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RESEARCH ARTICLE

INFLUENCE OF NITROGEN AND PHOSPHORUS LEVEL FOR THE PERFORMANCE OF FRENCH BEAN (*PHASEOLUS VULGARIS* L.)

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ABSTRACT

The field experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from November 2017 to February 2018 in order to assess the effect of nitrogen and phosphorus levels and their interaction on the performance of French bean. The experiment consisted of four levels of nitrogen viz. 80, 100, 120, 140 kg nitrogen ha^{-1} and four levels of phosphorus viz. 15, 20, 25 and 35 kg phosphorus ha^{-1}. The experiment was laid out in Randomized Complete Block Design with three replications. In case of nitrogen the highest plant height, branches plant^{-1}, chlorophyll content, dry matter, number of effective pods plant^{-1}, length of pod, 1000-grain weight, grain yield, stover yield, biological yield and harvest index were observed in 120 kg nitrogen ha^{-1}. Considering yield attributes against phosphorus treatment the highest plant height, branches plant^{-1}, chlorophyll content, dry matter, length of pod, 1000-seeds weight, grain yield, stover yield, biological yield and harvest index were observed in 25 kg phosphorus ha^{-1}. In case of interaction effect the highest plant height, branch plant^{-1}, chlorophyll content, dry matter, number of effective pods, length of pod, 1000-grain weight, grain yield, stover yield, biological yield and harvest index were observed in 120 kg nitrogen ha^{-1} and 25 kg phosphorus ha^{-1}. The results obtained in experiment indicate that there is a scope to increase the yield of French bean by applying proper dose of nitrogen and phosphorus fertilizer.

KEYWORDS

Nitrogen, Phosphorus, Yield, French bean.

1. INTRODUCTION

French bean (*Phaseolus vulgaris*) is one of the world's most important food legume for direct human consumption. It is originated in the Central and South America and belongs to the family Leguminosae (Swiader et al., 1992). It is also known as bush bean, kidney bean, snap bean, pinto bean, green bean, raj bean, common bean, basic bean, harcot bean, navy bean, pole bean, wax bean, string bean and bonchi (Duke, 1983; Salunkhe et al., 1987; Tindall, 1988). In our country it is known as "Farashi Sheem" (Rashid, 1993). In Bangladesh, beans are mainly used as green vegetables and also as pulse. It is valued for its protein (23%) rich seeds. Seeds are also rich in calcium, phosphorus and iron. The fresh pods are used as vegetable. As a nutritious vegetable, it contains calcium (50 mg), phosphorus (28 mg), iron (1.7 mg), carotene (132 mg), thiamine (0.08 mg), riboflavin (0.06 mg) and vitamin C (24.0 mg) in each 100 g of edible pods (Chadha, 2001). It is cultivated in many parts of the tropics, sub tropics and throughout the temperate regions (Purseglove, 1987). But it is more suitable as a winter (rabi) crop in the north eastern plains of India as well as Bangladesh (AICPIP, 1987). In Western World (USA, Western Europe), both the fresh pod and processed pod consumption is quite substantial. The countries producing substantial dry beans are Brazil, Mexico, Argentina, Chile, Central America and Latin America.

India is the largest producer of French bean in the world followed by Brazil, Myanmar, China, United States of America and Mexico. With an area of 15.42 million-hectares India produces 6390.00 thousand MT of French bean with an average productivity of 0.83 MT per hectare (FAO, 2018). In Bangladesh, French bean occupied 85423 hectares land with producing 75611 MT (FAO, 2018). It is not new crop in our country and is cultivated in Sylhet, Cox's Bazar, Chittagong Hill Tracts and some other parts of the country in a rather limited scale. A group researcher regarded French bean (*Phaseolus vulgaris*) as an important under-utilized vegetable in Bangladesh (Rahman et al., 2007). Foliage of the crop may also provide hay, silage and green manures and plants can be fed to cattle sheep and horses. Its edible pods supply protein, carbohydrate, fat, fiber, thiamin, riboflavin, Ca and Fe and the seed contains significant amount of thiamin, niacin, folic acid as well as fiber (Rashid, 1993; Shanmugavelu, 1989). Recently cultivation of French bean is gaining popularity in Bangladesh mainly because of its demand as a commodity for export.

Production of legume crops like mungbean, lentil, French bean depends on many factors such as quality of seed, time of sowing, application of plant growth regulator, fertilizer and proper agronomic management practices. (Uddin et al., 2010a; Uddin et al., 2010b; Uddin et al., 2013; Datta et al.,

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2013; Uddin et al., 2017; Uddin et al., 2018; Usha et al., 2019). Among those factors, fertilizer is an important factor to get high yield. Nitrogen management is played an important role in maximizing yield of French bean. Nitrogen is necessary for its vegetative growth and development. Nutrient requirement for different cultivars usually is similar except on poor soils (Adams, 1984). French bean cultivation requires ample supply of nitrogen. Therefore, it is necessary to find out a suitable nitrogen level for higher yield and economic return as well. However, very limited research was conducted to improve the fruit set and yields by growth regulator application and fertilizer management practices in French bean. The requirement of phosphorus fertilizer for all crops is of prime importance. Nutrient requirement of different cultivars is usually similar except on poor soils French bean cultivation requires sample supply of phosphorus (Adams, 1984).

Excessive or under doses of phosphorus can affect the growth and yield. So, optimum dose of phosphorus is necessary to produce maximum seed yield of French bean. Beans need Phosphorus for growth, utilization of sugar and starch, photosynthesis, nucleus formation and cell division, fat and albumen formation, transfer and storage of energy within plants. Energy from photosynthesis and the metabolism of carbohydrates is stored in phosphate compounds for later use in growth and reproduction (McKenzie and Middleton, 1997; Georgina et al., 2007; Sixbert and George, 2012). Studies have shown that an application of P fertilizer led to an increased legume grain yields, particularly with velvet bean, and soyabean (Kamanga et al., 2010). Other studies have shown that bean crop require more P because it is important for nodulation to take place effectively (Ssali and Keya, 1986). Studies carried out in Columbia showed significant genotype variability on P fertilizer application rates, indicating an increase in Fe and decrease in Zn concentration in seeds (Astudillo et al., 2008). Keeping in view the importance of nitrogen and phosphorus, this research was carried out with the objectives to determine the effect of nitrogen and Phosphorus and their interaction for maximizing the performance of French bean.

2. MATERIALS AND METHODS

2.1 Experimental site

The present research work was conducted in the experimental field is located at 24.75°N altitude, 90.50°E longitude and an average altitude of 18 m above the sea level. The experimental site belongs to the Old Brahmaputra Floodplain (AEZ-9) soil (UNDP and FAO, 1988). The texture of the soil in the experimental area was silty loam type and belongs to the Brahmaputra Alluvial Tract. The topography of the experimental field was medium high land. The soil of the experimental field is slightly acidic (pH 6.80) with low organic matter content (1.19%) and high soil bulk density (1.64 g cm^{-3}). The geographical location of the experimental area was under the sub-tropical climate which is characterized by comparatively heavy rainfall, high humidity, high temperature relatively long day during April to September and scanty rainfall, low humidity, low temperature and short-day period during December to March. During the winter season average temperature was 8-25°C. The winter season is favorable for French bean cultivation.

2.2 Treatments of the experiment and design

The experiment comprised two factors namely Nitrogen and Phosphorus level. The details of the factor treatments are as follows: **<u>Factor A</u>: Nitrogen** (4) levels: N_1 = 80 kg N ha^{-1}, N_2 = 100 kg N ha^{-1}N_3 = 120kg N ha^{-1} and N_4 = 140 kg N ha^{-1}. **<u>Factor B</u>:** Phosphorus (4) levels: P_1 = 15 kg P ha^{-1}, P_2 = 20 kg P ha^{-1}, P_3 = 25 kg P ha^{-1} and P_4= 35 kg P ha$^{-1.}$ The experiment was laid out in a Randomized Complete Block Design with three replications. The total number of plots was 48 (4×4×3). Each plot size was 5 10m^2 (4 m × 2.5 m). Seeds were sown maintaining the spacing of 25 cm × 15 cm. The blocks and unit plots were separated by 1 m and 0.75 m spacing, respectively.

2.3 Crop husbandry

BARI Jharsheem-3, locally, known as khaissa bean was used as experimental crop which is developed by the Olericulture Division, HRC, Gazipur in 2011, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, Bangladesh as a variety of French bean. The land was ploughed with a power tiller by several ploughing and cross ploughing followed by laddering to break the clods and to level the soil. The weeds and stubbles were collected and removed from the plot to bring the land under good tilth for seed sowing. Urea and TSP were used as source of Nitrogen and Phosphorous. The whole amount of TSP (according to treatment) and MoP (150 kg ha^{-1}) (FRG 2012) and half amount of urea (according to treatment) were applied during final land preparation and another half amount of urea (according to treatment) was top dressed at 30 days after sowing (DAS) of seeds. Before sowing seed were treated by Carbendazem @ 5g kg^{-1} seed for controlling soil borne diseases. Two seeds were sown per hill at a depth of 5.0 cm. One healthy seedling hill^{-1} was kept and excess seedling was uprooted after 15 days of emergence of seedlings. Weeding, Irrigation and drainage operations were done when as per necessary. The plots were infested by caterpillar, which was successfully controlled by applying Basudin 10 G at the rate of 16.8 kg ha^{-1}. Seedlings were attacked by damping off and anthracnose diseases. Topsin (Thiophanate methyl) was sprayed at the rate of 2 mL litre^{-1} at an interval of 7 days. Some plants were attacked by Bean Common Mosaic Virus (BCMV) which is a harmful disease of French bean. These plants were removed from the plots and destroyed for controlling BCMV without hampering the central portion for data collection. The crop was harvested when they reached maturity. Grains plant^{-1} were then weighed to record the yield and then converted to t ha^{-1}.

2.4 Data collection

Data of the yield and yield contributing characters were collected. The biological yield was calculated with the following formula:

Biological yield = Grain yield + Stover yield.

Harvest index (HI) was calculated from the ratio of grain yield to biological yield and expressed in percentage. It was calculated by using the following formula:

HI (%) = (Grain yield / Biological yield) × 100

2.5 Statistical analysis

The collected data were compiled and analyzed statistically using the analysis of variance technique with computer package program Minitab statistical software (2010). State college, PA: Minitab, Inc (www.minitab.com). The differences of mean values were adjudged by using Duncan's Multiple Range Test.

3. RESULTS AND DISCUSSION

3.1 Effect of nitrogen on the yield performance of French bean

Nitrogen had significant influence on most of the studied yield contributing characters and yield of French bean. The highest plant (54.75 cm), number of pods plant^{-1} (7.65), length of pod were recorded (12.81 cm), number of grains pod^{-1}(6.1), grain yield (1.95 t ha^{-1}), harvest index (32.13%), biological yield (6.07 t ha^{-1}), stover yield (4.12 t ha^{-1}) were found from 120 kg N ha^{-1} (N_3) application. (Table1). On the other hand, lowest plant height (44.62 cm), number of pods plant^{-1} (5.45), number of grains pod^{-1} (4.03), grain yield (1.24 t ha^{-1}), stover yield (3.2 t ha^{-1}),biological yield (4.44 t ha^{-1}), harvest index (27.90%) were observed from 80 kg N ha^{-1} (N_1) (Table 1). The shortest length of pod was recorded (11.76 cm) from 100 kg N ha^{-1} (N_2) (Table 1). The nitrogen had non-significant influence on the weight of 1000 grains (Table 1). A group researchers recorded high nitrogen application (180 kg/ha) for higher green pod yield in hilly areas (Singh et al., 2009). Chaudhury reported that grain yield showed significant increase up to 160 kg N/ha and found the optimum economic dose computed from quadratic response equation 152.5 kg N/ha with estimated grain yield of 29.15q/ha (Chaudhury, 2009). A group researchers found higher values of nitrogen application contributed higher values of yield contributing characters of French bean while observing highest pod length, number of green pods plant-1 and green pod weight plant-1 and pod yield (27.8 t/ha) were obtained from the application of 120 kg N ha-1 (Moniruzzaman et al., 2009). A group researcher reported that the higher number of green pods plant^{-1}(44.57), seed yield (119.70 q ha^{-1}) were recorded from 120 kg N ha^{-1} of which 50% N through urea and 50% N through poultry manure were applied (Sathe et al., 2015). Some researchers stated that 120 kg N ha^{-1} application proved significantly superior than to 90, 60 and 30 kg/ha regarding all growth and yield characters which recorded highest number of pods plant^{-1} (11.82), number of grains pod^{-1} (4.03), seed yield (13.59 q ha^{-1}) and straw yield (20.16 q ha^{-1}) of French (Singh et al., 2018). A group researchers recorded the highest number of pods plant^{-1}(7.485), number of seeds pod^{-1}(5.841), number of seeds plant^{-1}(26.55), grain yield (1.780 t ha^{-1}), stover yield (2.312 t ha^{-1}) and biological yield (4.095 t ha^{-1}) from the application of 120 kg N ha^{-1} (Usha et al., 2019).

Table 1: Effect of nitrogen on the yield and yield characters of French bean

Level of Nitrogen (kg N ha^{-1})	**Plant height (cm)**	**No. Branches plant^{-1}**	**No. of pods plant^{-1}**	**Pod's length (cm)**	**Number of grains Pod^{-1}**	**1000-grain weight (g)**	**Grain yield (t ha^{-1})**	**Stover yield (t ha^{-1})**	**Biological yield (t ha^{-1})**	**Harvest index (%)**
80	44.62d	3.66	5.45d	12.37ab	4.03d	425.2	1.24c	3.204b	4.444b	27.90c
100	46.72c	3.71	5.71c	11.76b	5.45c	425.3	1.43bc	3.269b	4.699ab	30.43b
120	54.75a	3.85	7.65a	12.81a	6.10a	425.7	1.95a	4.118a	6.068a	32.13a
140	49.53b	3.70	6.55b	12.29ab	5.71b	425.1	1.62b	3.747ab	5.367ab	30.18b
LSD $_{(0.05)}$	4.12	0.29	0.406	0.63	0.17	0.62	0.03	0.06	0.10	3.77
Level of Significance	**	NS	**	*	**	NS	*	**	*	**
CV (%)	10.27	9.36	10.74	6.22	5.11	0.18	28.44	24.43	24.02	15.33

In a column, mean values with same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT), * =Significant at 5% level of probability, ** =Significant at 1% level of probability, NS = Not significant

3.2 Effect of phosphorous on the performances of French bean

Phosphorous had significant influence on most of the studied yield contributing characters and yield of French bean at harvest time. The highest plant (48.4 cm), number of pods plant^{-1} (6.5), number of grains pod^{-1} (6.01), seed yield (1.81 t ha^{-1}), stover yield (3.66 t ha^{-1}), biological yield (5.47 t ha^{-1}), harvest index (33.08%) were found from 25 kg P ha^{-1} (P_3) (Table 2). Whereas, the lowest plant height (42.32 cm) , harvest index (28.38%) from 20 kg P ha^{-1} (P_2), number of pods plant^{-1} (5.45), number of grains pod^{-1} (4.0), seed yield (1.43 t ha^{-1}), stover yield (3.45 t ha^{-1}) biological yield (4.88 t ha^{-1}) were found from 15 kg P ha^{-1} (P_1) (Table 2). The phosphorous had non-significant influence on the number of branches plant^{-1}, length of pod and weight of 1000 grains (Table 2). Significant influence of Phosphorus on growth and yield contributing characters and yield of French bean also proved by various researches. The highest seed yield on application rate of 20 kg P ha^{-1}, the maximum pod yield (22.12 t ha^{-1}) from application of 60 kg P ha^{-1} when the soil having pH (5.85), organic matter (1.29%), nitrogen (0.07%), phosphorus (18.35 ppm), highest number of pods plant^{-1} (11.20), number of grains pod^{-1} (3.76), seed yield (12.08 q ha^{-1}) from 60 kg P_2O_5 ha^{-1} application, higher number of pods plant^{1} (8.0), seeds pod^{-1} (14.0) and seed yield (7.42 quintal ha^{-1}) from 46 P kg ha^{-1} sandy to sandy loam type having pH 6.7-7.3 were observed and reported in French bean (Turuko and Mohammed, 2014; Rahman et al., 2018; Singh et al., 2018; Zebire et al., 2019). The significant influence of Phosphorus growth and yield performance in legume crops like mungbean, lentil aslo proved by many researchers (Uddin et al., 2010, Datta et al., 2013, Uddin et al., 2013). However, high doses of Phosphorus fertilizer in different soil type affect other essential nutrient availability by forming interaction which leading to increase French bean production.

Table 2: Effect of phosphorus on the yield and yield characters of French bean

Level of phosphorus (kg P ha^{-1})	**Plant height (cm)**	**No. Branches plant^{-1}**	**No. of pods plant^{-1}**	**Effective pods plant^{-1}**	**Non-effective pods plant^{-1}**	**Pod's length (cm)**	**Number of grains Pod^{-1}**	**1000-grain weight (g)**	**Grain yield (t ha^{-1})**	**Stover yield (t ha^{-1})**	**Biological yield (t ha^{-1})**	**Harvest index (%)**
15	43.35c	3.76	5.45d	4.50b	0.95a	12.30	4.00c	425.3	1.43c	3.453c	4.883c	29.28bc
20	42.32c	3.61	5.65c	4.85ab	0.80b	12.35	4.01c	425.3	1.43c	3.608b	5.038b	28.38c
25	48.40a	3.80	6.50a	5.74a	0.76b	12.14	6.01a	425.7	1.81a	3.661a	5.471a	33.08a
35	45.55	3.75	6.14b	5.28ab	0.86ab	12.44	5.18b	425.4	1.56b	3.569b	5.129b	30.41b
LSD $_{(0.05)}$	3.70	0.29	0.29	0.93	0.11	0.63	0.17	0.62	0.03	0.06	0.10	3.77
Level of Significance	**	NS	**	*	*	NS	**	NS	**	**	**	**
CV (%)	10.12	9.36	7.67	9.72	33.67	6.22	5.11	0.18	28.44	24.43	24.02	15.33

In a column, mean values with same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT), * =Significant at 5% level of probability, ** =Significant at 1% level of probability, NS = Not significant

3.3 Interaction effect of nitrogen and phosphorous on the yield performances of French bean

Interaction effect between nitrogen and phosphorous had significant influence on the yield and yield contributing characters of French bean. The highest plant height (53.94 cm), number of pods plant^{-1} (8.49), number of effective pods plant^{-1} (7.8), number of grains pod^{-1} (7.78), grain yield (2.36 t ha^{-1}), stover yield (2.56 t ha^{-1}), biological yield (4.91 t ha^{-1}) and harvest index (48.06%) from 120 kg N ha^{-1} and 25 kg P ha^{-1} (N_3P_3) treatments and number of non-effective pods plant^{-1} (1.42) from 80 kg N ha^{-1} and 20 kg P ha^{-1} (N_1P_2) were observed (Table 3). Whereas, the lowest plant (34.16 cm), number of pods plant^{-1} (5.22), number of effective pods plant^{-1} (4.14), stover yield (1.46 t ha^{-1}), biological yield (2.52 t ha^{-1}), grain yield (1.06 t ha^{-1}) found from 80 kg N ha^{-1} and 15 kg P ha^{-1} (N_1P_1), number of non-effective pods plant^{-1} (0.55), harvest index (37.85%) were found from 100 kg N ha^{-1} and 15 kg P ha^{-1} (N_2P_1), lowest number of grains pod^{-1} (6.51) was found from 80 kg N ha^{-1} and 205 kg P ha^{-1} (N_1P_2) and 120 kg N ha^{-1} and 25 kg P ha^{-1} (N_2P_3) (Table 3). Interaction effect between nitrogen and phosphorous had not significant influence on the number of branches plant^{-1}, length of pods and weight of 1000 grains of French bean at harvest (Table 3). A group researchers obtained the highest number of pods plant^{-1} (27.90 at Jamalpur and 29.50 at Joydebpur) pod yield (13.60 t ha^{-1} at Jamalpur and 15.05 t ha^{-1} at Joydebpur) from the interaction of nitrogen (150 kg ha^{-1}) and phosphorus (60 kg ha^{-1}) application when soil was characterized by 0.95%, 1.60% organic matter (OM), 0.05%, 0.07% total N and 14 µg/g , 13 µg/g for Jamalpur and Joydevpur, respectively (Sen et al., 2010). A group researcher found crop receiving 100 kg N and 50 kg P_2O_5 ha^{-1} more profitable when highest grain & straw yield of French bean along with some other yield contributing characters recorded from the interaction of nitrogen (150 kg ha^{-1}) and phosphorus (75 kg/ha) application (Lad et al., 2014). In study state that an increasing trend was followed in maximum number of pods (9.45) and seed yield (1563.33 kg ha^{-1}) up to the treatment comprises with 150 kg N and 44 P Kg ha^{-1} in soil contained very low amount of organic matter (1.27 %), total nitrogen (0.067%) and phosphorus (9.6 %) (Kakon et al., 2016). A group researchers recorded higher number of pods plant^{-1}(18.03) and seed yield (1111 kg ha^{-1}) of French bean from the application 120 kg N ha^{-1} and 60 kg P ha^{-1} adoption of cultural practices including fertilizer, weeding, and insect pest management in medium available phosphors (22.42 kg ha^{-1}) of vertisols (Bansode et al., 2019). French bean responds to nitrogen and phosphorus more than other nutrients as nitrogen increases the plant growth and P enhances nodulation leading to increase productivity.

Table 3: Effect of interaction between nitrogen and phosphorus on the yield and yield characters of French bean

Interaction (Level of N × Level of P)	Plant height (cm)	No. Branches plant^{-1}	No. of pods plant^{-1}	Effective pods plant^{-1}	Non-effective pod plant^{-1}	Pod's length (cm)	Number of grains Pod^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Stover yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
$N_1 \times P_1$	34.16j	3.66	5.22jk	4.14ij	1.41a	12.67	6.81b	423.30	1.06jk	1.46gh	2.52k	42.05fghi
$N_1 \times P_2$	40.21efgh	3.66	5.89gh	4.47ghi	1.42a	12.21	6.51bc	430.00	1.16ij	1.70ef	2.86hi	40.58hij
$N_1 \times P_3$	38.86fgh	3.40	6.22fg	5.40de	0.82f	12.06	6.77b	427.30	1.40def	2.01d	3.40f	41.04ghij
$N_1 \times P_4$	35.36ij	3.53	6.22fg	4.87fg	1.35ab	12.55	6.88b	427.00	1.32fg	2.01d	3.59f	40.53hij
$N_2 \times P_1$	42.00def	3.80	5.42ij	4.87fg	0.55g	12.73	7.41ab	426.70	1.28gh	2.10cd	3.38f	37.85k
$N_2 \times P_2$	37.17hij	3.53	6.75de	5.40de	1.35ab	13.25	6.74b	427.70	1.11ij	1.70ef	2.81hij	39.50jk
$N_2 \times P_3$	39.91efgh	3.73	6.22fg	5.14ef	1.08cde	12.00	6.51bc	430.70	1.30fg	1.56efgh	2.86hi	45.54bcd
$N_2 \times P_4$	42.07def	3.80	7.89bc	6.94b	0.95ef	13.27	6.65bc	425.70	1.62c	2.13cd	3.75d	43.14efg
$N_3 \times P_1$	35.44ij	3.66	6.55ef	5.14ef	1.08cde	11.65	6.61bc	426.30	1.37efg	1.56efgh	2.93gh	46.70abc
$N_3 \times P_2$	42.75de	3.53	6.48def	5.14ef	1.34ab	11.57	6.68b	429.00	1.74b	2.41b	4.15b	41.96fghi
$N_3 \times P_3$	53.94a	4.00	8.49a	7.80a	0.69de	11.85	7.78a	427.70	2.36a	2.56a	4.91a	48.06a
$N_3 \times P_4$	46.63bc	3.60	6.49def	5.40de	1.09cde	11.98	6.60bc	418.30	1.78b	2.27bc	4.05bc	43.97def
$N_4 \times P_1$	41.10defg	3.93	7.62c	6.80b	0.82f	12.16	7.73a	425.70	1.76b	2.40b	4.16b	42.37fghi
$N_4 \times P_2$	50.95ab	3.73	8.22ab	7.14ab	1.08cde	12.38	6.72b	427.30	1.75b	2.15cd	3.90cd	44.92cde
$N_4 \times P_3$	42.52de	3.46	7.09d	5.94c	1.15cd	12.65	6.90b	427.30	1.49d	2.09cd	3.58e	41.68fghij
$N_4 \times P_4$	41.40def	4.26	7.02d	5.80cd	1.22bc	11.98	6.83b	427.70	1.46de	1.61efg	3.07g	47.57ab
LSD $_{(0.05)}$	0.971	0.58	0.141	0.114	0.048	1.27	0.140	3.44	0.037	0.061	0.058	0.742
Lev of Sig	**	NS	**	**	**	NS	**	NS	**	**	**	**
CV (%)	4.63	9.36	3.96	4.73	8.96	6.22	4.23	3.43	4.49	5.53	3.11	3.00

In a column, mean values with same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT), ** =Significant at 1% level of probability, NS = Not significant, N_1 = 80 kg N ha^{-1}, N_2 = 100 kg N ha^{-1}, N_3 = 120 kg N ha^{-1}, N_4 = 140 kg N ha^{-1}, P_1 = 15 kg P ha^{-1}, P_2 = 20 kg P ha^{-1}, P_3 = 25 kg P ha^{-1}, P_4 = 35 kg P ha^{-1}.

4. Conclusion

From the above results of the present study, it may be concluded that single application of nitrogen and phosphorus had significant result contribution to improving the yield in BARI Jharsheem-3. The treatments showed the positive effect in most cases and hence may be used for the improvement of yield and quality of French bean. From the above findings, the treatment combination of 120 kg Nitrogen ha^{-1} and 25 kg Phosphorus ha^{-1} along with recommended rate of other fertilizers significantly increased plant growth and yield of BARI Jharsheem-3 and this treatment combination can be treated as the best treatment considering all other combination in respect of yield and yield contributing characters.

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