http://www.pjbs.org

PJBS

ISSN 1028-8880

# Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 6 (22): 1902-1906, 2003
ISSN 1028-8880


# Morphological and Reproductive Attributes in French Bean (*Phaseolus vulgaris*) as Influenced by Sowing Time and Fertilizer Treatments

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 Govt. 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 time and fertilizer treatments with two varieties of French bean under the agroclimatic conditions of Mymensingh, Bangladesh. Fertilizer treatments had significantly different effects on plant height, leaf number, leaf length and breath, days required for maximum flowering, number of flowers per plant and number of pods per plant. The interaction of sowing dates and varieties, had significant effects on the above characters except plant height. The best morphological and reproductive attributes performance were observed in January sowing and highest fertilizer treatments combination.

**Key words:** Sowing time, fertilizer, morphological and reproductive attributes, french bean (*Phaseolus vulgaris*)

## INTRODUCTION

*Phaseolus vulgaris* L. is a member of the family Leguminosae and sub-family Papoilionacae. It is an annual harbaceous plant with errect stem and trifoliate leaves. The plant has terminal raceme and subtending axillary bisexual flowers. It's corolla are white, pink or yellow in colour. It has ten stamens, with small globuse anthers. The gynoecium is single with multi-ovuled ovary. The flowers are normally self fertilized developing into straight or slightly curved fruits (the pods). Nutrient requirements for different cultivars usually similar except on poor soils (Adams, M.W. 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 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 morphological and reproductive attributes 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 plots 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 43.8x33m equaled to 0.357 acre. The size of an individual experimental unit or plot was 4x2.4 m. 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 superphosphate 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 1 and 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 pod length, number of seeds/pod, weight of fresh pods/plant, weight of dry seeds/pod, moisture content of pod (percentage) and yield of pod and seed $qha^{-1}$ were recorded. Finally, collected data were analyzed by Duncan's Multiple Range Test (DMRT).

## RESULTS AND DISCUSSION

In case of fertilizer treatments, $T_2$ produced the tallest plants (21.76 cm) and $T_0$ the shortest one (15.10 cm) (Table 1). Among varieties, the variation was insignificant (Table 2). Among sowing dates, $S_1$ produced the tallest plants (22.30 cm), followed by $S_2$ (21.87 cm) and shortest in $S_3$ (12.80 cm) (Table 3). Interactions among sowing dates and varieties $S_1V_1$ produced the tallest plants (25.20 cm) and $S_1V_2$, $S_2V_2$ varied insignificantly between themselves (Table 4). The shortest plants were produced by $S_3V_2$ but $S_3V_1$ and $S_3V_2$ varied insignificantly between themselves. Interaction among sowing dates and fertilizer treatments $S_2T_2$ produced the tallest plant (26.04 cm) followed by $S_1T_2$ (25.65 cm) and $S_3T_2$, $S_3T_1$ varied insignificantly between themselves but produced the shortest plants (12.20 cm and 12.62 cm, respectively) (Table 5). The present observation is in full agreement with that of Chaib *et al.* (1984) who reported increased plant height with increasing fertilizer treatment in *Phaseolus vulgaris* L. Similar trend in height increment with nitrogen and phosphorus treatments were also observed by Srinivas and Naik (1988). The plant height might have varied due to the effect of low temperature prevailing in during the sowing time. Considering leaves, $T_2$ produced the highest number of leaves (23.87), $T_1$ (22.20), $T_0$ (14.20). Among the sowing dates, $S_1$ and $S_2$ varied insignificantly between themselves while $S_3$

Table 1: Morphological and reproductive attributes of French bean as influenced by d fertilizer treatments

| Treatments | Plant height (cm) | No. of leaves | Leaf size | | Days required for maximum flowering | No. of flowers per plant | No. of pods per plant |
|---|---|---|---|---|---|---|---|
| | | | Leaf length | Leaf breadth | | | |
| $T_0$ | 15.10c | 14.20c | 5.72b | 4.02b | 47.23a | 10.36c | 9.75e |
| $T_1$ | 21.12b | 22.20b | 7.52a | 4.93a | 47.00a | 13.73b | 13.17b |
| $T_2$ | 21.76a | 23.87a | 7.84a | 4.98a | 46.71b | 15.50a | 14.89a |

Table 2: Morphological and reproductive attributes of French bean as influenced by variety

| Variety | Plant height (cm) | No. of leaves | Leaf size | | Days required for maximum flowering | No. of flowers per plant | No. of pods per plant |
|---|---|---|---|---|---|---|---|
| | | | Leaf length | Leaf breadth | | | |
| $V_1$ | 20.07 | 20.13 | 6.97 | 4.57 | 46.87 | 12.61 | 12.67 |
| $V_2$ | 18.58 | 20.04 | 7.08 | 4.71 | 46.99 | 12.22 | 12.58 |

Table 3: Morphological and reproductive attributes of French bean as influenced by sowing dates

| Sowing date | Plant height (cm) | No. of leaves | Leaf size | | Days required for maximum flowering | No. of flowers per plant | No. of pods per plant |
|---|---|---|---|---|---|---|---|
| | | | Leaf length | Leaf breadth | | | |
| $S_1$ | 22.30a | 21.85 | 7.15a | 4.84a | 46.36b | 12.85b | 12.12b |
| $S_2$ | 21.87b | 21.74a | 7.09a | 4.63ab | 47.61a | 13.55a | 13.04a |
| $S_3$ | 12.80c | 16.68c | 6.84b | 4.47b | - | - | - |

Table 4: Morphological and reproductive attributes of French bean as influenced by sowing dates and variety

| Variety x sowing date | Plant height (cm) | No. of leaves | Leaf size | | Days required for maximum flowering | No. of flowers per plant | No. of pods per plant |
|---|---|---|---|---|---|---|---|
| | | | Leaf length | Leaf breadth | | | |
| $S_1V_1$ | 25.20a | 21.90 | 7.16 | 4.73 | 46.38 | 12.90 | 12.17 |
| $S_1V_2$ | 21.41a | 21.79 | 7.13 | 4.95 | 46.34 | 12.76 | 12.08 |
| $S_2V_1$ | 22.13b | 21.78 | 7.07 | 4.48 | 47.56 | 12.53 | 13.05 |
| $S_2V2$ | 21.61bc | 21.70 | 7.11 | 4.77 | 47.65 | 13.61 | 13.03 |
| $S_3V_1$ | 12.89d | 16.72 | 6.69 | 4.51 | - | - | - |
| $S_3V_2$ | 12.70d | 16.64 | 6.99 | 4.43 | - | - | - |

Table 5: Morphological and reproductive attributes of French bean as influenced by sowing dates and fertilizer treatments

| Sowing dates x fertilizer treatments | Plant height (cm) | No. of leaves | Leaf size | | Days required for maximum flowering | No. of flowers per plant | No. of pods per plant |
|---|---|---|---|---|---|---|---|
| | | | Leaf length | Leaf breadth | | | |
| $S_1T_0$ | 19.15c | 14.11d | 5.45c | 4.05c | 47.89a | 9.65d | 9.01c |
| $S_1T_1$ | 25.12b | 24.48b | 7.87ab | 5.25a | 47.21b | 13.63b | 12.97e |
| $S_1T_2$ | 25.65ab | 26.95a | 8.12a | 5.21a | 46.22d | 15.28a | 14.39b |
| $S_2T_0$ | 13.96d | 14.12d | 5.78c | 4.01c | 47.72a | 11.08c | 10.48d |
| $S_2T_1$ | 25.62ab | 24.35b | 7.61ab | 4.87ab | 46.58c | 13.84b | 13.38c |
| $S_2T_2$ | 26.04a | 26.75a | 7.88ab | 4.99a | 46.22d | 15.73a | 15.26a |
| $S_3T_0$ | 12.20e | 14.38d | 5.92c | 4.00c | - | - | - |
| $S_3T_1$ | 12.62e | 17.75c | 7.07b | 4.67b | - | - | - |
| $S_3T_2$ | 13.59d | 17.91c | 7.53ab | 4.73ab | - | - | - |

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

produced the lowest number of leaves per plant (16.68). Both the varieties, $V_1$ and $V_2$ did not produce any significant number of leaves per plant. Interactions, between sowing dates and varieties, they did not produce any significant variation in producing the number of leaves per plant. Interactions between sowing dates and fertilizer treatments, $S_1T_2$ and $S_2T_2$ varied insignificantly between themselves but produced the highest number of leaves (26.95) followed by $S_1T_1$ (24.48). The least number of leaves were produced by both the $S_1T_0$ and $S_3T_0$ treatments. The present observation is in full agreement with that of Meyer *et al.* (1964) who reported growth in a tissue that requires a constant supply of carbohydrate and nitrogenous food materials. This has been demonstrated in this study that the number of leaves was increased only with increasing supply of nutrient. In case of leaf length and breath, both the $T_2$ and $T_1$ fertilizer treatments produced the maximum leaf length (7.84, 7.52) and leaf breath (4.98, 4.93), respectively, while $T_0$ produced the minimum leaf length (5.72) and leaf breadth (4.02). Both the varieties $V_1$ and $V_2$ did not produce any significant variation in leaf length and leaf breadth. Larger leaf length were attained by both the $S_1$ and $S_2$ treatments (7.15) and (7.09), respectively followed by $S_3$ (6.84). $S_1$ also produced larger leaf breadth followed by $S_2$ (4.63) while $S_3$ gave the lowest leaf breadth (4.47). As regards interactions among sowing dates and fertilizer treatments, $S_1T_2$ produced the highest leaf length (8.12), $S_2T_2$, $S_1T_1$

and $S_2T_2$ produced the second highest leaf length and they did not produce significant variations among themselves. Minimum leaf length were found in $S_3T_0$, $S_2T_0$ and $S_1T_0$. Highest leaf breadth were obtained by $S_1T_1$, $S_1T_2$ and $S_2T_2$ followed by $S_2T_1$ and $S_3T_2$. Least leaf breadth were attained by $S_1T_0$ and $S_3T_0$. From the Table (Table 1 and column 6) it was found that the treatment $T_0$ and $T_1$ produced maximum number of flowers (47.23) and (47.00), respectively, while the $T_2$ produced the least. Varieties $V_1$ and $V_2$ were found insignificant. Among sowing dates, $S_2$ and $S_1$ gave maximum flower at 13.55 and 12.85 days after sowing, while $S_3$ failed to anthesis any bud. Interaction between varieties and sowing dates, produced no significant variation in days required for maximum flowering. Interactions between sowing date and fertilizer treatments varied insignificantly but anthesized maximum flower at 47.98 and 47.72 DAS. $S_3T_0$, $S_3T_1$, $S_3T_2$ failed to anthesize any flower. The present observation was in full agreement with that of Graham (1979) who reported the French bean plants did not flower at 35-25°C but flowered at day-night temperature of 25-15°C. The variation of flowering might be due to variations in temperature due to aspect of sowing dates. The $S_1$ (December) and $S_2$ (January) shown plants flowered at 25-28°C and $S_3$ (February) sown plants flowered was anthesized.

Among the fertilizer treatments, $T_1$ produced the maximum number of flowers per plant (15.50) followed by $T_1$ (13.73) and $T_0$ (10.36). Variety $V_1$ and $V_2$ did not vary significantly. The highest number of flowers per plant (13.55) showed the $S_2$ sowing date followed by $S_1$ (12.85) per plant. $S_3$ failed to anthesis any flower. Interactions between the sowing dates and varieties were statistically insignificant. However both the varieties failed to flower at $S_3$ sowing dates. The interactions between sowing dates and fertilizer treatments, $S_2T_2$ and $S_1T_2$ varied insignificantly between themselves but produced the maximum number of flowers 15.73 and 15.28 flowers per plant, respectively. The $S_2T_1$ and $S_1T_1$ produced the second highest number of flowers per plant while the $S_3T_0$, $S_3T_1$, $S_3T_2$ produced no flower. Graham (1979) reported that French bean did not flower at day/night temperature of 35/25°C but flowered at 25/15°C. For this observation it could be noted that temperature was an important factor for flowering. $S_3$ (February) sown plants were grown at 15-29°C. At flowering stage (March), the temperature was 19-33°C. Therefore, a few flower was initiated but no flower was anthesized. The flowers were withered and dried. So, February sown plants had no record of the number of flowers per plant. Among the fertilizer treatments, $T_2$ produced the maximum number of pods per plant (14.89) followed by $T_1$ and $T_0$. Both the varieties did not produced the any significant variation with respect to pots per plant. $S_2$ sowing date produced the maximum number of pods per plant (13.04) followed by $S_1$(12.12). Among the varieties and sowing dates interactions, they were found to be statistically insignificant. Among the sowing dates and fertilizer treatments interactions, $S_2T_2$ produced the maximum number of pods per plant followed by $S_1T_2$, $S_2T_1$ and $S_2T_0$. There had been no difference with the interaction $S_3T_0$, $S_3T_1$ and $S_3T_2$.The present observation was in full agreement with that of Sa *et al.* (1982) and edge *et al.* (1975) who reported significant differences in pod number per plant with fertilizer treatment. Abdalla and Fischbeak (1978) stated that the pod set of French bean was poor at day/night temperature of 30/25°C. From the above observation it was obvious that due to high temperature $S_3$ (February) sown plants failed to produce any pod.

## REFERENCES


Adams, M.W., 1984. Beans-Cowpea: 'Production constraints and national programs' -Bean-Cowpea Collaborative Research Program, Michigan State University, East Lansing, Michigan.

Abdalla, M.M.F. and G. Fischbeck, 1978. Growth and fertility of five stocks of field beans *Phaseolous vulgaris* L. grown under three temperature regimens and the effect of natural water stress on seed index of a collection of *Vicia faba* L. Zeitschrift fur Ackerund pflanzenbau. 147: 81-91.

Apel, P., 1988. Phenological studes at different temperatures in collection of *Phaseolus vulgaris* L. Kulturpfiance. 36: 331-341.

Chages, J.M., C. Nieira and G.F. Bartholo, 1982. Performances of bean varieties at three planting dates in winter. Centro Nacional de Pesquisa Arroz Feijao, pp: 127-129.

Chaib, S.L., E.A. Bulisami and L.H.S.M. Castro, 1984. Growth and yield of beans as affected by depth of phosphate fertilizer application. Pesquisa Agropecudria Brasileira. pp: 817-822.

Chandra, R., C.B.S. Rajput, K.P. Singh and S.J.P. Singh, 1987. A note on the effect of nitrogen phosphorus and *Rhizobium* culture of the growth and yield of French bean (*Phaseolus vulgaris* L.) cv. contender. Haryana J. Hort. Sci., 16: 146-147.

Edge, O.T., L.K. Mughogho and U.W.U. Ayonoadu, 1975. Bean yield and yield components as affected by fertilizer and plant population. Turrialba., 25: 79-84.

Gonzalez, A., J.DE. Guzman, V. Marrero and O. Rodriguez, 1983. The influence of fertilizer applications of N, $P_2O_5$, $K_2O$ on the yield of beans (*Phaseolus vulgaris* L) cv. ICA-Pijao on sandy alluvial soil. Ciencia Y tecnica en la Agricultura.

Graham, P.H., 1979. Influence of temperature on growth and nitrogen fixation of cultivars of (*Phaseolus vulgaris* L.), inoculated with Rhizobium. J. Agric. Sci., 93: 365-3370.

Hara, C., B. Popescu, G. Burlacu, M. Petre, A. Idriceanu, A. Stanciu, M. Bologa and E. Timirgaziu, 1985. Some aspects of nitrogen and phosphorus nutrition of *Phaseolus vulgaris* L. Analele Institutului de Cercetari pentru Cercale si Plante Tehnice Fundulea, 52: 163-181.

Iglesias, M. Iraneta and L. Perez, 1984. Influence of sowing date on bean cultivation. Ciencia Y Tecnica en la Agricultura. 3: 59-67.

Lima, A.De.A., A.A. Cardoso, C. Veira, B.V. Defehico and A.R. Conde, 1983. Response of bean *Phaseolus vulgaris* L. cultivars to spacing and fertilizer rates. Revista Ceres, 30: 245-248.

Meyer, B.S., B.D. Enderson and R.H. Bohoming, 1964. Introduction of Plant Physiology. Van Nostrand Company Incorporation London. pp: 400-453.

Perez, A.A., 1979. Fertilization of beans in the central part of the valle del cibao. Proceedings of the carib bean. Food Crop Soc., 16: 369-379.

Sa, M.E., S.De. Buzetti, S. Morello and N.D. Deziderio, 1982. Effects of plant density and phosphate fertilizer on bean production. Centro Nacional de Pesquisa Arroz Feijao, pp: 101-103.

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

Vyas, J.S., K.S. Autkar and K.B. Wanjari, 1994. Effect of sowing dates on French bean in nontraditional area of Maharashtra. Ann. Plant. Physol., 4: 29-35.