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Effect of biofertilizer consortium on yield, quality and soil health of french bean (*Phaseolus vulgaris* L.)

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ABSTRACT

An experiment was carried out during 2014-2015 at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat to study the effect of biofertilizer consortium on yield, quality and soil health of french bean (*Phaseolus vulgaris* L.). The experiment was laid out in a randomized block design (RBD) with seven treatments and replicated thrice. The treatments were T_1: FYM 20 t/ha+ NPK @ 30:40:20 kg/ha (RDF), T_2: Enriched compost @ 3 t/ha, T_3: Enriched compost @ 3 t/ha + Consortium, T_4: Vermicompost @ 3 t/ha, T_5: Vermicompost @ 5 t/ha, T_6: Vermicompost @ 2.5 t/ha+ Consortium and T_7: Consortium (Rhizobium + Azotobacter + Azospirillum + PSB). The performance of french bean was greatly influenced by different treatments. Application of recommended dose of fertilizer in T_1 recorded significantly higher yield attributing characters viz., pod/plant (28.57), pod length (15.07 cm), pod girth (0.96cm), seed/pod (6.73), pod yield(11.27 t/ha) and harvest index (67.67%) respectively. Similarly, T_1 also recorded minimum dry matter content (6.87%); crude fibre content (7.15%) and maximum crude protein content (22.63%). Among the organic treatments, T_3 reflected the maximum for all the yield attributing characters which was closure with T_1; while T_4 recorded significantly maximum ascorbic acid content (11.67 mg 100g/FW). Further, T_3 also recorded the best for soil parameters viz., bulk density (0.83 g/ cm^3), pH (5.33), P_2O_5 (47.40 kg/ha), microbial biomass carbon (630.33µg/g/24h), dehydrogenase activity (711.50 µg TPF/ g/24h) and phosphomonoesterase activity (442.43µg *p*-nitrophenol/g/h) respectively. T_5 recorded highest organic carbon (0.68%); while T_1 also revealed maximum N and K (220.56 and 119.31kg/ha) content.

Key words: Consortium, Enriched compost, French bean, Quality, Soil health, Yield.

INTRODUCTION

French bean (*Phaseolus vulgaris* L.) is a short duration legume, known as common bean or kidney bean. It is a valuable source of protein, vitamins and minerals.It is an important vegetable for its high quality, nutritional properties and as a grain legume for its major protein source and economic value (Martins and Silva, 2004). As a legume, it supplies nitrogento the soil by forming a symbiotic or mutually beneficial partnership with rhizobiathrough the biological nitrogen fixation process. Use of biofertilizers can provide quality produce for human consumption by way of reduction of the chemical residues and also reduces the risk of environmental pollution. However, due to increase in the prices of chemical fertilizers and also with a view to maintain the ecosystem of soil, it has become necessary to minimize the use of chemical fertilizers by adding organic ones to the soil more particularly biofertilizers of microbial origin. Now a day's use of biofertilizers such as consortia, *Rhizobium*, *Azotobacter*, *Azospirillum*, PSB and *Pseudomonas* etc. have been found to be very effective tools for improving yield and quality of the crop as well as maintains fertility status of the soil.

MATERIALS AND METHODS

The experiment was conducted during 2014-2015 at Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat to study the effect of biofertilizer consortum on yield, quality and soil health of french bean (*Phaseolus vulgaris* L.) of variety Pant Anupama. The experiment was laid out in randomized block design with seven treatments and three replications. The treatments were T_1: FYM 20 t/ha+ NPK @ 30:40:20 kg/ha (RDF), T_2: Enriched compost @ 3 t/ha, T_3: Enriched compost @ 3 t/ha + Consortium, T_4: Vermicompost @ 3 t/ha, T_5: Vermicompost @ 5 t/ha, T_6: Vermicompost @ 2.5 t/ha+ Consortium and T_7: Consortium @ 20 g/kgseeds. One week prior to sowing FYM, recommended dose of fertilizer, enriched compost and vermicompost were applied to the experimental area. Consortium was applied as seed treatment to the concerned treatments. Cultures of Consortium (*Rhizobium* + *Azotobacter* + *Azospirillum* + PSB) @ 20 g/ kg of seeds were used to pre-treat the seeds before sowing. This treated seeds were sown in 5 cm deep by following line sowing at a spacing of 30 cm (raw) and 20 cm (plant). Observations on pod/plant, pod length, pod girth, seed/

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pod,pod yield, harvest index, dry matter, crude fibre, crude protein, ascorbic acid, bulk density, pH, organic carbon, available N, P, K, microbial biomass carbon, dehydrogenase and phosphomonoesterase activity of soil were recorded.

RESULTS AND DISCUSSION

Yield parameters: The yield attributing parameters like pod/plant, pod length (cm), pod girth (cm), seed/pod, pod yield (t/ha) and harvest index (%) were significantly influenced by the application of different nutrient sources. The results of the present investigation are presented in Table 1. Data obtained during the investigation revealed that T_1 (FYM 20 t/ha+ NPK @ 30:40:20 kg/ha) recorded the highest for all the yield attributing characters which was closure with T_3 (Enriched compost 3 t/ha + Consortium). This increase of inorganic treatment T_1 as compared to organic treatments might be due to use of chemical fertilizers as they are more readily available to the plants immediately after application and more particularly with respect to major nutrients like N, P and K to plants at earlier stages of plant growth which helped in increasing the vegetative growth. This result was in conformity with Sharma and Verma (2011) who reported that rhizobium inoculation and application of FYM and chemical fertilizers had significantly increased the plant height, number of pods/plant, number of seeds/pod, yield and net returns over controls. Singh and Chauhan (2009) also reported similar results in french bean. Parmar (2009) also noticed enhancement in productivity of pea with conjoint use of rhizobium inoculated seeds, FYM and chemical fertilizers in soils of cold arid zone of Himachal Pradesh.However, similar increase in organic treatment $T_3$was mainly due to the inoculation of consortium along with organic fertilizers which significantly increased the yield. Thakur *et al.* (1999) also reported that rhizobium inoculation treatment may be attributed to increased nodulation and nitrogen fixation and production of secondary metabolites by the bacteria.

Quality parameters: In the present investigation the highest fibre and dry matter content was recorded in the treatment which did not received any organic amendment leading to compact soil (higher bulk density) and making the plants less responsive towards overall yield and quality. The results are presented in Table1. In contrast the T_1 i.e. which received maximum organic matter and the highest NPK tended to produce tender pods with least fibre and dry matter content. This is obvious it is a reflection on the part of the moisture content of the pod made available by the organic amendments in soil. Crude protein content was maximum in RDF because of supplementation of more nitrogen to the plants. A positive

Table 1: Pod/plant, pod length (cm), pod girth (cm), seed/pod, pod yield (t/ha), harvest index (%), dry matter (%), crude fibre (%), crude protein (%) and ascorbic acid (mg/100g FW) content of french bean as influenced by different treatments.

Treatments	Pod/plant	Pod length (cm)	Pod girth (cm)	Seed/pod	Pod yield (t/ha)	Harvest index (%)	Dry matter (%)	Crude fiber (%)	Crude Protein (%)	Ascorbic acid (mg/100g FW)
T_1 (FYM 20 t/ha+ NPK @ 30:40:20 kg/ha)	28.57	15.07	0.96	6.73	11.27	67.67	6.87	7.15	22.63	9.51
T_2 (Enriched compost 3 t/ha)	21.27	14.11	0.89	5.30	10.35	62.33	7.68	7.94	20.70	10.48
T_3 (Enriched compost 3 t/ha + Consortium)	23.53	14.50	0.93	6.30	10.95	65.00	7.23	7.33	21.80	10.38
T_4 (Vermicompost 3 t/ha)	19.27	13.93	0.87	5.00	9.63	62.00	7.83	8.04	20.34	11.67
T_5 (Vermicompost 5 t/ha)	21.93	14.34	0.89	6.07	10.58	63.33	7.53	7.92	20.88	10.70
T_6 (Vermicompost 2.5 t ha + Consortium)	22.07	14.41	0.92	6.20	10.63	64.33	7.24	7.44	21.70	10.46
T_7 (Consortium)	9.00	13.57	0.78	4.87	7.23	55.33	8.06	8.84	19.75	11.53
S.Ed	1.22	0.26	0.02	0.24	0.14	1.08	0.01	0.02	0.09	0.16
$C.D_{(5\%)}$	3.67	0.78	0.07	0.72	0.43	3.26	0.04	0.07	0.27	0.48

Table 2: Bulk density (g/cm^3), pH, organic carbon (%), available N (kg/ha), available P_2O_5 (kg/ha), available K_2O (kg/ha), microbial biomass carbon (µg/g/24h), dehydrogenase activity µg TPF/g/24h) and Phosphomonoesterase activity µg *p*-nitrophenol/g/h) of soil as influenced by different treatments

Treatments	Bulk density (g/cm^3)	pH	Organic carbon (%)	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)	Microbial biomass carbon (µg/g/24h)	Dehydrogenase activity (µg TPF/g/24h)	Phosphomono esterase Activity (µg *p*-nitrophenol/g/h)
T_1 (FYM 20 t/ha+ NPK @ 30:40:20 kg/ha)	1.07	5.21	0.58	220.19	46.79	119.31	365.80	395.37	315.48
T_2 (Enriched compost 3 t/ha)	1.05	5.28	0.65	216.01	42.25	114.52	512.37	624.43	355.80
T_3 (Enriched compost 3 t/ha + Consortium)	0.83	5.33	0.61	218.00	47.40	118.49	630.33	711.50	442.43
T_4 (Vermicompost 3 t/ha)	1.08	5.23	0.57	214.15	41.29	113.66	485.43	501.56	325.53
T_5 (Vermicompost 5 t/ha)	0.96	5.29	0.68	215.00	42.51	116.45	587.30	664.57	382.47
T_6 (Vermicompost 2.5 t/ha + Consortium)	0.87	5.31	0.64	217.48	44.06	117.47	624.27	710.40	421.47
T_7 (Consortium)	1.17	5.00	0.51	211.00	37.96	108.39	295.37	320.33	295.50
S.Ed	0.01	0.01	0.01	0.80	0.42	0.28	0.25	0.28	0.38
C.D $_{(5\%)}$	0.05	0.04	0.04	2.40	1.27	0.85	0.76	0.86	1.16

correlation between protein content and level of applied nitrogenous fertilizer was found by Weston and Barth (1997).

Soil parameters: Data on soil parameters presented in Table 2. showed significant difference among the treatments. The T_3(Enriched compost 3 t/ha + Consortium) recorded minimum bulk density, maximum pH, available phosphorus, microbial biomass carbon, dehydrogenase and phosphomonoesterase activity; while T_7(Consortium) recorded maximum bulk density with minimum pH, organic carbon, available NPK, microbial biomass carbon, dehydrogenase and phosphomonoesterase activity. Soil organic carbon content increased significantly in the plots that had received highest amount of organic matter content i.e. treatment T_5(Vermicompost 5 t/ha). The increase in organic carbon content might be attributed to addition of organic materials and better root growth. These findings are in consonance with the findings of Sharma *et al.* (2009). Organic matter resulted in improvement of soil aggregates, macro and micro pore spaces that increases free movement of water within the soil might have increased the available water content of the soil. Manthan and Thilagavathi (1997) observed that application of organic manures to the soil decreases bulk density and increases per cent pore space and water holding capacity. However, T_1 recorded maximum for soil available nitrogen and potassium. Parmar (2009) also noticed enhancement in available nitrogen content of soil with the use of farm yard manure, rhizobium inoculated seeds of pea and chemical fertilizers in soils of cold arid zone of Himachal Pradesh. Sharma *et al.* (2003) also recorded higher contents of available K under conjoint use of organics and fertilizers than the sole use of fertilizers under high hills dry temperate conditions of north western Himalayas. Sharma and Verma (2011) reported maximum soil organic carbon and the highest available N, P, K contents under the combined use of rhizobium and FYM along with chemical fertilizers. However, T_1 failed to maintain the soil health for the proceeding crops. In comparison with mineral fertilizers compost produces significantly greater increase in soil organic carbon and some plant nutrients reported by Nardi *et al.* (2004). The use of enriched compost along with consortium also improves the microbial and enzymatic activities in soil.

Hence, from the present study an alternative to RDF management, enriched compost 3 t/ha along with consortium is found to be effective to get more yields and improving the quality of french bean as well as maintains soil sustainability.

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