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Effect of integrated nutrient management on growth and yield of dolichos bean (*Lablab purpureus*)

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ABSTRACT

A field experiment was conducted in factorial randomized block design during the year 2012-2013 at farmer's field near Annamalai University, Tamilnadu to study the effect of organic and inorganic sources of nutrients in combination with consortium biofertilizers on growth, yield and quality of dolichos bean [Lablab purpureus (L.) Sweet]. The experiment comprised of 12 treatment combinations of organic manures (O_1- 25 t FYM ha^{-1}, O_2-25 t pressmud ha^{-1} and O_3- 5 t verimicompost ha^{-1}), inorganic fertilizers (I_1- 75 % RDF and I_2- 100 % RDF- 25 kg N + 50 kg P_2O_5 ha^{-1}) and Consortium biofertilizers (B_0- without CBF and B_1- with CBF). The growth, flowering and yield parameters of dolichos bean were significantly influenced by combined application of organic manures, inorganic fertilizers and CBF. Among the treatments, the highest growth parameters were recorded with 5 t Vermicompost ha^{-1} + 75% RDF + CBF and it was on par with 5 t Vermicompost ha^{-1} + 100 % RDF + CBF. The highest yield parameters and pod yield (15.5 t ha^{-1}) were observed in treatment combination of 5 t Vermicompost ha^{-1} + 75 % RDF + CBF (2 kg Rhizobium ha^{-1} + 2 kg VAM ha^{-1} + 2.5 kg PSB ha^{-1}). In general, the lowest values of growth, yield parameters and yield of dolichos bean were recorded with 25 t pressmud ha^{-1} + 75 % RDF + no CBF. Among these organic manures, vermicompost performed better than FYM and pressmud.

Key words: Biofertilizer, dolichos bean, INM, Organic manures, fertilizer

INTRODUCTION

Dolichos bean or garden bean (*Lablab purpureus* (L.) Sweet) (syn. *Dolichos lablab* (Roxb.) L. var. *typicus*) is an important leguminous vegetable of India. It occupies a unique position as vegetable among the legume crops due to its high nutritive value (Basu *et al.,* 2002). It is rich in protein (1.7g), calcium (132 mg), thiamine (0.08 mg) and vitamin C (24 mg per 100g of edible pods). In Tamil Nadu, total bean production (including all types of vegetable beans) was 1.64 lakh tonnes from an area of 0.076 lakh ha with a productivity of 21.45 tonnes ha^{-1} during 2015-17(Annon, 2017). However, the productivity of dolichos bean in farmer's field ranges from 7 to 13 t ha^{-1} only. Though, this crop has good demand in market, it is being cultivated in limited area due to its markedly low productivity. Low productivity of this crop is attributed mainly due to inadequate nutrient management practices. Use of chemical fertilizers along with organic manures and biofertilizers may increase productivity of dolichos bean, soil fertility and reduces the costs of production (Gandhi and Sivakumar, 2010). Being a nodule forming crop, it is advantageous of taking useful interaction of microorganisms in the form of consortium. Further, consortium bio fertilizer application was helpful to maintain diversity in agricultural ecosystems which are living in rhizosphere environment and are capable of improving plant nutrition and soil fertility through biological fixation of nitrogen, phosphate solubilization, and enhancement of plant growth (Akram Jafari fara *et al.,* 2014). Dual inoculation of *Rhizobium* and VAM was suggested to minimize nitrogen and phosphorus fertilizer application for leguminous crops. Application of organic manures like farmyard manure, pressmud and vermicompost proved to be a better alternative to inorganic fertilizers in enhancing growth and yield of the plant (Arora and Maini, 2011; Aleem *et al.,* 2014). Integrated approach of using both organic and inorganic nutrient sources along with consortium of biofertilizers seems to be a viable alternative to achieve higher yields in dolichos bean with acceptable quality. Further, integrated nutrient management system has become an accepted strategy to augment the yield and quality of vegetable cops under commercial production. Hence, an experiment was conducted to study the effect of organic and inorganic sources of

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nutrients in combination with consortium biofertilizers on growth, yield and quality of dolichos bean and to find out suitable combination of integrated nutrient management package with reduced dose of inorganic nutrients.

MATERIALS AND METHODS

The experiment was conducted in factorial randomized block design with three replications during the year 2012-2013 in farmer's field at Sivapuri village near Annamalai University, Tamilnadu. The experiment comprised of 12 treatments *viz.,* organic manures at three levels (O_1- 25 t FYM ha^{-1}, O_2- 25 t pressmud ha^{-1} and O_3- 5 t vermicompost ha^{-1}), two levels of inorganic fertilizers (I_1- 75 % RDF and I_2- 100 % RDF- 25 kg N + 50 kg P_2O_5 ha^{-1}) and Consortium biofertilizers (B_0- without CBF and B_1- with CBF 2 kg *Rhizobium* ha^{-1} + 2kg VAM ha^{-1} + 2.5 kg PSB ha^{-1}). Organic manures were thoroughly incorporated into the soil before 15 days of sowing. The recommended dose of P was applied as basal. Nitrogen was applied in two equal splits as basal and top dressing at 30 days after sowing. Dolichos bean seeds of the cultivar Arka Jay were sown at a spacing of 60x30cm. In each replication, five plants were selected randomly for recording observations. The growth and yield characters *viz.,* plant height, number of branches / plant, number of leaves / plant, leaf area, leaf area index, chlorophyll content, dry matter production, days to first flowering, days to 50% flowering, number of racemes / plant, raceme length, number of flower buds / raceme, pod length, single pod weight, number of pods / plant, yield / plant and yield / hectare were recorded. Protein content in pod was determined as per Lowry *et al.* (1951) method. The statistical analysis of data was carried out as per the procedure given by the Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Growth parameters

The effect of sources of nutrients *viz.,* organic manures, inorganic fertilizers and consortium biofertilizers had significant beneficial influence on all the growth attributes of dolichos bean (Table 1). Among the treatments, the highest growth in terms of plant height (92.2cm), number of branches /plant (7.8), number of leaves /plant (58.4), leaf area (17.9cm^2), chlorophyll content (2.59 mg g^{-1}) and dry matter production (270.5g $plant^{-1}$) were recorded with 5 t Vermicompost ha^{-1} + 75% RDF + CBF ($O_3I_1B_1$). However, the treatment $O_3I_1B_1$ was on par with $O_3I_2B_1$ (5 t Vermicompost ha^{-1} + 100 % RDF + CBF) in respect of these growth charecters. All the growth parameters were recorded the lowest in $O_2I_2B_0$ (25 t pressmud ha^{-1}+ 100 % RDF + without CBF) which was on par with $O_2I_1B_0$ (25 t pressmud ha^{-1} + 75 % RDF + without CBF). Enhancement in growth attributes of dolichos bean might be due to the pronounced influence of vermicompost and consortium biofertilizers as well as their complementary effect. These results were in accordance with those of Gandhi and Sivakumar (2010) who observed enhancement in growth characters due to application of vermicompost in combination with inorganic nutrients. Vermicompost treatments compensated the reduced level of recommended dose of inorganic fertilizers and even excelled 100 per cent RDF. This might be attributed to the fact that vermicompost is a nutritive 'organic fertilizer' rich in NKP, micronutrients, beneficial soil microbes like 'nitrogen-fixing bacteria' and 'mycorrhizal fungi' and are scientifically proving as 'miracle growth promoters and protectors'. Further, addition of consortium biofertilizer might have exerted their strong influences like improving soil biological activity, fixing atmospheric nitrogen by *Rhizobium* besides production of phytohormones and mobilizing of phosphorus by VAM in the rhizosphere and supplied the required nutrients to plant at optimum levels constantly from the soil solution at all stages of the crop growth (Dash and Gupta, 2011). Increased nutrient uptake, nodulation and biological nitrogen fixation of Rhizobium, colonization of vesicular arbuscular mycorrhizae and supplement of nutrients through vermicompost contributed to enhancement in growth of dolichos bean (Sajitha, *et al.*, 2016).

Yield parameters and yield

Organic manures, inorganic fertilizers and consortium biofertilizers significantly influenced the days taken for flowering. Significantly early flowering (38.4 days to first flowering and 44.8 days to 50 % flowering) was

Table 1: Effect of integrated nutrient management on growth parameters of dolichos bean

Treatment	Plant height (cm)	Branches per plant	Leaves per plant	Leaf area (cm^2)	Leaf Area Index	Chlorophyll content (mg g^{-1})	Dry matter production (t ha^{-1})	Days to first flowering	Days to 50 % flowering
T_1- $O_1I_1B_0$	77.9	6.9	50.4	16.5	6.20	2.33	223.5	42.5	48.6
T_2- $O_1I_1B_1$	89.2	7.6	56.7	17.6	7.43	2.54	260.6	39.6	45.8
T_3- $O_1I_2B_0$	75.5	6.8	49.0	16.2	5.94	2.29	215.6	43.1	49.1
T_4- $O_1I_2B_1$	86.6	7.4	55.3	17.3	7.15	2.49	252.1	40.2	46.5
T_5- $O_2I_1B_0$	72.4	6.5	47.1	15.6	5.70	2.20	211.3	42.2	48.2
T_6- $O_2I_1B_1$	84.7	7.3	54.2	17.1	6.94	2.45	245.9	40.7	46.9
T_7- $O_2I_2B_0$	71.1	6.5	46.6	15.8	5.47	2.21	201.5	43.9	49.9
T_8- $O_2I_2B_1$	82.3	7.2	52.8	16.9	6.68	2.41	237.9	41.3	47.5
T_9- $O_3I_1B_0$	80.1	7.1	51.7	16.7	6.45	2.37	230.9	41.9	48.0
T_{10}- $O_3I_1B_1$	92.2	7.8	58.4	17.9	7.76	2.59	270.5	39.0	45.3
T_{11}- $O_3I_2B_0$	78.6	7.0	50.9	16.6	6.26	2.35	225.7	42.9	49.1
T_{12}- $O_3I_2B_1$	91.5	7.7	58.0	17.8	7.68	2.58	268.1	38.4	44.8
SED	0.86	0.05	0.48	0.09	0.09	0.02	2.83	0.22	0.21
CD (p=0.05)	1.79	0.11	1.00	0.18	0.19	0.03	5.87	0.46	0.43

O_1- FYM @ 25 t ha^{-1}, O_2- Pressmud @ 25 t ha^{-1}, O_3- Vermicompost @ 5 t ha^{-1}, I_1- 75 % RDF, I_2- 100 % RDF, B_0- Without CBF, B_1- With CBF (Rhizobium + VAM + PSB)

Table 2: Effect of integrated nutrient management on flowering and yield parameters of dolichos bean

Treatment	Racemes per plant	Raceme length (cm)	Flower buds per Raceme	Flower buds per plant	Pods per plant	Pod length (cm)	Single pod weight (g)	Pod yield per plant (g)	Pod yield per ha (T)	Seeds per pod	Pod Protein Content %
T_1- $O_1I_1B_0$	7.3	37.8	27.6	203.9	55.9	9.02	4.08	228.4	12.6	4.72	3.79
T_2- $O_1I_1B_1$	8.0	41.0	30.3	246.0	60.8	9.82	4.45	270.9	15.0	5.15	4.13
T_3- $O_1I_2B_0$	7.1	37.2	27.1	194.8	54.9	8.85	4.00	219.8	12.2	4.63	3.72
T_4- $O_1I_2B_1$	7.9	40.2	29.7	236.2	59.7	9.64	4.36	260.7	14.4	5.05	4.05
T_5- $O_2I_1B_0$	6.8	35.7	26.0	187.0	52.7	8.49	3.84	202.6	11.2	4.44	3.57
T_6- $O_2I_1B_1$	7.7	39.7	29.3	229.4	58.9	9.51	4.30	253.8	14.1	4.98	4.00
T_7- $O_2I_2B_0$	6.7	35.7	25.8	175.1	52.6	8.47	3.83	201.5	11.2	4.43	3.56
T_8- $O_2I_2B_1$	7.6	39.1	28.7	220.4	57.9	9.34	4.23	244.6	13.5	4.89	3.93
T_9- $O_3I_1B_0$	7.4	38.5	28.2	212.4	56.9	9.18	4.16	236.7	13.1	4.81	3.86
T_{10}- $O_3I_1B_1$	8.2	41.6	30.8	254.1	61.8	9.98	4.52	279.5	15.5	5.23	4.20
T_{11}- $O_3I_2B_0$	7.3	38.2	27.9	205.9	56.5	9.11	4.12	233.0	12.9	4.77	3.83
T_{12}- $O_3I_2B_1$	8.0	41.0	30.3	245.8	60.8	9.82	4.45	270.5	15.0	5.14	4.13
SED	0.06	0.24	0.21	3.24	0.38	0.06	0.03	2.83	0.08	0.03	0.03
CD (p=0.05)	0.12	0.50	0.43	6.72	0.78	0.13	0.06	5.87	0.33	0.07	0.05

observed with 5 t Vermicompost ha^{-1} + 100 % RDF + CBF ($O_3I_2B_1$) was followed by 5 t Vermicompost ha^{-1} + 75% RDF + CBF ($O_3I_1B_1$), which recorded 39.0 days to first flowering and 45.3 days to 50 % flowering. The flowering was significantly delayed in $O_2I_2B_0$ (25 t pressmud ha^{-1}+ 100 % RDF + without CBF) with 43.9 days to first flowering and 49.9 days to 50 % flowering. The flowering and yield parameters of dolichos bean were also significantly influenced by organic manures, inorganic fertilizers and consortium biofertilizers (Table 2). Among the treatments, the highest yield parameters in terms of number of racemes / plant (8.2), raceme length (41.6cm), number of flower buds / raceme (30.8), number of flower buds / plant (254.1), number of pods / plant (61.8**),** pod length (9.9cm), single pod weight (4.5g), number of pods / plant (61.8), yield / plant (279.5g), yield (15.5 t ha $^{-1}$) and seeds / pod (5.23) and protein content (4.20) were recorded with 5t vermicompost ha^{-1} + 75 % RDF + CBF ($O_3I_1B_1$). The next best treatment in terms of these parameters was 5 t Vermicompost ha^{-1} + 100 % RDF + CBF ($O_3I_2B_1$) which was significantly less when compared to $O_3I_1B_1$. All yield parameters were lowest in Pressmud @ 25 t ha^{-1}+ 100 % RDF + without CBF which was on par with 25 t pressmud ha^{-1} + 75 % RDF + without CBF. The significant increase in the yield parameters due to application of Vermicompost @ 5 t ha^{-1}+ 75%RDF with consortium of biofertilizers (*Rhizobium* + VAM + PSB) might be ascribed to improved soil physical, chemical and biological properties. Higher availability of all plant nutrients resulted in the improved yield parameters like pods / plant, pod length, pod width, pod weight, pod yield / plant, pod yield / plot and pod yield /r hectare with 5 t vermicompost ha^{-1} + 75 % RDF + CBF followed by 5 t Vermicompost ha^{-1} + 100 % RDF + CBF. These finding are in conformity with the findings of Jaipaul Sharma *et al.* (2011) and Esakkiammal *et al.* (2015) in dolichos bean. Thus, vermicompost proved superior to FYM and pressmud n respect of growth and yield attributes and yield of dolichos bean.

From the results it may be concluded that the combined use of 5 t Vermicompost ha^{-1} + 75 % RDF + CBF can be considered as the best integrated nutrient management practice for higher yield and quality of dolichos bean.

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