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Effect of Sowing Dates and Fertilizer Treatments on the Reproductive Variability of French Bean (*Phaseolus vulgaris*)

A. Begum, [1]A. Ahad, [2]M.O. Kaisar, [3]M.M. Islam and [4]M.K. Anam
Department of Crop Botany, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[1]Sylhet Government Veterinary College, Telagor, Sylhet, Bangladesh, [2]OFRD, BARI, Sylhet, Bangladesh
[3]Plant Pathology Division, ARS, BARI, Burirhat Farm, Rangpur, Bangladesh
[4]Seed Pathology Centre, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

Abstract: The experiment was conducted to find out morphological and reproductive variability in response to different sowing dates and fertilizer treatments with two varieties of French bean under the agroclimatic conditions of Mymensingh, Bangladesh. The highest fertilizer treatment (90:50:120) produced the highest pod and seed yield per hectare. Fertilizer treatments had significantly different effects on pod length, number of seeds per pod, fresh pod weight per plant, dry seed weight per plant, pod yield and seed yield. The varieties differed significantly in respect to seed yield only. Yellow variety gave the highest seed yield per hectare. The January sowing gave the highest pod and seed yield. Seed sown in February failed to produce any fruit. The interaction of sowing dates and varieties had no significant effects on the above characters. The best morphological and reproductive characters performance were observed in January sowing and highest fertilizer treatments combination.

Key words: Sowing date, fertilizer, reproductive variability, french bean (*Phaseolus vulgaris*)

INTRODUCTION

French beans (*Phaseolus vulgaris* L.) are grown intensively in five major continental areas : Eastern Africa, North and Central America, South America, Eastern Asia and Western and South Eastern Europe. Brazil is by far the largest bean producing country in the world. Its annual harvested area increased from 2.9 x 10^6 hectare in 1961-65 to 4.3 x 10^6 hectare in 1976-80 (Adams, 1984). Nutrient requirements for different cultivars usually similar except on poor soils (Adams, 1984). Nitrogen, phosphorus and potassium are applied before planting followed by top dressing of potash or nitrogen to stimulate early growth. Chandra *et al.* (1987) stated that plant growth and yield increase with increasing nitrogen and phosphorus fetilizer treatments. Fertilizer placement at 10-25 cm depth has promoted growth and development of root or shoot of French bean (Chaib *et al.*, 1984). In case of application of various fertilizer doses, there were significant differences in pod number per plant in French bean (Sa *et al.*, 1982). Increased pod yield was reported with NPK fertilization (Srinivas and Naik, 1988). Seed yield also increased with increasing fertilizer doses (Perez, 1979; Hara *et al.*, 1985; Gonzalez *et al.*,1983). Abdalla and Fischbeck (1978) has stated that the pod set of French bean was poor at day/night temperature of 30/25°C. On average, duration of flowering in French bean was doubled when the day/night temperature was increased from 15/12°C to 18/15°C (Apel, 1988). The seed yield varied with different sowing dates (Chages *et al.*, 1982; Iglesias *et al.*, 1984; Vyas *et al.*, 1994). Dwarf cultivars of French bean is generally sown in 60x20 cm spacing. Spacing had little effect on yield except during the wet season when yields were significantly higher at wider spacing with no fertilizers (Lima *et al.*, 1983). French bean is grown in Sylhet and Chittagong in winter. Its young pods and mature seeds are used as a cooked vegetable. Beans are also pickled and cooked beans are served cold in salads, canned and home prepared red kidney beans are used in salads and meat and fish dishes. The young leaves are also used particularly in East Africa. French bean is used as fodder crop. French bean is very rich in protein as vegetables. In a country like Bangladesh where animal protein for human nutrition are becoming scarce day by day, French bean may be an alternative source of protein. Because beans and pulses are the best available source of vegetable proteins. Cultivars of French bean is not known to us like other beans and it is now being grown only in some parts of the country. While there is a lot of research information on other beans, there is little or no documented research reports on French bean are available in Bangladesh. So, this piece of research work was undertaken with the view to study the reproductive variability in French bean in response to sowing dates and fertilizer treatments on French bean.

MATERIALS AND METHODS

The present investigation was carried out in the field laboratory of the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh during the period from December 2001 to April 2002. The experimental plot belonged to the Brahmaputra alluvial soil tract. The soil was sandy loam. The plot had been used for rice cultivation for over a decade. Seeds of *Phaseolus vulgaris* L. (vars. yellow and red) were collected from Mitali seed store, Mymensingh. The experimental area was under sub-tropical climate. The land was ploughed with power tiller and the soil was exposed to sun for three days before the final preparation was made for planting. The experiment was laid out in Randomized Block Design using four replications each having two different varieties and three fertilizer treatments. The total experimental area was 43.8 x 33m equaled to 0.357 acre. The size of an individual experimental unit or plot was 4 x 2.4m. A drain of 1 meter width was made between two plots. Seeds were sown in rows. The row to row distance was 100cm or 1 meter and plant to plant distance was 60cm.Urea, triple super phosphate, muriate of potash and well rotten cow dung were applied at the rate of 47.23 quintal per hectare before final preparation of the land. The total quantity of cow dung and muriate of potash and 1/3rd of the quantity of urea and half of the quantity of triple superphospate were applied at the time of final preparation of the land was mixed thoroughly with the soil in the plots. Seeds were sown after seven days of application of manure and fertilizers. The rest quantity of urea and triple superphosphate were later on used as side dressing in two instalments. One when the plants were about 4-5 inches in height and the other just before flower initiation. Germination test was performed in the laboratory before sowing the seeds in the field by using, number of seeds germinated divided by number of seeds sown x 100 of this formula. Seeds were sown at three different times-December' 2001, January' 2002 and February' 2002. Due to non-availability of land and delayed rainy season an early sowing was not possible. In each plot seeds were sown in rows and there were five rows in each pot. In the row plant to plant distance was 60 cm and row to row distance was 100 cm. Two seeds were sown in each hill at a depth of about 1and ½ inches soil. Surrounding the experimental plot rows to bean plants were sown as broader crops to protect experimental plants from grazing by animals. Seedlings were transplanted to fill-up the gap where seeds failed to germinate. Seedlings of about 6 inches in height were transplanted from boarder rows with roots plunged 2 inches below the soil in hills preferably in the evening and then watering was to protect the seedlings from wilting. All gaps were filled up within two weeks after germination of seeds. Irrigation was done whenever necessary. Necessary precautions were also maintained against pest and diseases. As the seeds were sown in the field at three different times the crops were harvested at three different times. Immature green pods, suitable for use as vegetable, were harvested after 66 days of seed sowing and they were weighed to estimate fresh pod yield. These pods were smooth and soft. Again, the pods were harvested at mature stage when the plants and pods became yellow and dry. The seeds were collected from the pods and sun dried. Seeds were weighed to know the seed yield. The representative plants were selected at random from each unit plot and data pertaining to the characters of plant height, number of leaves per plant, leaf length and breath, days required for maximum flowering, number of flowers/plant and number of pods/plant were recorded. Finally, collected data were analyzed by Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Among the fertilizer treatments, T_2 produced the highest pod length (15.76 cm) followed by T_1 and T_0 (Table 1). Varietal effect was found to be insignificant (Table 2). Among the sowing dates, S_2 produced the longest pod (14.44 cm) followed by S_1 having a significant variation (Table 3). Among the sowing dates and varieties interactions, they did not produce any significant variation concerning pod length (Table 4). Among the sowing dates and fertilizer treatments interactions, S_2T_2 produced the longest pod (16.51 cm) followed by S_2T_1 and S_1T_0. The S_3T_0, S_3T_1, S_3T_2 did not produce any pod (Table 5).In fertilizer treatments, T_2 produced the highest pod weight (82.33 g) followed by T_1 while T_2 produced the lowest pod weight (64.07 g) (Table 1). Among the varieties, V_1 produced the V_1 produced the highest pod weight (73.02 g) and V_2 produced the lowest pod weight (72.52 g) (Table 2). Among the sowing dates, S_2 produced the highest pod weight (73.21 g) followed by S_1(Table 3). Among the sowing dates and varieties interactions, the variation in pod weight was insignificant (Table 4). Among sowing dates and fertilizer treatments interactions, S_2T_2 produced the highest pod weight (83.09 g) followed by S_1T_2, S_2T_1 and S_1T_1. The S_3T_0, S_3T_1, S_3T_2 did not give any significant result. From the table (Table 1 and column 5) it was found that among the fertilizer treatments, T_2 produced the highest seed weight (61.07 g) followed by T_1 and T_0. Among the varieties, the variation was insignificant (Table 2). Among the sowing dates, S_2 produced the highest seed weight (46.36 g) followed by S_1 (Table 3). Among the sowing dates and varieties

Table 1: Reproductive characters of French bean as influenced by fertilizer treatments

Treatments	Pod length (cm)	No. of seeds/pod	Fresh pod weight/plant (g)	Dry seed weight/plant (g)	Moisture content of pod (%)	Yield (q ha^{-1})	
						Pod	Seed
T_0	11.17c	3.09c	64.07c	26.58c	74.22c	11.91c	4.10c
T_1	14.84b	5.51b	71.92b	46.68b	74.95a	12.46b	7.97b
T_2	15.76a	6.00a	82.33c	61.07a	74.30b	13.99a	9.08a

Table 2: Reproductive characters of French bean as influenced by variety

Variety	Pod length (cm)	No. of seeds/pod	Fresh pod weight/plant (g)	Dry seed weight/plant (g)	Moisture content of pod (%)	Yield (q ha^{-1})	
						Pod	Seed
V_1	13.62	5.20	73.02a	47.55	73.93	12.47	7.19a
V_2	13.61	5.19	72.52b	47.01	73.85	14.44	6.98b

Table 3: Reproductive characters of French bean as influenced by sowing dates

Sowing date	Pod length (cm)	No. of seeds/pod	Fresh pod weight/plant (g)	Dry seed weight/plant (g)	Moisture content of pod (%)	Yield (q ha^{-1})	
						Pod	Seed
S_1	13.41b	5.09	72.34b	44.78b	74.16a	12.24b	6.57b
S_2	14.44a	5.31	73.21a	46.36a	74.26a	12.67a	7.54a
S_3	-	-	-	-	-	-	-

Table 4: Reproductive characters of French bean as influenced by sowing dates and variety

Variety x sowing date	Pod length (cm)	No. of seeds/pod	Fresh pod weight/plant (g)	Dry seed weight/plant (g)	Moisture content of pod (%)	Yield (q ha^{-1})	
						Pod	Seed
S_1V_1	13.39	5.09	72.52	43.33	74.19	12.29	6.60
S_1V_2	13.42	5.08	72.16	43.00	74.13	12.19	6.53
S_2V_1	14.44	5.31	73.53	46.36	74.17	12.66	7.59
S_2V2	14.44	5.31	72.89	46.36	74.35	12.69	7.48
S_3V_1	-	-	-	-	-	-	-
S_3V_2	-	-	-	-	-	-	-

Table 5: Reproductive characters of French bean as influenced by sowing dates and fertilizer treatments

Sowing dates x fertilizer treatments	Pod length (cm)	No. of seeds/pod	Fresh pod weight/plant (g)	Dry seed weight/plant (g)	Moisture content of pod (%)	Yield (q ha^{-1})	
						Pod	Seed
S_1T_0	11.15e	4.00d	63.59d	26.09d	74.32	10.59e	3.83d
S_1T_1	14.06d	5.43c	71.96c	45.18c	73.94	12.43c	7.56c
S_1T_2	15.00c	5.83b	81.57b	58.29b	74.21	13.69b	8.30b
S_2T_0	11.18e	4.18d	64.66d	27.07d	74.38	11.22d	4.33d
S_2T_1	15.62b	5.59b	71.88c	48.17c	74.01	12.49c	8.41b
S_2T_2	16.51a	6.17a	83.09a	63.57a	74.39	14.30a	9.47a
S_3T_0	-	-	-	-	-	-	-
S_3T_1	-	--	-	-	-	-	-
S_3T_2	-	-	-	-	-	-	-

Similar letters in a column do not differ significantly at 1 % level of probability

interactions, the variation was insignificant (Table 4). Among the sowing dates and treatments interactions, S_2T_2 produced the highest seed weight (63.57 g) followed by S_1T_2, S_2T_1 and S_1T_1. The S_3T_0, S_3T_1, S_3T_2 did not produce any seed (Table 5).The present observation was in full agreement with that of Grafton and Schneiter (1985) who reported in *Phaseolus vulgaris* L. 250 seed weight vary significantly with sowing dates. Among the fertilizer treatments, T_1 showed the highest moisture percentage (74.95) of fresh pods followed by T_2 and T_0 (Table 1). Among the sowing dates and varieties interactions, they did not give in any significant variation in moisture content of the fresh pods (Table 4). Among the sowing dates and fertilizer treatments interactions, S_2T_2 showed the highest moisture percentage (74.39) and S_1T_1 showed the lowest moisture percentage (Table 5). From the table 1 it was found that T_2 produced the highest pod yield (13.99) followed by T_1 and T_0 (Table 1). Among the varieties, thy did not give in any significant variation in pod yield (Table 2). Among the sowing dates, S_1 and S_2 were highly significant and produced the highest pod yield (Table 3). Among the sowing dates and varieties interactions, the variation in pod yield was insignificant (Table 4). Among the sowing dates and fertilizer treatment interactions, S_2T_2 produced the highest pod yield (14.30) followed by S_1T_2 and S_1T_0 (Table 5).The present observation was in full agreement with that of Srinivas and Naik (1988), Costigan (1987) and Chandra (1987) who

reported increased pod yield of French bean with increasing fertilizer doses. Pandey *et al.* (1978) stated the pod yield of French bean increased mainly due to higher pod number per plant and pod weight per plant. Pod yield was positively correlated with green-shell yield at different sowing dates (Beaver and Roman-Hernandez, 1994).Among the fertilizer treatment, T_2 produced the highest seed yield (9.08) followed by T_1 and T_0 (Table 1). Among the varieties, V_1 produced the highest seed yield (7.19 qha^{-1}) and V_2 produced the lowest (6.98 q ha^{-1}) seed yield (Table 2). Among the sowing dates, S_1 produced the highest seed yield (7.54 q ha^{-1}) followed by S_1 (6.57 q ha^{-1}) (Table 3). Among the sowing dates and varieties interactions, they were found insignificant (Table 4). Among the sowing dates and fertilizer treatments interactions, S_2T_2 produced the highest seed yield (9.47 q ha^{-1}) followed by S_2T_1 and S_1T_0 (Table 5).In the present observation, it was in full agreement with that of Cardoso *et al.* (1978) who reported seed yield of French bean showed a positive linear response to nitrogen. Seed yield of French bean increased significantly by potassium fertilizer application (El-leboudi *et al.* 1994). Different seed yield were achieved with different fertilizer treatments in French bean such as 20.7 q ha^{-1} with 80:90:30 NPK/ha with 120:60:90 NPK/ha (Gonzalez *et al*, 1983). Vyas *et al.* (1994) and Chages *et al.*(1982) stated that seed yield varies with sowing dates. Seed yield was observed to be higher in French bean sown at the end of October in compared to that sown in other dates (Ali and Kushwaha, 1987). In the present experiment, it was revealed that S_3 (February) was not suitable for sowing time of French bean.

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