EFFECT OF NITROGEN AND PHOSPHORUS ON THE GROWTH AND YIELD OF FRENCH BEAN

M A RAHMAN[1], A K M S HOQUE[2], M N RAHMAN[1], M B TALUKDAR[3] AND M S ISLAM[1]

[1]=Scientific Officer, Soil Science Division, , [2]= Senior Scientific Officer, Soil Science Division, [3]= Scientific Officer, Horticulture Research Centre, Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh.

Accepted for publication: 13 July 2007

ABSTRACT

Rahman, M.A., Hoque, A.K.M.S., Rahman, M.N., Talukdar, M.B. and Islam, M.S. 2007. *Effect of Nitrogen and Phosphorus on the Growth and Yield of French Bean.* **J .Soil .Nature .1(2): 30-34**

A field experiment on French bean was conducted in Old Brahmaputra Floodplain Soil of Jamalpur and Grey Terrace Soil of Joydebpur during 2005-2006 to find out the optimum rates of N and P for yield maximization of French bean. Four levels of nitrogen (0, 100, 150 and 200 kg ha^{-1}) and 3 levels of phosphorus (0, 40 and 60 kg ha^{-1}) were used in the experiment. Potassium (K) 80 kg, 10 kg sulphur (S) and 5 t cowdung ha^{-1} were applied as a blanket dose. The experiment was laid out in a randomized complete block design with 12 treatments replicated 4 times. Nitrogen and phosphorus alone significantly influenced the pod yield of French bean. Among the N levels, the highest pod yield (13.33 t ha^{-1} at Jamalpur & 14.68 t ha^{-1} at Joydebpur) were obtained with 150 kg N ha^{-1}. Among the P levels, the highest pod yield (12.35 t ha^{-1} at Jamalpur & 13.69 t ha^{-1} at Joydebpur) were obtained with 60 kg P ha^{-1}. Interaction effect was not significant. However, highest pod yield (13.60 t ha^{-1} at Jamalpur & 15.05 t ha^{-1} at Joydebpur) was obtained from 150 kg N plus 60 kg P ha^{-1}. Economic analysis showed that 150 kg N plus 40 kg P ha^{-1} gave the highest gross margin of Tk. 1,66,684/ha.

Key words: Nitrogen, Phosphorus, Yield, French bean

INTRODUCTION

The French bean (*Phaseolus vulgaris* L.) belongs to the family Leguminoceae is reported to be a native of central and South America (Swaider *et al*, 1992). This crop is widely cultivated in the temperate and subtropical regions and also in many parts of the tropics (Purseglove, 1987). In Bangladesh, generally country bean, yard long bean and garden pea are widely cultivated. French bean is an export oriented vegetable rich in protein, calcium, iron and vitamins. It is used as vegetables when pods are immature and tender. French bean (*Phaseolus vulgaris*) is an important under utilized vegetable in Bangladesh (Rahman *et al*., 2002). French bean can easily be grown in the field as well as in the homestead garden if the soil is managed properly. Srinivas and Nailk (1988) observed that the pod yield of French bean increased with increasing rate of N application and they obtained 13.2 t ha^{-1} pod by using 160 kg N ha^{-1}. Guu *et al*. (1995) recorded 17.2 t ha^{-1} pod yield with fertilizer and manure application. As a legume roots of French bean root system has nodules with nitrogen fixing bacteria. It can also be used in the crop rotation system in the field. Soil nutrient content and nutrient management is a key factor for crop production. Phosphorus is a major essential plant nutrient. Parodi *et al*, (1977) observed that 50 kg P ha^{-1} was the maximum requirement for French bean. Eira *et al*, (1974) found in an experiment that the economic rate of P application for French bean was 55 kg ha^{-1}.Research on fertilizer management for French bean in Bangladesh is in preliminary stage. The present research work was, therefore, undertaken to find out the response of French bean to nitrogen and phosphorus.

MATERIALS AND METHODS

The experiment was conducted at BARI Regional Station, Jamalpur and BARI central farm, Joydebpur during 2005-2006 to find out the requirement of nitrogen and phosphorus for French bean. Before starting the experiment, soil samples was collected from the field and analyzed in the laboratory following standard methods. The fertility status of the initial soil has been presented in Table 1.

Table 1. Nutrient status of experimental soil prior to fertilization

Location	pH	OM (%)	Ca	Mg	K	Total N	P	S	B	Cu	Fe	Mn	Zn
			meq/100g			%	µg/g						
Jamalpur	5.8	0.95	4.2	1.7	0.13	0.05	14	12	0.24	5	120	11	1.3
Joydebpur	6.4	1.60	6.4	2.9	0.18	0.07	13	16	0.30	4	161	51	2.0
Critical level	-	-	2.0	0.8	0.20	-	14	14	0.20	1	10	5	2.0

Organic matter content of the soil was poor. The soil was acidic in nature. Phosphorus, potassium, sulphur, boron and zinc status of the soil were found to be either at par or below the critical level. Based on soil test values the different treatment combinations were formulated as follows**:**

Treatment combination

T_1 =	N_0P_0 kg ha^{-1}	T_7 =	$N_{150}P_{40}$ kg ha^{-1}
T_2 =	$N_{100}P_0$ kg ha^{-1}	T_8 =	$N_{200}P_{40}$ kg ha^{-1}
T_3 =	$N_{150}P_0$ kg ha^{-1}	T_9 =	N_0P_{60} kg ha^{-1}
T_4 =	$N_{200}P_0$ kg ha^{-1}	T_{10} =	$N_{100}P_{60}$ kg ha^{-1}
T_5 =	N_0P_{40} kg ha^{-1}	T_{11} =	$N_{150}P_{60}$ kg ha^{-1}
T_6 =	$N_{100}P_{40}$ kg ha^{-1}	T_{12} =	$N_{200}P_{60}$ kg ha^{-1}

There are twelve treatment combinations comprising 4 levels of N (0, 100, 150 and 200 kg ha^{-1}) and 3 levels of P (0, 40 and 60 kg ha^{-1}). The treatments were arranged in factorial RCB design with 4 replications. A blanket dose of 80 kg K, 10 kg S and 5t cowdung ha^{-1} was applied in the experiment. The sources of N, P, K and S were urea, TSP, MP and gypsum, respectively. The unit plot size was 3.0m x 2.4m. The whole amount of P, K, S, cowdung and ½ of N were applied at final land preparation and the remaining ½ of N was top dressed 25 days after sowing. The tested variety was BARI French bean-1. The seeds of French bean were sown on late November in both the years at both locations with a spacing of 25cm x 15cm. Intercultural operations like weeding, irrigation and pest control measures were done as and when required. Data on yield components were collected. The green pods were harvested 4 times in February at both locations. The collected data were analyzed statistically by Computer following IRRISTAT package.

RESULTS AND DISCUSSION

Effect of nitrogen

French bean responded significantly to different levels of nitrogen (Table 2). Yield and yield components of French bean increases with the increase of nitrogen upto 150 kg N ha^{-1} and decrease thereafter. The highest number of pods/plant (25.90 at Jamalpur & 27.90 at Joydebpur), pod length (14.68 cm at Jamalpur & 14.98 cm at Joydebpur) and pod circumference (1.15 cm at Jamalpur & 1.17 cm at Joydebpur) were recorded in the treatment that received 150 kg N ha^{-1}. Plant height was found highest (39.68 cm at Jamalpur & 40.26 cm at Joydebpur) in the same treatment. The highest significant pod yield (13.33 t ha^{-1} at Jamalpur & 14.68 t ha^{-1} at Joydebpur) was obtained with 150 kg N ha^{-1} which was statically similar with N @ 200 kg/ha treated yield (12.99 t ha^{-1} at Jamalpur & 14.55 t ha^{-1} at Joydebpur). The lowest pod yield (7.03 t ha^{-1} at Jamalpur & 8.46 t ha^{-1} at Joydebpur) was obtained from N-control treatment. Higher pod circumference and length, and pods/plant might have contributed to the higher yield of French bean. The result is in agreement with that of Hoque *et al.* (2002) and R V Singh (2000). Pod yield increased significantly with each successive increment in N up to 120 kg/ha were reported by Baboo *et al*. (1998)

Table 2. Effects of different levels of nitrogen on the growth and yield of French bean during 2005-06

Treat-ment	Plant height (cm)		Pod length (cm)		Pod circumference (cm)		Pods/plant (no.)		Pod yield (t/ha)	
	Jamalpur	Joydebpur	Jamalpur	Joydebpur	Jamalpur	Joydebpur	Jamalpur	Joydebpur	Jamalpur	Joydebpur
N_0	34.19b	35.00b	12.87ab	13.10b	1.08	1.13	18.47c	19.53d	7.03c	8.46c
N_{100}	35.56b	35.98b	13.78a	13.95b	1.10	1.17	21.73b	21.70c	12.01b	13.00b
N_{150}	39.68a	40.26a	14.68a	14.98a	1.15	1.17	25.90a	27.90a	13.33a	14.68a
N_{200}	39.45a	39.61a	14.43a	14.72a	1.12	1.17	25.20a	25.00b	12.99ab	14.55a
CV %	8.1	8.0	8.7	8.5	7.6	7.5	9.8	9.6	10.4	9.3

Effect of Phosphorus

Different levels of phosphorus significantly influenced the yield and yield components of French bean (Table 3). The highest number of pods/plant (24.18 at Jamalpur & 24.83 at Joydebpur), pod length (14.29 cm at Jamalpur & 14.62 cm at Joydebpur) and pod circumference (1.12 cm at Jamalpur & 1.17 cm at Joydebpur) were recorded in the treatment that received 60 kg P ha^{-1}. Plant height was found highest (38.17 cm at Jamalpur & 38.69 cm at Joydebpur) in the same treatment. The highest significant pod yield (12.35 t ha^{-1} at Jamalpur & 13.69 t ha^{-1} at Joydebpur) was obtained with 60 kg P ha^{-1} which was followed by P @ 40 kg/ha treated yield (11.54 t ha^{-1} at Jamalpur & 12.80 t ha^{-1} at Joydebpur). The lowest pod yield (10.12 t ha^{-1} at Jamalpur & 11.53 t ha^{-1} at Joydebpur) was obtained from P-control treatment. It is revealed that pod yield increased with increasing rate of

phosphorus. French bean responds to the application of phosphorus more than to other nutrient (Hagg *et al*., 1967) and production increases proportionately with the increase in the level of phosphorus fertilizer (Miranda and Lobato, 1978). Increasing level of Phosphorus increase the pod yield of French bean was reported by Roy and Parthasarathy (1999). French been develop poorly when grown in P-deficient soil and its low level leads to low bean productivity (Kanwar, 1982).

Table 3. Effects of different levels of phosphorus on the growth and yield of French bean during 2005-06

Treat-ment	Plant height (cm)		Pod length (cm)		Pod circumference (cm)		Pods/plant (no.)		Pod yield (t/ha)	
	Jamalpur	Joydebpur	Jamalpur	Joydebpur	Jamalpur	Joydebpur	Jamalpur	Joydebpur	Jamalpur	Joydebpur
P_0	36.24	36.84	13.48c	13.71c	1.11	1.14	21.78c	22.15c	10.12c	11.53c
P_{40}	37.25	37.60	14.05b	14.25b	1.12	1.17	22.53b	23.63b	11.54b	12.80b
P_{60}	38.17	38.69	14.29a	14.62a	1.12	1.17	24.18a	24.83a	12.35a	13.69a
CV%	8.1	8.0	8.7	8.5	7.6	7.5	9.8	9.6	10.4	9.3

Interaction effect

The interaction effect of N and P on pod yield and yield components of French bean was found insignificant (Table 4). However, highest pod yield (13.60 t ha^{-1} at Jamalpur & 15.05 t ha^{-1} at Joydebpur) was obtained from $N_{150}P_{60}$ treatment. The lowest pod yield (5.92 t ha^{-1} at Jamalpur & 6.92 t ha^{-1} at Joydebpur) was obtained from N_0P_0 treatment. Similar findings were also reported by Baboo *et al*. (1998) and R V Singh (2000).

Table 4. Effects of nitrogen and phosphorus on growth and yield of French bean during 2005-06

Treatment	Plant height (cm)		Pod length (cm)		Pod breadth (cm)		Pods/plant (no.)		Pod yield (t/ha)	
	Jamalpur	Joydebpur	Jamalpur	Joydebpur	Jamalpur	Joydebpur	Jamalpur	Joydebpur	Jamalpur	Joydebpur
$T_1= N_0P_0$	33.56	34.87	11.65	11.90	1.07	1.10	17.20	18.90	5.92	6.92
$T_2= N_{100}P_0$	33.93	34.21	13.61	13.72	1.10	1.14	20.30	20.40	9.86	11.24
$T_3= N_{150}P_0$	38.92	39.35	14.56	14.86	1.16	1.17	25.00	26.10	12.78	14.05
$T_4= N_{200}P_0$	38.55	38.95	14.10	14.35	1.11	1.16	24.60	23.20	11.93	13.90
$T_5= N_0P_{40}$	34.11	34.89	13.46	13.67	1.08	1.13	18.80	19.80	6.29	8.36
$T_6= N_{100}P_{40}$	36.11	36.32	13.73	14.00	1.10	1.16	22.40	22.20	12.79	13.11
$T_7= N_{150}P_{40}$	39.22	39.76	14.61	14.61	1.18	1.20	24.80	28.10	13.60	14.94
$T_8= N_{200}P_{40}$	39.56	39.44	14.41	14.70	1.12	1.18	24.10	24.40	13.49	14.78
$T_9= N_0P_{60}$	34.89	35.23	13.49	13.74	1.08	1.15	19.40	19.90	8.88	10.09
$T_{10}=N_{100}P_{60}$	36.66	37.40	14.00	14.14	1.11	1.20	22.50	22.50	13.37	14.64
$T_{11}=N_{150}P_{60}$	40.89	41.68	14.86	15.47	1.12	1.15	27.90	29.50	13.60	15.05
$T_{12}=N_{200}P_{60}$	40.22	40.45	14.79	15.12	1.12	1.18	26.90	27.40	13.54	14.98
CV(%)	8.1	8.0	8.7	8.5	7.6	7.5	9.8	9.6	10.4	9.3

Economic analysis

In order to identify a suitable treatment combination, economic evaluation of different treatment combination was done through partial budgeting.

Table 5. Partial budget analysis for different nitrogen and phosphorus response data of French bean (average of 2 locations)

Treatment	Nitrogen cost (Tk./ha)	Phosphorus cost (Tk./ha)	Total variable cost (Tk./ha)	Mean pod yield (Ton/ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)
$T_1 = N_0P_0$	0	0	0	6.42	77,040	77,040
$T_2 = N_{100}P_0$	1,304	0	1,304	10.55	1,26,600	1,25,296
$T_3 = N_{150}P_0$	1,956	0	1,956	13.42	1,61,040	1,59,084
$T_4 = N_{200}P_0$	2,608	0	2,608	12.92	1,55,040	1,52,432
$T_5 = N_0P_{40}$	0	2,600	2,600	7.33	87,960	85,360
$T_6 = N_{100}P_{40}$	1,304	2,600	3,904	12.95	1,55,400	1,51,496
$T_7 = N_{150}P_{40}$	1,956	2,600	4,556	14.27	1,71,240	1,66,684
$T_8 = N_{200}P_{40}$	2,608	2,600	5,208	14.14	1,69,680	1,64,472
$T_9 = N_0P_{60}$	0	3,900	3,900	9.45	1,13,400	1,09,500
$T_{10} = N_{100}P_{60}$	1,304	3,900	5,204	14.01	1,68,120	1,62,916
$T_{11} = N_{150}P_{60}$	1,956	3,900	5,856	14.35	1,72,200	1,66,344
$T_{12} = N_{200}P_{60}$	2,608	3,900	6,508	14.26	1,71,120	1,64,612

Price : 1 kg N = Tk. 6; 1 kg P = Tk. 65; 1 kg French bean = Tk. 12

Economic analysis presented in Table 5 revealed that highest gross margin of Tk. 1,66,684/ha was obtained from the treatment T_7 ($N_{150}P_{40}$ kg/ha) with a variable cost Tk. 4,556/ha. Lowest gross margin of Tk. 77,040/ha was obtained from control (N_0P_0) treatment. Thirumalai and Khalak (1993) also reported increasing gross margin with rising N and P. The rate of net returns however decreased beyond 150 kg N/ha.

From the above discussion, it may be concluded that 150 kg nitrogen, 40 kg phosphorus along with a blanket dose of 80 kg potassium, 10 kg sulphur and 5 t cowdung ha^{-1} are found economic for optimum yield of French bean in Old Brahmaputra Floodplain Soil of Jamalpur and Grey Terrace Soil of Joydebpur.

References

Baboo R, Rana N S and Pantola P. 1998. Response of French bean to nitrogen and phosphorus. *Ann. Agric. Res.* 19 (1) : 81-82.

Eira, P.A.Da; G.G. Pessanha; D.P.P.De S. Britto and A.R. Carbajal. 1974. Pesquisa gropecuasia Brasileira, 9: 121-124. (Cited from Vegetable Crops. eds. Bose, T.K.; M.G. Som and J. Kabir. 1993. Nays Prokash, 206 Bidhan Sarani, Cacutta 700006, India).

Guu J W, Yang T C and Fong T Y. 1995. Effects of organic manure on the growth and yield of common bean at fall season bulletin of Taichung. District Agricultural Improvement Station. 49: 41-48 (Cited from Horticultural Abstracts, CBA.1997. 67:4).

Hagg H P, Malavolta E, Garganitini H and Blanco H G. 1967. Absorcao de nutrientes pela culture do fei joeiro. *Bragnita*. 26 : 381-391.

Hoque A K M S, Shahiduzzaman M and Farid A T M. 2002. Integrated nutrient management for French bean amaranth cropping pattern in homestead. Research Report 2001-2002, Soil Sci. Div. BARI, Joydebpur, Gazipur.

Kanwar J S. 1982. Phosphorus management of Indian soils: Problems and prospects. *Fertilizer News*. 27(2):43-45.

Miranda L N de and Lobato E. 1978. Tolerancia de versiedade de foigaoe de trigo ao aluminio e a baixa disponibilidade de fosforo no solo. *Rev. Bras. Cience Solo*. 2: 44-50.

Parodi, A.E.; A.J.D. Opazo and C.H. J. Mosjidis. 1977. Agriculture Tecnica, 37: 12-18. (Cited from Vegetable Crops. eds. Bose, T.K.; M.G. Som and J. Kabir. 1993. Nays Prokash, 206 Bidhan Sarani, Cacutta 700006, India).

Purseglove, J.W. 1987. Tropical crops. Dicotyledons. Longman, New York. pp. 132-136.

Rahman M O, Rabbani M G, Nasiruddin K M, Yesmin R and Rahman M M. 2002. Effect of different levels of nitrogen and plant spacing on the growth and yield of French bean. *Progress. Agric*. 13 (1 & 2) : 35-37.

Roy N R and Parthosarathy V A. 1999. Note on phosphorus requirement of French bean varieties planted at different dates. *Indian J. Hort*. 56 (4) : 317-320.

Singh R V. 2000. Response of french bean to plant spacing, and nitrogen & phosphorus fertilization. *Indian J. Hort*. 57 (4): 338-341.

Srinivas K and Naik L B. 1988. Response of vegetable French bean (*Phaseolus vulgaris*) to nitrogen and phosphorus fertilization. *Indian J. Agril. Sci.* 58 (9) : 707-708.

Swaider, J.M., G.W. Ware and J.P. Mc Collum. 1992. Producing vegetable crops. 4th ed. Interstate Publishers. Inc. Danville, Illinoois, USA. pp. 233-249.

Thirumalai M and Khalak A. 1993. Fertilizer application economics in French bean. *Cur. Res., Univ. Agric. Sci. (Bangalore)*. 22 : 67-69.