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Influence of FYM and fertility levels on the productivity, economics and nutrient use efficiency of French bean (*Phaseolus vulgaris* L.) under high altitude of north-western Himalayas

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Abstract

French bean plants were treated with 50, 75, 100 and 125% of the recommended fertilizer dose (RDF) and two levels of farmyard manure (5 and 10 t/ha) in combination doses in a field experiment conducted in Kukumseri, Himachal Pradesh, India during the summer seasons of 2001 and 2002 to determine their effect on yield attributes, yield and nutrient use efficiency. Pods/plant, seeds/pod, seed and haulm yields, net return, B: C ratio and N, P and K uptake increased with the increasing fertilizer dose up to RDF. Nutrient efficiency ratio and physiological efficiency index for N, P and K decreased with the increasing fertility level. FYM at 10 t/ha resulted in significant increase in plant height, pods/plant, seeds/pod, seed and haulm yields and N, P and K uptake over 5t/ha.

Key words: French bean, fertilizers, FYM, nutrient efficiency ratio, physiological efficiency index.

Introduction

French bean (*Phaseolus vulgaris* L.) is one of the most important crops cultivated both for green pods and dry seeds. In the world, it is cultivated in 97 countries for green pods (as vegetable crop) and 119 countries as dry seed crop (FAO, 2004). This crop occupies considerable area in our country also. The area, production and productivity of green and dry bean in India are 150 and 9000 thousand hectares, 420 and 2900 thousand tonnes and 2.8 and 0.32 tonnes/ha, respectively. In Himachal Pradesh, French bean cultivation is mainly confined to mid and high hills and has turned to be one of the most important cash crops. Among the various components of production technology, fertilizers are the kingpin for improving French bean production. The continuous use of inorganic fertilizers has shown gradual decline in the fertilizers use efficiency especially under conditions where these are applied without organic sources of nutrients. Therefore, partial substitution of mineral nutrients using organic sources has been well envisaged (Chattapadhyay and Chatterjee, 2004; Jasrotia and Sharma, 1998; Singh and Verma, 2002). Organic sources of nutrients are among the most essential components in agricultural production not only for nutrients but for maintaining proper hydro-thermal regime and improving other physico-chemical and biological properties of the soil (Tisdale *et al.* 1995; Jasrotia and Sharma, 1998; Singh and Verma, 2002). FYM is a scarce resource in the dry temperate region, whereas, the farmers of Himachal Pradesh in general and dry temperate region in particular could hardly afford recommended application of nutrients, as is evident from the per hectare consumption of NPK (48.4 kg/ha, FAI, 2005). Therefore, the present investigation was undertaken to economize the dose of fertilizers along with locally available organic source mainly FYM.

Material and Methods

A field experiment was conducted during the summer seasons of 2001 and 2002 at Regional Research Station, Kukumseri (2872 m above msl) of Himachal Pradesh Krishi Vishvavidyalaya, Palampur. The soil of the experimental field was sandy loam in texture, rich in organic matter (2.5%) with pH 6.7. The soil had 373, 32.0 and 298 kg available N, P_2O_5, K_2O per ha, respectively. The crop was sown on May 29 and June 7 during 2001 and 2002, respectively. Four fertility (50, 75, 100 and 125% of the recommended) and two FYM levels (5 and 10 t/ha) constituting eight treatment combinations were evaluated in randomized block design with three replications. The recommended dose of fertilizers was 20 kg N, 60 kg P_2O_5 and 20 kg K_2O/ha. The crop was fertilized as per treatment through calcium ammonium nitrate, single super phosphate, and muriate of potash, respectively. The recommended package of practices was adopted to raise the crop. Yields were harvested

from the net plot. Estimations for nutrient contents were done following standard procedures. Nutrient efficiency ratio and physiological efficiency index were worked out as per the formulae given below,

$$\text{Nutrient efficiency ratio} = \frac{\text{Dry matter accumulation (kg/ha)}}{\text{Nutrient uptake (kg/ha)}}$$

$$\text{Physiological efficiency index} = \frac{\text{Seed yield (kg/ha)}}{\text{Nutrient uptake (kg/ha)}}$$

Results and Discussion

FYM

The data are summarized in Table 1 & 2. FYM at 10 t/ha resulted in significant increase in plant height, pods/plant and seeds/pod and thereby seed and haulm yields over its lower rate (5t/ha). Jasrotia and Sharma (1998) have also reported substantial increase in green pod yield of French bean using 20 t FYM/ha under mid hills conditions of Himachal Pradesh. However, in the present investigation increase in seed and haulm yields owing to 10 t FYM/ha was just 90 and 110 kg/ha over 5 t FYM/ha.

Table 1. Effect of FYM and fertility levels on growth, yield attributes and yield of French bean (Mean of two years)

Treatments	Plant Height (cm)	Pods/ plant	Seeds/ pod	Seed yield (kg/ha)	Straw yield (kg/ha)	Net return (Rs/ha)	B:C ratio
FYM (t/ha)							
5	46.7	13.03	4.48	2660	3090	92257	4.89
10	47.5	13.33	4.75	2750	3200	92766	4.23
LSD (P=0.05)	0.3	0.16	0.11	42	38	NS	0.09
Fertility levels							
50% RDF	45.8	12.58	4.30	2480	2890	83971	4.37
75% RDF	46.7	13.20	4.45	2700	3130	92634	4.64
100% RDF	47.6	13.95	4.95	2890	3320	99837	4.84
125% RDF	48.4	13.00	4.75	2760	3230	93604	4.39
LSD (P=0.05)	0.4	0.23	0.15	60	54	2475	0.12

RDF, recommended dose of fertilizers (20 kg N, 60 kg P_2O_5 and 20 kg K_2O/ha)

Table 2. Effect of FYM and fertility levels on growth, yield attributes and yield of French bean (Mean of two years)

Treatments	Nutrient uptake (kg/ha)			Nutrient efficiency ratio			Physiological efficiency index		
	N	P	K	N	P	K	N	P	K
FYM (t/ha)									
5	75.9	5.8	41.1	76.8	994.1	141.5	35.5	460.2	65.5
10	88.8	6.5	49.4	67.4	915.6	121.3	31.1	423.2	56.1
LSD (P=0.05)	3.1	0.2	2.1	1.4	34.7	5.9	1.3	16.5	2.7
Fertility levels									
50% RDF	67.5	5.2	38.0	80.4	1041.9	142.9	37.1	480.5	65.9
75% RDF	81.2	6.1	42.9	72.3	965.3	136.8	33.5	447.3	63.4
100% RDF	88.9	6.7	48.3	70.2	931.8	129.6	32.7	433.5	60.3
125% RDF	91.9	6.8	51.9	65.4	880.4	116.4	30.1	405.7	53.7
LSD (P=0.05)	4.3	0.3	3.0	1.9	49.0	8.3	1.9	23.3	3.9

The higher application price of FYM could not increase net return significantly over the later FYM level. The benefit: cost ratio owing to lower level of FYM was significantly higher over its higher level. N, P and K uptake following 10 t FYM/ha was significantly higher but nutrient efficiency ratio and physiological efficiency index of the absorbed nutrients were significantly lower than 5 t FYM/ha.

Fertility levels

Plant height increased with increasing dose of the fertilizers. However, pods/plant and seeds/pod and thereby seed and haulm yields increased with the increasing fertilizer dose only

up to RDF (recommended fertilizer dose). Singh and Verma (2002) have also obtained highest yield following RDF. Owing to higher seed and haulm yields, recommended fertilizer dose fetched highest net return (Rs 99837/ha) and B: C ratio (4.84). N and K uptake increased with the increasing fertilizer dose up to the highest level tried (125% recommended); whereas, P uptake increased upto RDF. Nutrient efficiency ratio and physiological efficiency index for N, P and K decreased with the increasing fertility dose which may be ascribed to law of diminishing returns (Tisdale *et al.* 2005). Similar results have also been reported by Parmar *et al.* (1999).

Seed yield was significantly and positively correlated with plant height (0.761, significant at 1% level of significance), pods/plant (0.846) and seeds/pod (0.821) showing high degree of association with the parameters studied.

The findings of the present investigation conclusively inferred that for making French bean cultivation a remunerative venture, crop should be fertilized with 100% recommended fertilizer dose (20 kg N and 60 kg P_2O_5/ha) along with 5 t FYM/ha.

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