

RESPONSE OF FRENCH BEAN (*Phaseolus vulgaris* L.) TO DIFFERENT LEVELS OF NITROGEN AND PHOSPHORUS UNDER MIDDLE GUJARAT CONDITIONS

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ABSTRACT

A field experiment was conducted at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) to study the response of french bean (*Phaseolus vulgaris* L.) to different levels of nitrogen and phosphorus under middle Gujarat conditions during rabi 2010-11. Twelve treatment combinations comprised of three levels of nitrogen viz., N_1 (60 kg N/ha), N_2 (90 kg N/ha) and N_3 (120 kg N/ha), and four levels of phosphorus viz., P_1 (0 kg P_2O_5 /ha), P_2 (30 kg P_2O_5 /ha), P_3 (60 kg P_2O_5 /ha) and P_4 (90 kg P_2O_5 /ha) were tested in randomized block design (Factorial) with four replications using French bean variety cv. Guj. Rajma-1. Results revealed that nitrogen level N_3 (120 kg N/ha) recorded significantly higher plant height at 60 DAS and at harvest, which was at par with Nitrogen level N_2 (90 kg N/ha). Significantly the highest number of branches per plant, length of pod, numbers of pods per plant and seeds per pod as well as seed and haulm yield and harvest index recorded at harvest were observed at nitrogen level N_3 (120 kg N/ha). Number of branches per plant and yield attributes viz., length of pod, number of pods per plant, seeds per pod seed and haulm yield of french bean tended to increase with increasing levels of phosphorus and application of phosphorus @ 90 kg P_2O_5 /ha, being at par with 60 kg P_2O_5 /ha and 30 kg P_2O_5 /ha recorded significantly higher values for these attributes as compared to no application of phosphorus. Highest net return and BCR were obtained with 90 kg N/ha and 90 kg P_2O_5 /ha.

KEY WORDS: French bean, levels of nitrogen, Levels of phosphorus

INTRODUCTION

Among the pulses, french bean (*Phaseolus vulgaris* L.) is one of the high potential pulse crops with a yielding potential of 18 to 20 q/ha (Anonymous, 2012). French bean is one of the precious and highly relished pulse crops of North India. However, it is an unconventional *rabi* season pulse crop in Gujarat. Its cultivation confined to sandy and sandy loam soils of north Gujarat, which comprises of Sabarkantha, Banaskantha and Mehsana districts. Though it is a new introduced crop in middle Gujarat, it has

good yield potentiality. However, due to lack of suitable agro techniques, its yield performance is poor. Among the different production factors, nitrogen and phosphorous management are of immense importance.

Being a shy nodulating crop french bean responds sharply to high doses of nitrogen (Ali and Kushwaha, 1987) due to the lack of buildup of naturally efficient *Rhizobium* strains (Jaiswal et al., 1997) which might be the result of absence of NOD gene regulator even with native *Rhizobia* and commercially produced cultures (Kushwaha,

1994). Hence, the nitrogen requirement of french bean is different from other pulse crops and application of nitrogen through fertilizers is imperative for exploiting its yield potential.

As nodulation is poor in french bean, it requires more nitrogen and phosphorus for root development, nodulation and better plant growth and hence, responds even to application of phosphorus (Ssali and Keya, 1986). The information pertaining to its nitrogen and phosphorus requirements to exploit its fullest yield potential is not available for middle Gujarat; therefore, the experiment was conducted.

MATERIALS AND METHODS

A field experiment was conducted at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) to study the response of french bean (*Phaseolus vulgaris* L.) to different levels of nitrogen and phosphorus under middle Gujarat conditions during *rabi* 2010-11 on loamy sand soil, low in organic carbon (0.23%) and available nitrogen (242.32 kg/ha), medium in available phosphorus (34.20 kg/ha) and high in available potassium (385.86 kg/ha) having 7.5 pH. Twelve treatment combinations comprised of three levels of nitrogen viz., N₁ (60 kg N/ha), N₂ (90 kg N/ha) and N₃ (120 kg N/ha), and four levels of phosphorus viz., P₁ (0 kg P₂O₅ /ha), P₂ (30 kg P₂O₅ /ha), P₃ (60 kg P₂O₅ /ha) and P₄ (90 kg P₂O₅ /ha) were tested in randomized block design (Factorial) with four replications using french bean variety cv. Guj. Rajma-1.

RESULTS AND DISCUSSION

Effect of nitrogen levels

Growth parameters

Results (Table 1) revealed that periodical plant height of french bean recorded at 60 DAS and at harvest was significantly influenced due to nitrogen levels. Nitrogen applied @ 120 kg N/ha (N₃), being at par with preceding lower level of N₂ (90 kg N/ha) recorded significantly higher plant height at 60 DAS (53.97 cm) and at harvest (59.09 cm). An increase in plant height at 30 DAS, 60 DAS and at harvest noted under nitrogen level N₃

(120 kg/ha) was to the extent of 6.45, 9.45 and 8.86 per cent, respectively over nitrogen level N₁ (60 kg/ha). Significantly the highest number of branches per plant (6.31) was also recorded with 120 kg N/ha (N₃).

Application of N increases size of cells, meristemic activities and formation and function of protoplasm, which consequently increases crop growth. Being an essential constituent of diverse type of metabolically active compounds, like amino acids, protein, nucleic acid, purine and pyrimidine nucleotide and alkaloids, nitrogen plays an important role in plant metabolism. This could be attributed to the fact that basal application of N supported vegetative growth while split application balanced the vegetative growth (Kushwaha, 1994). These results are in confirmation with that of Dhanjal *et al.* (2001).

Yield attributes and yield

The yield attributes viz., length of pod, number of pods per plant and seeds per pod were significantly improved by nitrogen levels. Application of Nitrogen at 120 kg N/ha recorded significantly the highest length of pod (13.81 cm), number of pods per plant (13.93 cm) and seeds per pod (5.22 cm). While different nitrogen levels did not show any significant influence on the test weight (100 seeds weight) of french bean (Table 1).

Results shown in Table 2 revealed that seed and haulm yield were significantly affected due to different levels of nitrogen. Nitrogen level N₃ (120 kg N/ha) produced significantly the highest seed yield (1990 kg/ha). The increase in seed yield in nitrogen level N₃ (120 kg/ha) was to the tune of 11.67 and 23.14 per cent over nitrogen levels N₁ (60 kg/ha) and N₂ (90 kg/ha), respectively. Significantly higher haulm yield (2235 kg N/ha) was recorded with N₃ (120 kg N/ha), which was 4.39 and 9.88 per cent higher over N₂ and N₁, respectively. However, it remained at par with nitrogen level N₂ (90 kg N/ha). The increased crop growth might be ensued to yield components and finally the seed yield. Moreover, the split application of nitrogen, if

applied at right stage might improve the nitrogen use efficiency besides increased grain yield. The results are in close agreement with those reported by Reddy *et al.* (2010) and Shubhashree *et al.* (2011).

Similar trend was also found for harvest index of french bean (Table 2). Significantly higher harvest index (46.97 %) was recorded with nitrogen level N₃ (120 kg N/ha) which remained at par with nitrogen level N₂ (90 kg N/ha).

Effect of phosphorus levels

Growth parameters

Growth parameters given in Table 1 indicated that periodical plant height of french bean recorded at 30 DAS, 60 DAS and at harvest was found non-significant with different levels of phosphorus. Application of 90 kg P₂O₅ /ha recorded significantly higher number of branches per plant (6.24), which was at par with application of 60 kg P₂O₅ /ha (5.56).

Yield attributes and yield

Significantly higher pod length (13.17 cm) was observed with 90 kg P₂O₅ /ha, which was at par with 60 kg P₂O₅ /ha (12.58 cm). Similar result was also found in case of numbers of pods per plant and seeds per pod, wherein higher phosphorus level i.e. 90 kg P₂O₅ /ha being at par with 60 kg P₂O₅ /ha and 30 kg P₂O₅ /ha recorded significantly higher number of pods per plant (13.70) and number of seeds per pod (5.14) over no phosphorus application (0 kg P₂O₅ /ha). Different phosphorus levels were failed to show their significant influence on the test weight (100 seeds weight) of french bean (Table 1).

Levels of phosphorus had significant impact on seed yield of french bean. Significantly higher seed yield (1911 kg/ha) was obtained with phosphorus application of 90 kg/ha, however, it was at par with 60 kg P₂O₅ /ha and 30 kg P₂O₅ /ha, which was higher to the tune of 2.08, 6.81 and 18.62 per cent over phosphorus levels P₃ (60 kg P₂O₅ /ha), P₂ (30 kg P₂O₅ /ha) and P₁ (0 kg P₂O₅ /ha), respectively. Similar trend was found for haulm yield of french bean and higher phosphorus level i.e. 90 kg P₂O₅ /ha, being at par with 60 kg

P₂O₅ /ha and 30 kg P₂O₅ /ha produced significantly higher haulm yield (2218 kg/ha) over no application of phosphorus (P₁). Application of phosphorus had no remarkable impact on harvest index (Table 2). This is might be due to phosphorus is known to play beneficial role in legume growth by promoting extensive root development and nodulation and thereby ensuring proper growth and yield (Joseph *et al.*, 1995). Phosphorus increases metabolic activity of plant and enhances root system which enables plants to extract more water and nutrients from soil depth, resulting in better development which might have increase the values of growth and yield attributes viz., branches per plant, pod length, pods per plant and seeds per pod. These are the important growth and yield parameters, which collectively had synergistic influence on seed yield. Shivkumar *et al.* (2004) also confirmed the results.

Interaction effect

Interaction effect between levels of nitrogen and phosphorus was found non-significant for all the parameters.

Economics

Economics pertaining to effect of different levels of nitrogen and phosphorus on french bean (Table 3) indicated that nitrogen applied @ 120 kg/ha⁻¹ fetched the highest gross and net realization (Rs. 80717 and Rs. 57088 per ha, respectively) with maximum BCR value of 3.41 followed by application of 60 kg N/ha, which realized the net income of Rs. 49118 per ha with the BCR value of 2.11.

Application of 90 kg P₂O₅ /ha recorded maximum gross and net realization (Rs. 77549 and Rs. 51347 per ha, respectively) with BCR 2.95 closely followed by 60 and 30 kg P₂O₅ /ha, which realized the net realization of Rs. 51167 per ha and Rs. 49209 per ha and BCR of 3.06 and 3.10, respectively. As far as economics is concerned, 120 kg N/ha was found beneficial along with either 90 or 30 kg P₂O₅ /ha.

CONCLUSION

In light of the results obtained from this investigation, it can be concluded that for securing

maximum seed yield and for getting higher net monetary realization, french bean var. Guj. Rajma 1 should be fertilized with 120 kg N and 30 kg P₂O₅ /ha.

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Table 1: Effect of different levels of nitrogen and phosphorus on growth and yield attributes of french bean

Treatment	Plant Height (cm)			Number of Branches per Plant	Pod Length (cm)	Number of Pods per Plant	Numbers of Seeds per Pod	100 Seed Weight (g)
	30 DAS	60 DAS	At Harvest					
Nitrogen Levels (N)								
N ₁ = 60 kg/ha	30.06	49.31	54.28	4.89	9.69	12.08	4.41	38.38
N ₂ = 90 kg/ha	31.06	51.03	56.41	5.19	11.38	13.03	4.65	40.25
N ₃ = 120 kg/ha	32.00	53.97	59.09	6.31	13.81	13.93	5.22	41.50
S. Em.±	0.56	1.14	1.11	0.21	0.44	0.28	0.16	0.99
C.D. (P = 0.05)	NS	3.30	3.19	0.62	1.28	0.83	0.46	NS
Phosphorus Levels (P ₂ O ₅)								
P ₁ = 0 kg/ha	29.92	48.92	53.92	4.77	9.83	12.17	4.34	39.17
P ₂ = 30 kg/ha	30.33	50.79	55.79	5.27	10.92	12.90	4.74	40.00
P ₃ = 60 kg/ha	31.67	52.04	58.00	5.56	12.58	13.27	4.82	41.67
P ₄ = 90 kg/ha	32.25	54.00	58.67	6.24	13.17	13.70	5.14	39.33
S. Em.±	0.65	1.32	1.28	0.25	0.51	0.33	0.18	1.14
C.D. (P = 0.05)	NS	NS	NS	0.72	1.48	0.96	0.54	NS
N × P Interaction								
S. Em.±	1.13	2.29	2.22	0.43	0.89	0.57	0.32	1.98
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS
C.V %	7.31	8.93	7.84	15.90	15.38	8.90	13.67	9.90

Table 2: Effect of different levels of nitrogen and phosphorus on seed and haulm yield as well as on harvest index of french bean

Treatment	Yield (kg/ha)		Harvest Index (%)
	Seed	Haulm	
Nitrogen Levels (N)			
N ₁ = 60 kg/ha	1616	2034	44.10
N ₂ = 90 kg/ha	1782	2141	45.41
N ₃ = 120 kg/ha	1990	2235	46.97
S. Em.±	59.22	53.30	13.73
C.D. (P = 0.05)	170.41	153.37	1.92
Phosphorus Levels (P ₂ O ₅)			
P ₁ = 0 kg/ha	1611	1965	44.79
P ₂ = 30 kg/ha	1789	2153	45.29
P ₃ = 60 kg/ha	1872	2211	45.80
P ₄ = 90 kg/ha	1911	2218	46.09
S. Em.±	68.39	61.55	0.77
C.D. (P = 0.05)	197	177	NS
N × P Interaction			
S. Em.±	118.45	106.61	1.33
C.D. (P = 0.05)	NS	NS	NS
C.V %	13.19	9.98	5.86

Table 3: Effect of different levels of nitrogen and phosphorus on economics of french bean

Treatment	Yields (kg/ha)		Total Cost of Cultivation per Ha	Gross Realization per Ha	Net Realization Per Ha	BCR
	Grain	Haulm				
Nitrogen Levels (N)						
N ₁ = 60 kg/ha	1616	2034	22836	65657	42821	2.87
N ₂ = 90 kg/ha	1782	2141	23232	72350	49118	3.11
N ₃ = 120 kg/ha	1990	2235	23629	80717	57088	3.41
Phosphorus Levels (P ₂ O ₅)						
P ₁ = 0 kg/ha	1611	1965	21923	65422	43499	2.98
P ₂ = 30 kg/ha	1789	2153	23427	72636	49209	3.10
P ₃ = 60 kg/ha	1872	2211	24818	75985	51167	3.06
P ₄ = 90 kg/ha	1911	2218	26202	77549	51347	2.95

Selling price: Seed: 40.00 Rs. per kg. Haulm: 0.50 Rs. per kg

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