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EFFECT OF SOWING DATE AND NITROGEN ON THE GROWTH AND YIELD OF FRENCH BEAN *(Phaseolus vulgaris* L.)

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ABSTRACT

The experiment was conducted to investigate the effect of sowing date and nitrogen on the growth and yield of French bean (BARI Zhar Sheem-1) at the farm of Sher-e-Bangla Agricultural University, Dhaka. The experiment included two factors; A: Sowing date (T_1 -15 November, T_2 -30 November, T_3 -15 December and T_4 -30 December) and Factor B: Nitrogen level (N_o - 0 kg N/ha, N_1 - 45 kg N/ha, N_2 - 90 kg N/ha and N_3 -135 kg N/ha). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The results of this study revealed that treatment T_1 gave the highest yield of green pod (15.6 t/ha) among the other treatments. Nitrogen fertilizer also showed significant variation among the treatments and N_2 produced the highest green pod yield (15.7 t/ha). Thus, this study demonstrated that T_1N_2 gave the highest green pod yield of French bean (17.9 t/ha) as well as the highest net return (TK. 1, 70,023 /ha) and benefit cost ratio (2.7) among the other treatment combinations.

Keywords: french bean, growth and yield, nitrogen, sowing time

INTRODUCTION

French bean *(Phaseolus vulgaris* L.) is an important vegetable crop belonging to the family Fabaceae, has been reported to be a native to central and South America (Swiader *et al.,* 1992). In Bangladesh it is known as farashi sheem (Rashid, 1993). It is also known as basic bean, navy bean, pinto bean, raj bean, snap bean and string bean (Duke, 1983; Tindall, 1988). In our country beans are mainly used as green vegetables and seeds used as pulse in Sylhet, Moulvibazar, Sonamgoj, Hobigonj and Chittagong districts.

Generally, sowing date is an important factor for the yield of a crop. French bean can be grown well at 19-27°C (Nonneck, 1989). Abdalla and Fischbeek (1978) stated that the pod set of French bean was poor at day 30°C and at night 25°c temperature. Farmers frequently sow French bean seeds too early or too late, not knowing when the best time to sow them is. In Bangladesh, French bean grows successfully in winter due to optimum temperature for their proper growth, development and fruit setting. It is sown in mid-October to mid-November. However, the temperature remains fairly high upto mid-October, which gradually comes down in mid-December (Kakon *et al.,* 2017). So, it is an important to study the effect of sowing time for achieving optimum yield attributes and yield of French bean.

The French bean has a great yield potential, but it is not nodulated by indigenous Rhizobia, unlike other leguminous crops (Ali and Kuahwaha, 1987). As a result, nitrogenous fertilizer is required by the crop. Except in low-nutrient soils, the nutritional requirements of different cultivars are usually similar (Adams, 1984). A considerable amount of nitrogen is required for the production of French beans. Too much or too little nitrogen might have an impact on yield characteristics and yield. The right amount of nitrogen is needed to produce the best yield of top-quality French bean.

MATERIALS AND METHODS

The present experiment was conducted to study the effect of sowing date and nitrogen on the yield contributing characters and yield of French bean. The land was belonging to Agro Ecological Zone of Modhupur tract (AEZ 28). The selected experimental site was well-drained high land. The soil was silt

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loam in texture of pH 6.18. The content of organic carbon, total N, available P and K were 1.25%, 0.08%, 20 ppm and 0.20 mg 100 g soil, respectively. The experiment included two factors, namely, Factor A: date of sowing (T_1-15 November, T_2-30 November, T_3-15 December and T_4-30 December) and Factor B: levels of nitrogen (No- 0 kg/ha, N_1 -45 kg/ha, N_2 -90 kg/ha and N_3 -135 kg/ha). The experiment was laid out in RCBD with three replications. Each unit plot was 2m x 1.5 m in size. The variety of French bean used in the experiment was BARI Zhar Sheem 1. The seed was collected from the Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. At first the land was ploughed with a power-tiller on 2 November, 2006 and opened to sunlight. Afterwards experimental plot was prepared by five ploughings and followed by laddering to break the clods and to level the soil. The weeds and stubble of previous crop were collected and removed from the soil. These operations were done to bring the land until good tilth for sowing of seeds.

Cow dung, Triple Super Phosphate and Muriate of Potash were applied at the rates of 10 t/ha, 150 kg/ha and 150 kg/ha, respectively. Nitrogen was applied according to the treatments allotted for each plot in form of urea. The half amount of urea was applied during final land preparation and rest amount in two installments at 15 and 30 days after sowing (DAS).

Two seeds were sown in each hill at a depth of 3.0 cm. The seeds were covered with pulverized soil just after sowing and gently pressed with hands. Seeds were sown at four different dates viz. 15 November, 30 November, 15 December and 30 December in 2006 in rows with a spacing of 30 cm × 15 cm. Intercultural operations were done as and when necessary.

Immature green pods were harvested at tender stage through hand picking and weighed to estimate the yield. Ten plants were selected randomly in such a way that the border effect could be avoided. Data were taken on seedling emergence, plant height, number of levels per plant, leaf length, leaf breadth, number of branches per plant, days to first flowering, number of flowers per plant, number of green pods per plant, length of green pod, diameter of green pod and number of seeds per plant. Economic analysis was done for cost of production, gross return; net return and benefit cost ratio (BCR) calculation. The analyses of variance for the characters under study were performed by F variance test and mean differences were adjudged by using the Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Plant height of French bean varied significantly at 15, 25, 35 and 45 DAS that were shown in Table 1. At 15 DAS, the longest plant height (14.9 cm) was observed in treatment T_1 and the shortest (12.2 cm) plant was found in T_4 treatment. Similar trend was followed at 25, 35 and 45 DAS whereas the longest (26.8 cm, 49.0 cm, 57.8 cm) plant height was recorded from T_1 and the shortest (24.4 cm, 36.3 cm, 47.2 cm) plant was found in T_4 treatment respectively. The plant height gradually decreased with the delay in sowing. This difference may be due to climatic differences. Andrews *et al.* (1983) reported

Table 1. Effect of sowing time on plant height and number of leaves per plant of French bean

Treatment	Plant height (cm)				No. of leaves/plant			
	15 DAS	25 DAS	35 DAS	45 DAS	15 DAS	25 DAS	35 DAS	45 DAS
T_1	14.9a	26.8a	49.0a	57.8a	3.7a	7.1b	11.7ab	17.2a
T_2	14.7a	24.6b	48.9a	55.5b	3.4a	7.8a	12.3a	16.8a
T_3	13.8b	24.4b	36.2b	53.6b	2.7b	6.2c	11.4b	15.1b
T_4	12.2c	24.4b	36.3b	47.2c	2.3c	4.7d	10.7c	12.3c
LSD	0.28	0.60	0.94	1.04	0.34	0.50	0.66	0.59
Level of significance	**	**	**	**	**	**	**	**
Cv (%)	2.44	2.87	2.66	2.29	13.30	9.31	6.86	4.58

T_1-15 November; T_2- 30 November; T_3- 15 December; T_4- 30 December

that the low temperature in December suppressed the growth of lateral branches. The plant height might have varied due to the effect of low temperature prevailing during December. Singer *et al*. (1996) found that sowing date had a substantial impact on plant height.

A rise in the number of leaves signifies healthy growth, and the yield of the pod is directly connected to the number of leaves. The more the leaf produces, the more photosynthate is produced, resulting in a higher yield. Number of leaves per plant of French bean varied significantly at 15, 25, 35 and 45 DAS due to different of sowing time (Table 1). At 15 DAS, the maximum (3.7) and the minimum (2.3) number of leaves per plant was recorded due to T_1 and T_4 treatment, respectively. Similarly, the maximum number of leaves per plant (7.8, 12.3) was recorded due to T_2 treatment and the minimum (4.7, 10.7) was found from T_4 treatment at 25 and 35 DAS respectively. At 45 DAS, the maximum (17.2) number of leaves per plant was recorded from T_1 whereas the minimum (12.3) was found from T_4 treatment. The difference in leaf number produced by sowing date could be related to changes in environmental circumstances. Early sowings appeared to have a more favorable climate and more time to grow than late sowings. The results are in conformity with that of Singer *et al*. (1996).

A significant variation was found in total number of branches showed in different sowing time (Table 2). The maximum number of branches (11.0) was observed from T_1 and the minimum (7.6) number of branches was observed from T_4 treatment. It was possible because early lead sowing resulted in stronger vegetative growth, resulting in a higher number of branches per plant.

Table 2. Effect of sowing time on number of branches, flowers, pod length of green pod and pod weight per plant of French bean

Treatments	No. of branches per plant	No. of flowers per plant	No. of pods per plant	Length of green pod (cm)	Pod weight per plant (g)
T_1	11.0 a	43.4 a	29.2 a	14.9 a	79.7 a
T_2	9.4 b	41.3 b	27.2 b	14.8 a	75.4 b
T_3	9.1 b	36.3 c	22.7 c	13.4 b	62.4 c
T_4	7.6 c	33.0 d	20.5 d	12.6 c	57.6 d
LSD(0.05)	0.75	0.96	0.90	0.65	1.49
Level of significaance	**	**	**	**	**
CV (%)	9.64	2.99	4.33	5.58	2.60

T_1-15 November; T_2- 30 November; T_3- 15 December; T_4- 30 December

There was a significant variation in number of flowers per plant due to different sowing time (Table 2). The maximum number of flowers (43.4) was found from T_1 and the minimum number of flowers (33.0) was observed in T_4 treatment. Temperature was a significant impact in flowering, it should be highlighted. It's probable that earlier sowing finished vegetative growth before flowering, and that the cold nights of December aided early flowering. With the delay in sowing, the quantity of flowers reduced. In bean plants, Sesay (1983) reported a similar result.

Sowing time showed significant influence on number of pods per plant (Table 2). The highest (29.2) number of pods per plant was obtained from T_1 and the lowest (20.5) number of pods per plant was found from T_4 treatment. According to Abdalla and Fischbeak (1978), the pod set of French bean was poor at day and night temperatures of 30 and 25^0C, respectively. From the aforementioned, it was clear that the variation in pod set could be due to temperature variations due to different sowing times, as the number of pods per plant was significantly reduced with delay in sowing. Fisher (1980) described similar results in his research. There was significant variation on length of pod at harvest due to different sowing time (Table 2). The longest (14.9 cm) length of green pod was found from T_1 and the shortest (12.6cm) length of green pod was found in T_4 treatment.

There was significant variation on weight of pod per plant of French bean due to the effect of different sowing time (Table 3). The highest (79.7 g/plant) pod weight was obtained from T_1 and the lowest (57.6 g/plant) pod weight was found from T_4 treatment. The pod weight decreased with delay in sowing.

The yield of French bean per hectare was converted from the production of each individual plot. Sowing time had a considerable impact on yield per hectare, as evidenced by the results. (Fig. 1). The highest (15.6 t) yield per hectare was obtained from T_1 which was followed by T_2 treatment (14.8 t). The lowest yield (11.3 t) per hectare was obtained from T_4 treatment. The sowing date has a significant impact on the production of French bean. The higher yield obtained from early seeding was most likely due to the plants' improved vegetative growth, which led to better flowering, fruit set, and eventually enhanced output per plant and per hectare. The number of pods per plant fell as the yield of French bean reduced with delayed sowing due to the shift in time in fall. The current finding is consistent with that of Bhadwaj et al (1994). At various seeding times, pod yield was positively linked with green-shell production (Beaver and Roman-Hermandez, 1994).

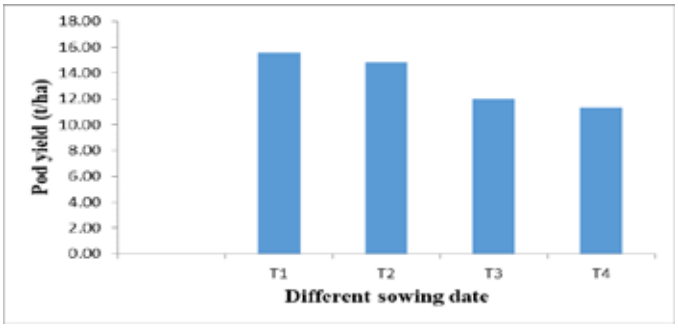

Fig. 1. Effect of sowing time on pod yield (t/ha) of French bean

Significant variation was observed due to application of different levels of nitrogen (Table 3). At 15 DAS, the longest (15.4cm) plant was produced due to application of 135 kg N/ha and the shortest (12.2 cm) plant was produced in control treatment. At 25 DAS, the longest (28.0 cm) plant was produced from N_3 treatment which was identical (25.7 cm) to N_2 and the shortest (22.9 cm) was found from N_0 treatment. At 35 DAS, the longest (44.5 cm) plant was produced in N_3 treatment and the shortest (39.9 cm) was found from control (N_0) treatment. At 45 DAS, the longest (56.3cm) plant and the shortest (50.6 cm) plant were observed in N_2 and control (N_0) treatment respectively. The application of nitrogen enhanced the plant height in French bean, according to Vishwakarma *et al.* (2002).

Table 3. Effect of nitrogen on plant height and number of leaves per plant of French bean.

Treatment	Plant height (cm)				No. of leaves/plant			
	15 DAS	25 DAS	35 DAS	45 DAS	15 DAS	25 DAS	35 DAS	45 DAS
No	12.2 d	22.9 c	39.9 c	50.6 c	3.0	5.3 b	10.8 b	14.3 c
N_1	13.3 c	23.5 c	42.6 b	54.1 b	3.0	6.8 a	10.8 b	14.9 c
N_2	14.6 b	25.7 b	43.3 b	56.3 a	3.1	6.8 a	11.9 a	15.7 b
N_3	15.4 a	28.0 a	44.5 a	55.0 a	3.0	6.9 a	12.6 a	16.5 a
LSD	0.28	0.60	0.94	1.04	0.34	0.50	0.66	0.59
Level of significance	**	**	**	**	**	**	**	**
Cv (%)	2.44	2.87	2.66	2.29	13.3	9.31	6.86	4.58

N_0- 0Kg N/ha; N_1- 45Kg N/ha; N_2- 90 Kg N/h; N_3- 135 Kg N/ha

According to Arya *et al.* (1999), nitrogen application stimulates the growth of French bean. It was because the plant got more nitrogen, which stimulated more vegetative development. Srinivas and Naik (1988) and Chandra *et al.* (1990) both reported similar findings (1987). Number of leaves per plant of French bean varied significantly at 15, 25, 35 and 45 days after sowing (DAS) due to different nitrogen levels (Table 3). The maximum (3.1) number of leaves per plant was recorded in N_2 treatment and the minimum (3.0) was recorded from control (N_0) at 15 DAS. At 25 DAS, the maximum (6.9) number of leaves per plant was recorded from N_3 and the minimum (5.3) was found in control condition. At 35 DAS, the maximum (12.6) number of leaves per plant was obtained from N_3 and the minimum (10.8) was found from control (N_0) treatment. The maximum (16.5) number of leaves per plant was recorded from N_3 and the minimum (14.3) was obtained from control (N_0) at 45 DAS.

Table 4. Effect of nitrogen on Number of branch*e*s flowers, pod length of green pod and pod weight per plant of French bean

Treatments	No. of branches	No. of flowers	No. of pods	Length of green pod(cm)	Pod weight (g)
No	6.2 c	29.2 d	17.8 d	11.9 c	50.6 c
N_1	8.9 b	37.3 c	23.4 c	13.6 b	65.3 b
N_2	11.1 a	44.5 a	29.8 a	15.0 a	79.7 a
N_3	10.8 a	43.2 b	28.6 b	15.3 a	79.4 a
LSD(0.05)	0.75	0.96	0.90	0.65	1.49
Level of signification	**	**	**	**	**
CV(%)	9.64	2.99	4.33	5.58	2.60

Whereas, N_0- 0Kg N/ha; N_1- 45Kg N/ha; N_2- 90 Kg N/h; N_3- 135 Kg N/ha

Application of different levels of nitrogen had highly significant effect on the total number of branches per plant (Table 4). The highest (11.1) and the lowest (6.2) number of branches per plant were found in the treatment N_2 and control (N_0) treatment, respectively. Nitrogen enhanced plant vegetative growth and development up to a limiting level, while larger nitrogen doses (135 N/ha) reduced the number of branches per plant.

The number of flowers was also significantly influenced by the application of different levels of nitrogen (Table 4). The maximum (44.5) number of flowers per plant was recorded when 90 kg N/ha was applied and the minimum (29.2) number of flowers was found when no nitrogen was applied.

Nitrogen showed significant effect on the number of pods per plant (Table 4). The number of pod increased significantly with the increase in nitrogen rate. The highest *(*29.8) number of pods per plant was obtained from N_2 treatment while the lowest number of pods per plant (17.8) was recorded in control (N_0) treatment. However, when compared to 90 kg N/ha, the application of 135 kg N ha resulted in no further increase in the quantity of pods per plant. The current study agreed with Edje *et al*. (1975), Sa *et al.* (1982), and Calvache *et al.* (1997), who found a substantial variation in pod number per plant with varying nitrogen levels.

The effect of nitrogen on length of green pod at harvest was significant (Table 4). The longest (15.3 cm) green pod was obtained from N_2 treatment and the shortest (11.9 cm) green pod was found in control (N_0) treatment. The pod weight per plant was significantly influenced due to different level of nitrogen (Table 4). The pod weight per plant increased with the increasing level of nitrogen and being the highest (79.7 g/plant) at N_2 treatment, while the lowest (50.6 g/plant) was found from control treatment where no nitrogen was applied.

The yield of French bean per hectare was significantly influenced by different level of nitrogen (Fig. 2). The maximum (15.7 t) yield of French bean was recorded with the application of 90 kg N/ha (N_2)

and the minimum (9.8 t) yield of French bean was found from the control treatment. A fertilizer dose of 90 kg N/ha was advised by Chowdhuri *et al.* (2001). According to Dahatonde and Nalarnwar (1996), the pod yield improved dramatically up to 90 kg N/ha.

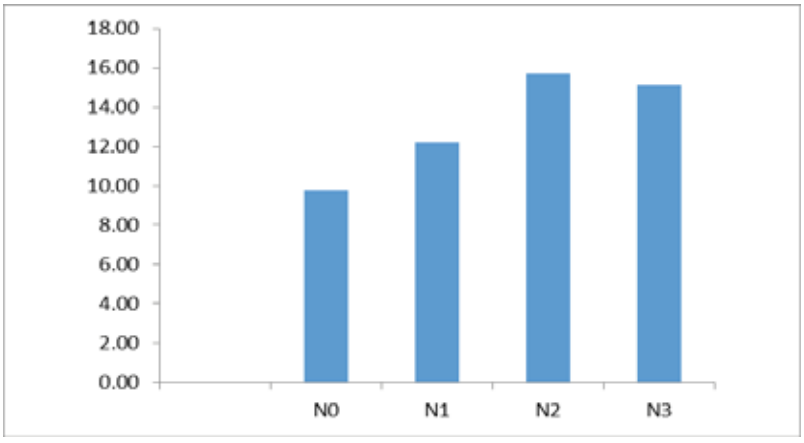

Fig. 2. Effect of nitrogen on pod yield (t/ha) of French bean

Whereas, N_0- 0Kg N/ha; N_1- 45Kg N/ha; N_2- 90 Kg N/h; N_3- 135 Kg N/ha

CONCLUSION

Due to the existing cropping pattern, environmental conditions, and a variety of other factors, yield characteristics and yield gradually declined. If the current cropping schedule for sowing time French bean was adjusted, early sowing would be advantageous. Nitrogen performed better at a level of 90 kg N/ha in terms of all the characteristics and yield.

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