.15
T_7 – VC @ 5 t ha^{-1} + NC @ 2.25 t ha^{-1}	102.23	23.86	98.52
T_8 - VC @ 7.5 t ha^{-1} + NC @ 1.50 t ha^{-1}	110.73	25.60	101.65
T_9 - VC @ 5 t ha^{-1} + NC @ 2.0 t ha^{-1}	94.69	21.87	94.87
T_{10} - VC @ 7.5 t ha^{-1} + NC @ 1.5 t ha^{-1}	97.79	22.89	95.98
T_{11} - PM @ 7.5 t ha^{-1} + NC @ 2.25 t ha^{-1}	98.62	22.97	96.13
T_{12} - PM @ 10 t ha^{-1} + NC @ 1.5 t ha^{-1}	106.10	24.84	100.43
T_{13} - PM @ 7.5 t ha^{-1} + NC @ 2.0 t ha^{-1}	91.61	20.61	93.54
T_{14} - PM @ 10 t ha^{-1} + NC @ 1.5 t ha^{-1}	88.60	19.32	92.04
S.ED	**1.260**	**0.286**	**0.217**
CD (P=0.05)	**0.611**	**0.139**	**0.446**

G.Post-harvest soil nutrient statu

Available nitrogen in soil

The Nitrogen in available form after harvest differed significantly among all the treatments when compared with control. The treatment T_2 (inorganic fertilizer) recorded the highest soil available nitrogen of 208.89 kg ha^{-1}. The next best value was exhibited in the treatment T_8 (200.26 kg ha^{-1}) followed by T_{12} (193.12 kg ha^{-1}). The treatment T_4 and T_3 were however on par with each other. The lowest soil available nitrogen was recorded in T_1 which served as control (Table 5).

Available phosphorus in soil

The available phosphorus in post harvest soil differed significantly among all the treatments. The highest value was recorded in the treatment T_2 (60.14 kg ha^{-1}) which was followed by T_8 (58.51 kg ha^{-1}) and T_{12} (55.91 kg ha^{-1}). The lowest value for this parameter was recorded in control T_1 (25.84 kg ha^{-1}) as presented in the table 5.

Available potassium in soil

The available potassium after harvest varied significantly among all the treatments when compared with control. The value for this parameter was the highest in T_2 (260.18 kg ha^{-1}) and was followed by T_8 (254.52 kg ha^{-1}). The treatment T_2 however did not exhibit significant difference with T_8. The value for this parameter was lowest in T_1 (201.52 kg ha^{-1}) the control as shown in the table 5.

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Table 5:Effect of bulky and concentrated organic manures on post harvest soil nutrient status in garden bean

Treatments	Available soil nutrient (kg ha^{-1})		
	Nitrogen	**Phosphorus**	**Potassium**
T_1 - Control	128.01	25.84	201.52
T_2 - Inorganic fertilizers (36:72 NP kg ha^{-1})	208.89	60.14	260.18
T_3 - FYM @ 10 t ha^{-1} + NC @ 2.25 t ha^{-1}	135.12	30.10	208.12
T_4 - FYM @ 15 t ha^{-1} + NC @ 1.50 t ha^{-1}	135.62	31.25	210.32
T_5 - FYM @ 10 t ha^{-1} + CC @ 2.0 t ha^{-1}	130.12	27.01	204.12
T_6 - FYM @ 15 t ha^{-1} + CC @ 1.50 t ha^{-1}	132.43	28.41	206.10
T_7 – VC @ 5 t ha^{-1} + NC @ 2.25 t ha^{-1}	185.06	53.17	245.16
T_8 – VC @ 7.5 t ha^{-1} + NC @ 1.50 t ha^{-1}	200.26	58.51	254.52
T_9 – VC @ 5 t ha^{-1} + NC @ 2.0 t ha^{-1}	167.43	46.95	236.42
T_{10} - VC @ 7.5 t ha^{-1} + NC @ 1.5 t ha^{-1}	176.14	50.45	239.05
T_{11} - PM @ 7.5 t ha^{-1} + NC @ 2.25 t ha^{-1}	177.02	50.93	240.25
T_{12} - PM @ 10 t ha^{-1} + NC @ 1.5 t ha^{-1}	193.12	55.91	248.23
T_{13} – PM @ 7.5 t ha^{-1} + NC @ 2.0 t ha^{-1}	159.65	43.22	231.38
T_{14} – PM @ 10 t ha^{-1} + NC @ 1.5 t ha^{-1}	151.63	40.45	228.94
S.ED	**0.73**	**0.36**	**0.67**
CD (P=0.05)	**1.50**	**0.77**	**1.38**

IV.DISCUSSION

Regarding the physico chemical properties, numerically higher values for EC, organic carbon, water holding capacity and lower values for pH and Bulk density were registered under 75 per cent N supplied through oil cakes. But the values among all the treatments were statistically not significant since it was tried for one season. If the practice is continued for few more years there must be a change in the physico chemical properties. Application of manures, irrespective of sources and rates recorded significantly higher organic carbon and this might be due to increased yield of roots and plant residues and external application of organic manures as reported by Yadav et al., (2000). The differences in the organic carbon content with the application of different sources of nutrients might be due to the result of differential rate of oxidation of organic matter by microbes (Trehan, 1997). The decrease in soil pH after organic matter addition might be because of the production of CO_2 and organic acids during decomposition of organic materials. Consequently, if there is decrease in soil pH directly it is related with increase in EC. This is in accordance with Shelkeet al. (2001) and Mali et al. (2004). The decreased bulk density might be due to incorporation of organic manures with lower bulk density (Umamaheswari., 2009).

The data on nutrient uptake pattern revealed that the application of inorganic fertilizers resulted in the highest nutrient uptake. This is in accordance with Sharma et al., (1995). Among the various organic manures and concentrated oil cakes tried, application of 75 per cent N through vermicompost along with 25 per cent N through neem cake recorded the highest nutrient uptake. This could be attributed to the supplementation of higher nitrogen, phosphorus and potassium supplied by means of vermicompost and neem cake. Moreover, Vermicompost contains nutrients in forms that are readily taken up by plants such as nitrates, exchangeable phosphorus and soluble potassium as reported by Edwards and Burrows (1988).

Similarly, the nutrients in neem cake are also in readily available from. This is in accordance with the reports of Chinnaswamy (1976), Sridhar (2003);Bharathi(2004) and Sundhararaman (2009). The next recognizable treatment for nutrient uptake pattern was the application of poultry manure @ 2.16 t ha^{-1} along with neem cake @ 0.73 t ha^{-1}. The increased nutrient uptake by the crop due to neem cake can be ascribed to the presence of alkaloids like nimbin and nimbidin, which have nitrification inhibiting properties and releases N slowly. Thus apart from the nutrient content in the neem cake, the retention capacity of nutrients to a prolonged period and its balanced availability might have resulted in better uptake of nutrients as reported by Deshpande et al. (2007).

Significant variation was observed among the treatments for the trait, post harvest nutrient status of soil. The maximum availability of nitrogen, phosphorus and potassium were obtained with application of vermicompost @ 10.03 t ha^{-1} along with neem cake @ 0.73 t ha^{-1}. This might be due to the fact thatvermicompost was found to enhance the number of nitrogen fixing bacteria and symbiotic microbial association thereby contributing to increase in nitrogen, phosphorus and potassium in soil. This is in line with the work of Kale et al. (1987). Another reason may be the higher amount of total and mineral nitrogen level as ammonia in the vermicompost that could be rapidly converted to nitrate thus minimizing the loss of N from soil reported by Kale et al. (1992). Application of vermicompost increased the proportion of mineral nitrogen available for plants at any given time, although nitrogen was immobilized in the initial stage as reported by Mahesh (1995), an increased availability of nitrogen in soil by the application of vermicompost compared to poultry manure and FYM is due to mineralization of native 'N' by higher bacterial population. Rao et al., (1996) stated that, higher levels of available potassium were recorded with vermicompost application due to earth worm activity. Further, presence of more organic matter in vermicompost amended soil might have enhanced the nutrient retention in post harvest soil as earlier reported by Aranconet al. (2006). Since the nutrient content in neem cake is greater, the availability of soil nutrients was also higher. The influence of neem cake in increasing the rhizosphere micro flora was also discussed earlier by Subramanian and Rao (1974). The microbiological properties of soil could influence in decomposition of organic matter and enzymatic activities in soil (Nannipieriet al., 1990). This also might be the reason for increasing the availability of nutrients. The lower loss of nutrients due to the slow release in the manure amended plots may be responsible for an increase in available nutrients in soil when compared to inorganic manures as reported by Upperiet al.(2011)

V.CONCLUSION

Among the treatments comprising organic manures and concentrated oil cakes, 75 per cent N supplied through vermicompost 2.41 t ha^{-1} along with 25 per cent N supplied through neem cake @ 0.22 t ha^{-1} followed by incorporation of poultry manure @ 0.61 t ha^{-1}25 per cent N supplied through neem cake @ 0.22 t ha^{-1} recorded the maximum number of root nodules and maximum values for growth and yield attributes. . Numerically higher values for organic carbon, ECand lower value for pH and bulk density were observed in the treatment combination, 75 per cent N through bulky organic manures along. with 25 per cent N through oil cakes. Within the treatments, insignificant variation was observed for these traits. . The maximum values for uptake and availability of nitrogen, phosphorus and potassium, pod yield were obtained with application of vermicompost @ 10.03 t ha^{-1}along with neem cake @ 0.73 t ha^{-1} followed by poultry manure @ 2.16t ha^{-1} and with neem cake @ 0.75 t ha^{-1}.

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