Effect of various nutrient management practices on productivity, soil fertility status and water use efficiency of french bean grown under homestead condition in Nadia district of West Bengal.

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ABSTRACT

Among all the vegetables grown in New Alluvial zone of West Bengal, french bean occupies special importance in terms of production, acreage and economic return. But non-application of adequate nutrients prevents the farmers for getting desired yield from this vegetable. Generally the farmers cultivate their own variety without any integrated nutrient management approach at homestead level under irrigated farming situation. Keeping this view an investigation was undertaken during the year 2007-08 to 2008-09 in a instructional farm of Nadia Krishi Vigyan Kendra as well as in farmer's field under the jurisdiction of Nadia Krishi Vigyan Kendra to find out the effect of various nutrient management practices including organic manure of FYM, vermi-compost, bio-fertilizer (Rhizobium culture) as well as integrated approach of both inorganic and organic based nutrient on productivity, soil moisture and fertility status and water use efficiency of french bean grown in winter season under irrigated condition. The results reveal that integrated nutrient management approach like fertilizer management with organic manure (FYM) @ 6 plus 3 of vermicompost as well as seed inoculation with Rhizobium culture along with 75% of recommended dose of fertilizer increase the fresh pod yield, water use efficiency, economic return and build up the soil fertility status by improving physico-chemical properties of soil significantly over the control (farmer's practice) plot where only chemical fertilizer was used. This study suggest that soil fertility status as well as economic return can be improved on sustainable basis by supplying all the nutrient in judicious way if the farming community of this area advised to follow such kind of integrated nutrient management approach.

Key words: Economic return, *Rhizobium* and vermicompost

Choice of soil management practices to improve or maintain soil fertility is of utmost importance to farmers both in terms of their agronomic and economic performance. The modern agriculture technology emphasizes wide spread of use of chemical fertilizer (off farm inputs) as a source of nutrients. Infact, fertilizer use is considered as a barometer of agricultural production but use of chemical fertilizer is limited in many areas due to high cost and lack of availability. In order to reduce dependence on commercial fertilizer, there much interest to use local available farm yard manure as alternative source. The organic fertilizer cannot meet crop nutrient demand over large areas because of limited availability, low nutrient composition and high labor requirement (P*alm et al.,* 1998). Supplementation of farm yard manure/compost as well as application of nitrogen fixing microorganism along with chemical fertilizer is the most potentially option for agronomic effectiveness of the component crops. Integrated nutrient management methods, mineral and organic nutrient combining source, offer better results than reliance on one source alone (Bekunda, 1999). Keeping this in view, the present investigation was under taken to study the effect of various nutrient management practices including organic manure of FYM and vermi compost, bio-fertilizer (*Rhizobium* culture) as well as integrated approach of both in organic and organic based nutrient on productivity, soil moisture and fertility status and water use efficiency of french bean.

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MATERIALS AND METHODS

The field experiment was conducted during the rabi season of 2007-08 and 2008-09 in New Alluvial agro-climatic zone of West Bengal. French bean variety Pusa parvati was shown in Instructional farm of Nadia Krishi Vigyan Kendra under homestead condition. The experimental soil was well drained, sandy loam soil. The physico-chemical properties of surface soil are, sand 72.68 %, silt 14.76 % and clay 12.56 % with bulk density value 1.48 mgm^3. Soil pH is 6.4 to 6.8 with available N, P_2O_5 and K_2O are 230-240, 50-55 and 110-115 kg ha^{-I} respectively. The organic carbon status of the soil is 0.48 to 0.50 %.

The experimental field was laid out in a randomized block design (RBD) and replicated four time. The treatments used are:

- T_1 - Farmers practice (control) only chemical fertilizer @ 30 : 30 : 30 NPK, $kgha^{-1}$
- T_2 - Recommended dose of chemical fertilizer (RDF) @40 : 60 : 50 NPK, $kgha^{-1}$
- T_3 - Only FYM @ 6 t ha^{-I} and vermicompost @ 3t ha^{-I},
- T_4 - 50 % of RDF plus 6t ha^{-I} FYM and 3t ha^{-I} vermicompost
- T_5 - 75 % of RDF + 6t ha^{-I} FYM and 3t ha^{-I} vermicompost along with bio fertilizer (*Rhizobium* culture)

The seeds were inoculated with standard culture of *Rhizobium* as per treatment concern. The seed after drying in shade were sown in line. Nitrogen, phosphorus and potassium were applied in

the form of urea, single super phosphate and muriate of potash respectively. Full P and K and 50 % of N were applied as basal and the remaining 50 % of N was top dressed at 30 days after showing. Well decomposed FYM and vermicompost was applied during final land preparation as per treatment concern. Crop variety pusa parbati was sown in small furrows 15th November in both the year of 2007-08 and 2008-09 at a spacing of 45 x 15 cm. The net plot size of the each treatment was 10 m^2. Initial soil moisture was 18.2 percent (gravimetric) in 15 cm top soil. A light irrigation (2 cm) with the help of thali was given for easy and even emergence of the crop. Another 3 irrigations was given in the critical physiological growth stages of the crop with a depth of 5 cm. Harvesting was completed within February after 6-7 picking. Number of fruit per plant, plant height, number of branch, test weight of pod, and pod yield per plot was recorded. Soil moisture upto 60 cm depth were studied to evaluate total soil moisture depletion pattern and water use efficiency of crop. Surface soil sample (0-15 cm) after harvest of the crop was analysed for pH organic carbon, available N, P and K following the standard procedure as outlined by Jackson (1967). All the measured data were statistically analyzed for critical difference as suggested by Panse and Sukhatme (1989).

RESULTS AND DISCISSION

Pod yield and yield attributes

The data presented in the table-1 revealed that the farmers' traditional practice of adding of NPK @ 30:30:30 (in the form of Sufala 15-15-15)q ha^{-1} to crop registered the less pod yield of 79.59 ha^{-1}. On the other hand application of recommended dose of chemical fertilizer either alone or in conjunction with FYM, vermicompost and microbial inoculant or both increased the fresh pod yield of 16.75 to 47.04% over farmer's practice. The economic yields consistently increased to about 92.92 q ha^{-1}at 100% RDE. The pod yield further increased significantly when 75% recommended fertilizer dose were supplemented with FYM and vermicompost. Further application of both *Rhizobium* culture and FTM, vermicompost in combination with 75% recommended dose of chemical fertilizer increased pod yields 47.04% and were superior to the rest of the treatments under study. This amply demonstrate that the activity of *Rhizobium* culture in promoting pod yield was more pronounced when it was enriched with organic manure and vermicompost. This was mainly due to the availability of the micro-organism to fix atmospheric nitrogen to the soil and made available to the growing plants, beside secretion of growth promoting substances which were partly responsible for the enhanced plant growth and yield (Rao 1981). It also reveals to the fact that correct bacterization (symbiotic association) along with judicious application of FYM, vermicompost and chemical fertilizers could save at least 25-50% chemical fertilizer which ultimately increase higher net economic return and benefit cost ratio.

The results of the effect of various treatments on average yield attribute of french bean are also presented in table-I. Significant variation of on plant height, No. of branch per plant, No. of pod per plant, test weight green pod have been observed due to variation of treatments. In general each of the attributes has been found to increase over control by application of treatment except T_3 where only FYM and vermicompost have applied. The interaction effect of 75% RDF plus application of FYM and vermicompost along with seed inoculation with *Rhizobium* culture shows maximum increase of yield attributing character. The variation of yield attributes of crop by the variation of treatments also reflects, for causing similar treands of variation of pod yield.

Crop water use

Significant variation of both total water use and water use efficiency are observed with the variation of treatments. The data from the Table-2 reveals that in general, the significant increase of total water use and water use efficiency with the increasing level of manuring and fertilization. Maximum use of total water and water use efficiency was found plot treated with 75% of RDF plus FYM and vermicompost along with the application of *Rhizobium* culture.

The results also find agreement with the finding of several author, who have the opinion that better root development with organic and bio-fertilizer favours the extraction of more soil water from the profile leading to increase water use efficiency. (Arora *et al.,* 1991)

Effect on soil properties and fertility status

The effect of various treatments on chemical properties of soil are presented in Table-3. The pH of the soil in general are not greatly influenced by the application of treatments, however it tends to increase with the application organic and inorganic fertilizer. Maximum increase was observed when the soil was inoculated with *Rhizobium* culture with FYM and vermicompost plus 75% of recommended dose of chemical fertilizer. The organic carbon status was found to be relatively higher wherever FYM and vermicompost applied. The effects are more pronounced with increasing level of chemical, organic and inoculation of bio-fertilizer as integrated approach. Better root and shoot growth, higher bio-mass production association with stimulating effect of growth and activity of micro-organism may leave the reasons for increasing organic matter content in soil.

Table 1: Effect of various nutrient management on yield and yield attribute of french bean

Treatments	Plant height (cm)	No. of branch / plant	Yield attributes (pooled data)		Green pod yield (qha^{-1})	Yield increase over control (%)	Net return ($Rsha^{-1}$)	B:C ratio
			No. of pod/plant	100 green pod weight (g)				
T_1-Farmers' practice	40	10	24	318	79.59	-	33672	2.05:1
T_2- RDF	50	13	28	388	92.92	16.75	40336	2.18:1
T_3-FYM 6 t ha^{-1} + VC.3t ha^{-1}	37	09	22	390	72.10	(-)10.38	32890	2.02:1
T_4-50% RDF+ T_3	48	12	29	416	95.93	20.53	42703	2.19:1
T_5-75% RDF+ T_3	51	14	33	434	106.77	34.15	46416	2.23:1
T_6-T_5+bio-fertilizer	54	17	37	466	117.03	47.04	52124	2.28:1

Table 2 : Effect of various nutrient management practices on total water use and water use efficiency of french bean.

Treatments	Profile contribution(mm)		Total water use(mm)		Water use efficiency (mm)	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
T_1-Farmers' practice	57.29	51.72	227.29	221.72	34.79	36.12
T_2- RDF	63.70	49.50	233.70	219.50	39.60	42.49
T_3-FYM 6 t ha^{-1} + VC.3t ha^{-1}	61.18	42.93	231.18	212.93	30.83	34.24
T_4-50% RDF+ T_3	64.43	45.54	234.43	214.54	40.60	45.06
T_5-75% RDF+ T_3	65.90	45.90	235.90	215.90	44.91	49.82
T_6-T_5+bio-fertilizer	67.40	44.86	237.90	214.86	48.8	54.89

Table 3 : Effect of various nutrient management practices on changes of soil properties.

Treatments	pH	Organic carbon (%)	Available N (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})
Initial (Before sowing)	6.75	0.49	241.90	52.25	113.60
After harvest					
T_1-Farmers' practice	6.68	0.50	243.40	54.83	112.90
T_2- RDF	6.70	0.58	251.73	59.67	120.10
T_3-FYM 6 t ha^{-1} + VC.3t ha^{-1}	6.80	0.62	254.13	61.70	123.43
T_4-50% RDF+ T_3	6.82	0.63	265.74	65.93	135.63
T_5-75% RDF+ T_3	6.85	0.64	272.17	69.17	143.30
T_6-T_5+bio-fertilizer	6.84	0.66	286.93	72.83	148.62

RDF - Recommended dose of fertilizer (NPK@40:60:50 kg ha^{-}) ; T_1 – NPK @ 30:30:30 kg ha^{-1} VC = Vermicompost

REFERENCES

Bekunda, M. 1999 . Farmer's responses to soil fertility decline in banana-based cropping systems of Uganda. Dry lands programme, International Institute for Environment and Development; London; UK. *Managing. Africa's. Soils*. No.**4**, pp.19

Palm, C. A, Murwira, H. K. and Carter, S. E. 1998. Organic matter management : From science to practice. In: Sharma, O. P. and A. K. Gupta. 2001 – Comparing the fusibilities of pear millet. Based intercropping system. Supplied with varying levels of nitrogen and phosphorus. *J. Agron. Crop Sci.,* **186** : 73-144.

Babhulkar, R. M. Wandle, W. P., Badole and Balpande, S. S. 2000. Residual effect of long term application of FYM and fertilizer on soil properties (vertisols) and yield of soybean. *J. Indian Soc. Soil Sci.* **48** : 89-92.

Varalakshmi, L. R. Srinivasmurthy and Bhaskar, S. 2005. Effect of integrated used of organic manure and inorganic fertilizer on productivity of ground nut, finger millet cropping system. *J. Indian Soc. Soil Sci.* **53** : 315-18.

Arora, V. K. Gajri, P. R. and Prihar, S. S. 1991. Tillage effects on corn is a sandy soil in relation to water retentivity nutrient and water management and seasonal evaporativity. *Soil Tillage Res.,* **21** : 1-21.

Rao, S. M. S. 1981. Contribution of biofertilizer in supplementing nitrogen requirements. *Indian Farm,* **31** : 13-16.

Panse, V. G. and Sukhatme, P. V. 1989. *Statistical Methods for Agricultural Workers*. ICAR, New Delhi, pp. 175-165.

Jackson, M. L. 1967. *Soil Chemical Analysis*, Prentice Hall of India Pvt. Ltd., New Delhi.