PERFORMANCE OF FRENCH BEAN CULTIVARS AS INFLUENCED BY MANURES

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CERTIFICATE

This is to certify that thesis entitled, "***PERFORMANCE OF FRENCH BEAN CULTIVARS AS INFLUENCED BY MANURES"*** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of ***MASTER OF SCIENCE IN HORTICULTURE,*** embodies the result of a piece of *bona fide* research work carried out by ***SHAHANA SULTANA ,*** Registratrion No. **07-02237** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Dated: June, **2014**
Place: Dhaka, Bangladesh

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ABSTRACT

An experiment was carried out at the Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka during the period from November, 2012 to February, 2013 to study the effects of different organic manure on the growth and yield of French bean. The experiment consisted of 4 levels of organic manure, viz. F_0: Control; F_1: Cowdung (12 t/ha); F_2: Vermicompost (9 t/ha); F_3: Poultry manure (11 t/ha) and two cultivars of French bean viz, V_1: BARI French bean 1; V_2: BARI French bean 2. The experiment was laid out in Randomized Complete Block Design with three replication. The organic manure had significant effect on the plant height, number of branch, leaf size, number of flower, number of pod per plant and pod yield per hectare. The highest (10.62 t/ha) yield of French bean was observed in F_3 and the lowest (9.61 t/ha) was obtained from F_1. On the other hand, the highest (11.75 t/ha) yield was from V_2 and lowest (10.01t/ha) from V_1.The results indicated that, the better results were obtained from BARI French bean 2 when combined with poultry manure.

CONTENT

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

AEZ	=	Agro Ecological Zone
BARC	=	Bangladesh Agricultural Research Council
BARI	=	Bangladesh Agricultural Research Institute
BAU	=	Bangladesh Agricultural University
BBS	=	Bangladesh Bureau of Statistics
CV	=	Coefficient of Variation
DAS	=	Days After Sowing
EC	=	Emulsifiable Concentration
FAO	=	Food and Agriculture Organization of the United Nations
g	=	Gram
Kg/ha	=	Kilogram per hectare
LSD	=	Least Significant Difference
Max.	=	Maximum
Min.	=	Minimum
MOP	=	Muriate of Potash
NS	=	Non-significant
No.	=	Number
RCBD	=	Randomized Complete Block Design
RH	=	Relative Humidity
SAU	=	Sher-e-Bangla Agricultural University
t/ha	=	Ton per hectare
TSP	=	Triple Super Phosphate

CHAPTER I

INTRODUCTION

French bean *(Phaseolus vulgaris*) is an important vegetable crop belonging to the family *Leguminosae* and sub family *Papilionaceae* has been reported to be a native of Central and South America (Swiader *et al.,* 1992). It is also known as bush bean, kidney bean, snap bean, raj bean, common bean, basic bean, navy bean, haricot bean, pole bean, wax bean, string bean and bonchi (Salunkhe *et al*., 1987). In our country it is known as "Farashi Sheem" (Rashid, 1993). The green pods and mature seeds are used as cooked vegetable in our country. Seeds are also used as pulse in Sylhet, Moulvibazar, Sonamgonj, Habigonj, Brahmmanbaria, Feni, Coxs bazar, Chittagonj etc.

It is widely cultivated in many parts of the tropical, subtropical and throughout the temperate regions (Pursglove, 1987). But it is more suitable as a winter (rabi) crop in the northern eastern plain of India (AICPIP, 1987). According to the FAO statistics, French bean including other related species of the genus *Phaseolus* occupied 32.08 million hectares of the world cropped area and the production of pods was about 23,139,004 tons (FAO, 2013).

Brazil is the largest French bean producing country in the world. In Bangladesh there is no statistics about the area and production of this crop. 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 limited scale. Recently Hortex Foundations and BRAC are trying to extend the production area because French bean is now exportable vegetable among others. Bangladesh presently earns about US$ 15 million per annum be exporting fresh horticultural produces, French bean share a big portion.

Immature green pods are marketed fresh, frozen or canned. The dry

seeds also have a good market demand. Foliage of the crop may also provide lay, silage and green markets. After harvest plants can be fed to cattle, sheep and horses. Its edible pods supply protein, carbohydrate, fat, fiber, thiamin, riboflavin, calcium and iron (Shanmugavelu, 1989) and the seed contains significant amount of thiamin, niacin, folic acid as well as fiber (Rashid, 1993). Recently cultivation of French bean is gaining popularity in Bangladesh mainly because of its demand as a commodity for export. Hortex foundation exported 330 metric tons of fresh French bean during the year 2012-2013 (Anonymous, 2013).

In Bangladesh, French bean is cultivated in Sylhet, Cox's Bazar, Chittagong Hill Tracts and some other parts of the country during the winter season in limited scale. Although the crop is not extensively grown in Bangladesh, it has a great export potentiality. The Hortex Foundation facilitated the export of 23.86 tons of green French bean during July-December, 2001 (Anonymous, 2001).

There are two types of supplies for agriculture, specifically fertilizer and pesticides. It can be said that the fertilizer is food and pesticide is medicine for plants in conventional agriculture. Soil fertility is diminishing gradually due to the erosion, loss of nutrients, accumulation of salts and other toxic elements and unbalanced nutrients compensation. Many efforts are being exercised to combat the adverse consequences of chemical farming (Faheed *et al*., 2008). During the last decades French bean is becoming increasingly important as a cash bean, common bean or French bean is an important legume for human nutrition and a major protein and calorie source in the world. Bean requires nitrogen in quite high amount in the first stage of development for the emergence of the nodules and builds up of the symbiotic nitrogen

fixation. The amount of nitrogen which symbiotically bound depends on the kind of plant, the efficiency of the bacteria inoculated and soil properties (Baldric and Yilmaz, 2005).

Research on the growth and yield of French bean influenced by variety and organic fertilizer is very limited. The yield of French bean may be increased through judicious combination of cultivars and organic manure application. Considering all above the factors, the present study was undertaken with the following objectives:

1. to investigate the effect of organic manure for higher yield of green pods of French bean;
2. to study the effect of cultivars on yield and yield contributing characters of French bean;
3. to select the suitable combination of cultivar and organic manure for higher production of French bean.

CHAPTER II

REVIEW OF LITERATURE

French Bean (*Phaseolus vulgaris* L.) is a popular vegetable crop of the world. Many research work have been done in different parts of the world to study the effect of organic manure and varieties on the growth and yield of French bean. But in Bangladesh available literature regarding effect of organic manure and variety is insufficient. However, some of the literatures relevant to the effect of organic manure and variety on French bean production are reviewed in this chapter.

Lima *et al*. (1983) reported that dwarf cultivars of French bean is generally sown in 60×20 cm spacing. Spacing had little effect on yield except during the wet season when yields were significantly higher at wider spacing with no fertilizers.

Abbound and Duque (1986) conducted a field experiment to find out the effects of application of organic matter and vermiculite in a French bean- maize production. They found that seed yield of the crop was increased by incorporation of organic matter.

The Shakers Gardener's Manual (1996) clearly illustrates the planting techniques for both the bush and climbing legume varieties. The bush or dwarf bean may be sown in drills, 20 inches apart, 2 inches deep, 2 inches apart, and 6 inches apart in the row. The running or pole bean should be planted in hills, three and a half feet distant each way. We prefer setting the poles before planting, then dig and loosen the earth, and drop five or six beans in a circle around the pole, about 3 inches from it, and cover with mellow dirt (Buchanan 72).

Adetunji (1990) have reported similar findings in beans cultivated with organic manures. Specific leaf weight showed decreasing pattern by increasing the amounts of vermicompost and application of organic mulch. The finding clearly shows that optimum dose of vermicompost and organic mulching play an important role towards partitioning of photo assimilates from vegetative source to reproductive sink (leaf to green pod) which will ultimately lead to development of yield attributes.

Duffus and Slaughter (1980) indicated that bush legume varieties reach a height of about 20-60 cm tall and contain anywhere from 4-8 nodes, while climbing varieties typically reach a height of 2-3 m tall and contain between 11-30 longer nodes.

Chaib *et al.* (1984) reported that fertilizer placement at 10.25 cm depth has promoted growth and development of root or shoot of French Bean.

Amanullah *et al*. (2007) indicated that application of organic manure yielded higher uptake of NPK than the control. The study also revealed that uptake of nutrient was higher with Composted Poultry Manure. The added organic manure not only acted as a source of nutrient might have influenced their availability.

Alves *et al.* (2000) conducted a field experiment in Brazil to investigate the French bean seed production according to levels and sources of organic matter. They applied 0-20 ton cattle or goat manure, 0-20 ton chicken manure or earthworm humus/ha and they observed that maximum seed production was obtained with 20 ton cattle manure ha^{-1}. They also reported that cattle manure or cowdung was the most economically viable source of fertilizer.

Alves *et al.* (1999) conducted a field experiment in Brazil to determine the effect of productivity evaluation and seed quality of French bean cultivated with organic matter. They considered of 4 organic amendments applied 5 levels (0, 5, 10, 15 and 20 ton ha^{-1} of earthworm or chicken manure and 0, 10, 20, 30 and 40 ton ha^{-1} of bovine or poultry manure). They found that the maximum production was obtained with 30 ton ha^{-1} poultry manure when applied.

Vishwakarma *et al.* (2002) conducted a field experiment in Varanasi, Uttar Pradesh, India, during 1996-97 and 1997-98 to determine the response of two French bean cultivars (Holland 84 and PDR 14) to different application rates (0, 30, 60, 90 Kg/ha) of nitrogen. Holland 84 was tallest, whereas 'PDR 14' recorded the highest dry matter production per plant as well as pods per plant, grains per pod, grains per plant, pod length and 100 grain weight. The growth and yield attributes and yield increased with increasing rate of nitrogen up to 90 kg/ha.

Ibeawuchi *et al*. (2006) reported that in a degraded soil of Nigeria, poultry manure application increased the residual soil N, K, Ca, Mg and organic matter. The high organic matter with increase in other soil chemical components is an indication that poultry manure has high potential of gradual nutrient release to the soil that can help to improve the fertility of a degraded soil thereby sustaining yield in a continuous cropping system.

Mullens *et al*. (2002) revealed that poultry litter contains a considerable amount of organic matter due to the manure and the bedding material. Litter can also have an impact on soil pH and liming due to varying amounts of calcium carbonate in poultry feed. Poultry manure improved soil physical properties significantly by reducing soil bulk density and temperature.

Raffi *et al.* (2004) carried out a field experiment in Mymensingh to evaluate the stability analysis for pod and seed production in French bean. They conducted an experiment with 9 genotypes and 4 environments under different rates of chemical fertilizers and common dose (10 ton ha^{-1}) of cowdung manure. They observed that there were significant variations due to genotype, environment and genotype × environment interaction for the characters studied, which were also highly correlated among themselves.

Santos *et al.* (2001) conducted an experiment to evaluate the effect of levels and sources of organic matter on French bean in Brazil. Treatments comprised 4 sources of organic matter, such as, poultry manure or cowdung (0, 5, 10, 15 and 20 ton ha^{-1}), cattle manure, goat manure and earthworm compost (0, 10, 20, 30 and 40 ton ha^{-1}). They found that pod length increased linearly with the levels of poultry, cattle and got manure, but the average weight of pod only by poultry manure or cowdung. They also found that pod yield was the highest when poultry manure or cowdung was applied at the rate of 20 ton ha^{-1}.

Singer *et al.* (1999) conducted an experiment in Egypt to study the effects of delta mix and organic matter on growth and productivity of French bean plants. They applied different doses of delta mix and organic matter at 10 and 20 ton ha^{-1} and NPK fertilizers were applied at different doses. They found that plant height, number of leaves and number of shoots were significantly affected by the different rates of delta mix and different levels of organic matter and chemical fertilizers.

Taylor and Cormack (2002) reported that the most important considerations for organic growers in the choice of field bean varieties are straw height, earliness of ripening, disease resistance and yield. As in other organic crops, yield was more influenced by growing conditions than by variety and organic growers should select for agronomic characteristics before yield.

In an experiment with French bean, Yadav and Vijayakumari (2003) found that the maximum overall growth and yield recorded from the vermicompost treatment and admixed with FYM were found consistent with the findings.

Zamil *et al*. (2004) found the highest mustard seed yield (8.68 g pot^{-1}) was obtained in cage system poultry manure at 20 ton ha^{-1} which was statistically similar to chemical fertilizer (8.49 g pot^{-1}). The lowest seed yield was obtained from the control. Cage system poultry manure showed better performance in producing seed yield.

From the above mentioned literature, it can be concluded that effect of cultivars and organic manure have significant effect on growth and yield of French bean. It was also observed that pod yield increases with the use of organic manures. On the basis of above mentioned facts the expectable view may be designed to know the effect of cultivars and organic manure on yield and yield contributing characters of French bean.

CHAPTER III

MATERIALS AND METHODS

In this chapter a short description of the location of the experimental plot, climatic condition of the area where the plot was situated, materials used for experimental treatments, design of the experiment, method of cultivation, method of data collection, statistical analysis have been presented.

3.1 Experimental site

The research work was conducted at the Horticulture farm of Sher-e-Bangla Agricultural University, Dhaka-1207 to study the effect of organic manure and variety on the yield contributing characters and yield of French bean during the period from November 2012 to March 2013. Experimental field was located at 90°22′ E longitude and 23°41′ N latitude and altitude of 8.2 m above the sea level.

3.2 Climate

Experimental area belongs to subtropical climatic zone which is characterized by heavy rainfall, high temperature and relatively long day period during "Kharif-1" season (April-September) and scarce rainfall, low humidity, low temperature and short day period during "Rabi" season (October-March). This climate is also characterized by distinct season, viz. the monsoon extending from May to October, the winter or dry season from November to February and per-monsoon period or hot season from March to April (Edris *et al*., 1979). The meteorological data in respect of temperature, rainfall, relative humidity, average sunshine and soil temperature for the entire experimental period have been shown in Appendix I & II.

3.3 Characteristics of soil

The soil of the experimental area belongs to the Modhupur Tract in Agroecological Zone (AEZ)-28 (UNDP, 1988). It was medium high land and

the soil series was Tejgaon (FAO, 1988). The soil was having a texture of sandy loam with pH and CEC were 5.6 and 2.64 meq/100 g soil, respectively. The characteristics of the soil under the experimental plot were analyzed in the Soil Testing laboratory, SRDI, Khamarbari, Dhaka and details of the recorded soil characteristics were presented in Appendix II.

3.4 Planting materials

The varieties of French bean used in the present experiment was BARI French bean. The seeds were collected from the Horticulture Research Center (HRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur.

3.5 Treatments of the experiment

The experiment involved two factors as follows:

Factor A : Organic Fertilizers

It consisted of four levels as follows:

(i) F_0 : Control
(ii) F_1: Cowdung (12 t/ha)
(iii) F_2: Vermicompost (9 t/ha)
(iv) F_3: Poultry Manure (11 t/ha)

Factor B : Varieties

It consisted of two levels as follows:

(i) V_1: BARI French bean 1
(ii) V_2 : BARI French bean 2

There were 8 (4×2) treatment combinations given below:

V_1F_0, V_1F_1, V_1F_2, V_1F_3, V_2F_0, V_2F_1, V_2F_2, V_2F_3.

3.6 Design and layout of the experiment

The two factor experiment was laid out in the randomized complete block design (RCBD) with three replications. There were 8 treatment combinations.

In total 24 plots for 3 replications. Each block consisted of 8 unit plots. The size of each unit plot was (2 m x1.5 m) or 3 m^2. The distance maintained between two replications and two plots were 1 m and 0.5 m, respectively. The layout of the experiment is shown in Figure 1.

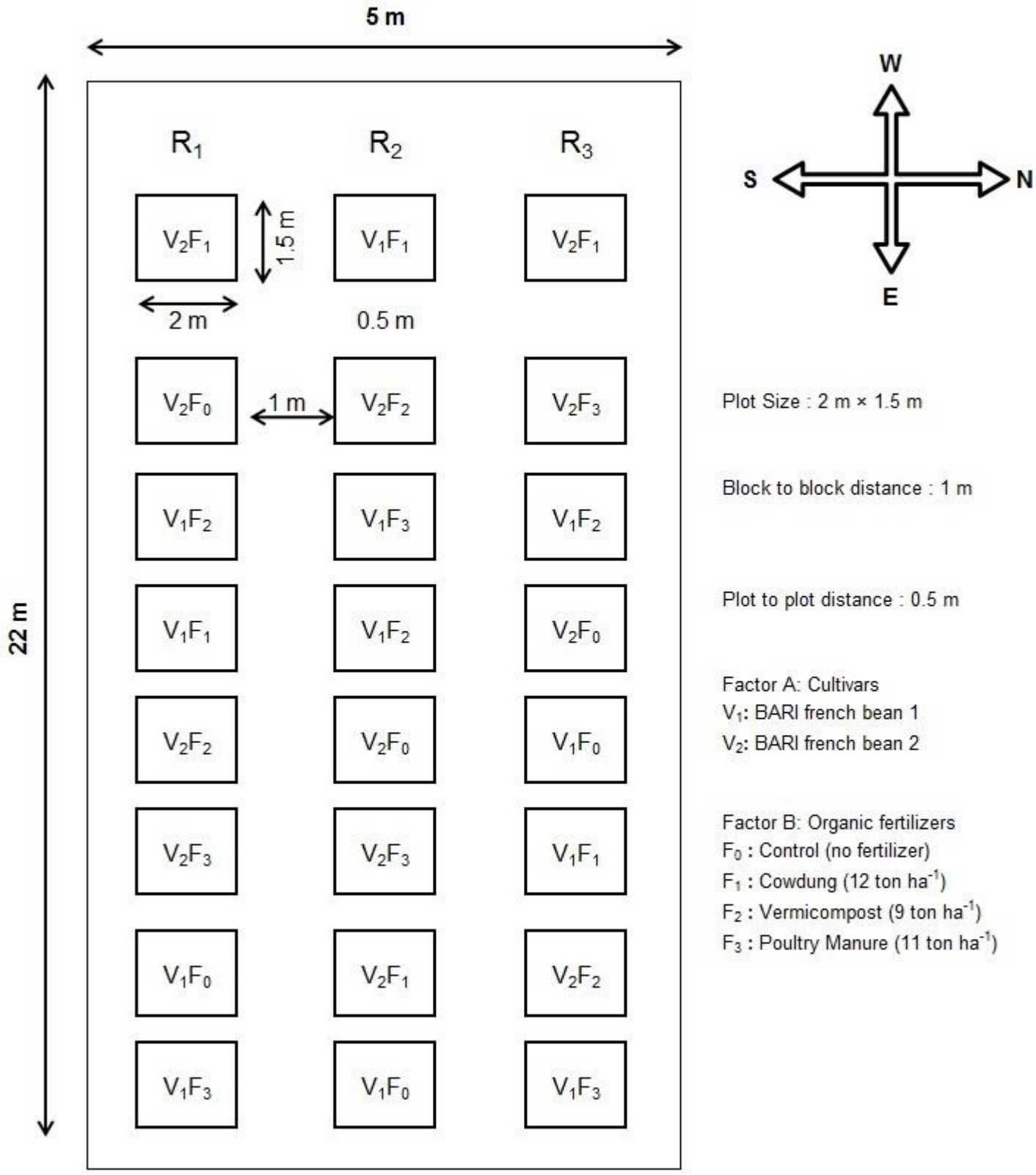

Figure-1. Layout of experimental field

3.7 Land preparation

The experimental area was first ploughed by a power tiller and the soil was exposed to sun for 5 days. Then the land was thoroughly prepared by ploughing and cross ploughing. The weeds and stubbles were removed from the field. Then the land was divided into 24 unit plots keeping plot and block to block spacing. During land preparation, carbofuran @ 16 kg ha^{-1} was mixed with the soil uniformly for controlling soil borne insects.

3.8 Manure application

All the cowdung, vermicompost and poultry manure were incorporated into the soil during final land preparation.

3.9 Sowing of seeds

Two seeds were sown per hill at a depth of 3.0 cm on 19 November, 2012 in the row, plant to plant distance was 15 cm and row to row distance was 30 cm. The seeds were covered with pulverized soil just after sowing and gently pressed with hands. Surrounding of the experimental plots, French been seeds were also sown as border crop to reduce border effects.

3.10 Intercultural operation

3.10.1 Gap filling

During seed sowing, few seeds were sown in the border of the plots. Seedlings were transferred to fill up the gap where seeds failed to germinate. Seedlings about 15 cm height were transplanted from border rows with roots plunged 5 cm below the soil in hills in the evening and watering was done to protect the seedlings from wilting. All gaps were filled up within two weeks after germination of seeds.

3.10.2 Thinning

When the plants established, one healthy plant per hill was kept and remaining one was plucked.

3.10.3 Weeding and mulching

Weeding and mulching were done whenever it was necessary to keep the plots free from weeds and to pulverize the soil.

3.11 Plant protection

3.11.1 Insect pests

At the early stage of growth, some plants were attacked by insect's pests (mainly aphid) and Malathion 57 EC was sprayed twice at the rate of 2 ml /liter at an interval of 10 days.

3.11.2 Diseases

Seedlings were attacked by damping off and Dithane M-45 was sprayed twice 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 an important disease of French bean. These plants were removed from the plots and destroyed and also Admire 20 SL sprayed twice at the rate of 1ml liter^{-1} at 10 days interval.

3.11.3 Harvesting

Immature green pods were harvested at tender stage through hand picking and weighed to estimate the yield of fresh pod. At harvest, pods were nearby full size, with the seeds still small (about one quarter developed) with firm flesh (Swiader *et al*., 1992) and the pods were soft and smooth.

3.12 Collection of data

Five representative plants were selected at random from each of unit plot to avoid border effect and tagged in the field. Data were recorded periodically from the sample plants at 15 days interval. The details of data recording are given below:

3.12.1 Plant height

Plant height was considered as the height from ground level to the tip of largest leaf of the plants. The plant height was recorded at 15, 30, and 45 days after sowing (DAS). Plant height of five randomly sampled plants were recorded and mean was calculated in centimeter (cm).

3.12.2 Number of compound leaves per plant

The number of leaves of five randomly selected plants was counted from each unit plot at 15 days interval from 15 to 45 DAS and means were calculated.

3.12.3 Leaf size

The length and breadth of full grown selected leaves were measured by using a measuring scale.

3.12.4 Number of branches per plant

The number of branches of five randomly selected plants from each plot at final harvest was recorded.

3.12.5 Number of flowers per plant

From five randomly selected plants per unit plot, the number of flowers were counted and their mean values were found out.

3.12.6 Number of pods per plant

Number of pods from five randomly selected plants were counted and their mean values were calculated.

3.12.7 Length of green pod

Ten pods were randomly selected from green pods and measured using a centimeter scale, and the mean value was calculated and expressed in centimeter.

3.12.8 Diameter of green pod

Diameter of green pods from ten randomly selected green pods and measured in cm with the help of a slide calipers and the average was taken and expressed in cm.

3.12.9 Number of seeds per green pod

Numbers of seeds per green pod was recorded from ten randomly selected green pods and the mean value was calculated.

3.12.10 Weight of green pods

Pods of ten sample pods were weighed and their average was taken in gram (g).

3.12.11 Pod yield per plot

Green pod were harvested at regular interval from each unit plot and their weight was recorded. As harvesting was done at different and the total pod weights were recorded in each unit plot and expressed in kilogram (kg).

3.12.12 Pod yield per hectare

The green pod yield per plot was finally converted to yield per hectare and expressed in ton (t).

3.13 Statistical analysis

The recorded data on different parameters were statistically analyzed using MSTAT computer package programme. The analysis of variance for the characters under study were performed by 'F' variance test. The differences between the pairs of treatment means was compared using least significant difference (LSD) test (Gomez and Gomez, 1984).

CHAPTER IV

RESULTS AND DISCUSSION

The experiment was carried out to see the effect of different organic manure and their interaction on growth and yield contributing characters of French bean. A summary of the analysis of variances of all the characters studied together with their sources of variation and corresponding degrees of freedom have been shown in Appendix IV. The effect of different cultivars, organic manure and their interaction on growth yield and yield contributing characters have been presented and discussed in this chapter under the following heads.

4.1. Effect of organic manure on growth and yield of French bean

4.1.1. Plant height

Application of organic manures exhibited a significant influence on plant height of French bean plants at 15, 30, 45 days after sowing (Appendix I). At 15 DAS, the longest plant (15.85 cm) was found in the application of poultry manure (F_3) and the shortest plant (13.48 cm) in control treatment (F_0). At 30 DAS, the highest plant height (49.17 cm) was recorded from F_3, while the lowest (36.33 cm) was recorded from F_0. The longest plant (50.97 cm) was recorded from F_3 and the shortest plant (39.63 cm) was recorded from F_0 at 45 DAS. It was revealed that the plant height increased with the increased days after sowing i.e., 15, 30, 45 DAS. Poultry manure is rich in its nitrogen and nutrient content. This favorable condition creates better nutrient absorption and for vegetative growth, consequently, the longest plant was found by poultry manure. Vermicompost also showed considerable plant height (42.10 cm) which is smaller than cowdung. The effect of cowdung and vermicompost on plant height more or less similar (Fig.1).

Different varieties showed significant variation on plant height of French bean. At 15DAS, the tallest plant (16.18 cm) was found from V_2 (BARI French bean 2) and the shortest plant (13.26 cm) was found in V_1 (BARI French bean 1). At 30 DAS the highest plant height (42.05 cm) was recorded from V_2, while the lowest (40.58 cm) was recorded from V_3. The longest plant (44.43 cm) was recorded from V_2 and the shortest plant (43.38 cm) was recorded from V_1 at 45 DAS.

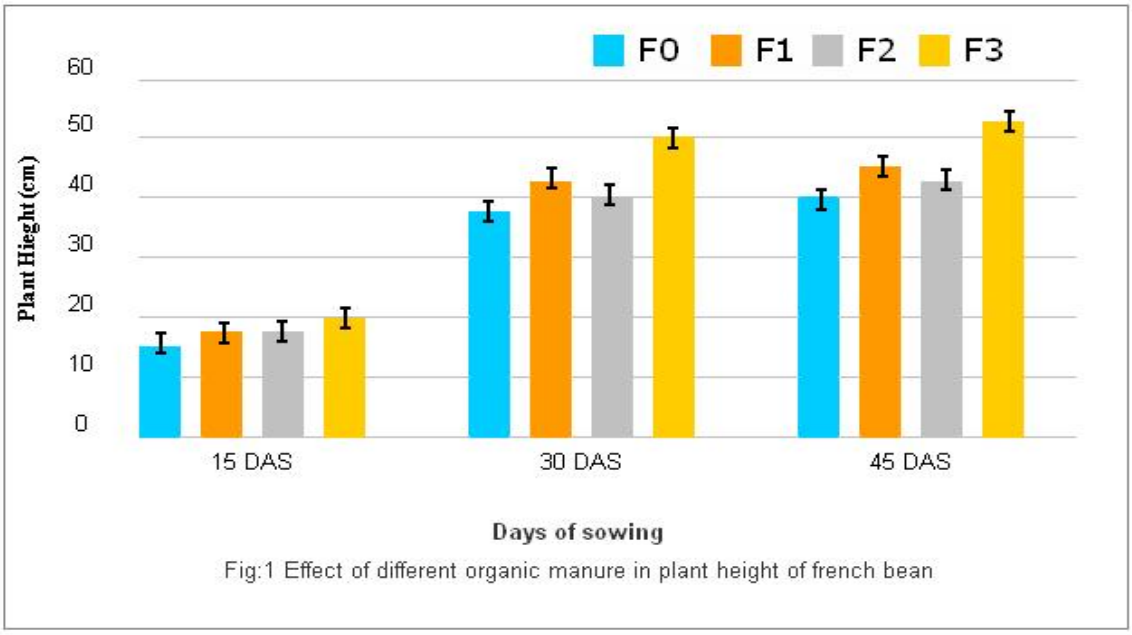

Fig:1 Effect of different organic manure in plant height of french bean

The significant variation was found due to combined effect of organic manure and variety for plant height at different days after sowing (Table 2). The maximum plant height (16.93 cm) was recorded from treatment combination of V_2F_3, while the minimum plant height (11.75 cm) from V_1F_0 at 15 DAS. At 30 DAS significant differences in terms of plant height was observed among the treatment combinations and the maximum plant height (51.27 cm) was recorded from the treatment combination of V_2F_3, whereas the minimum (36.27 cm) was noted from the treatment combination of V_1F_0. At 45 DAS, the maximum plant height (52.53 cm) was recorded from

the treatment combination of V_0F_0 , whereas the minimum (39.87) from V_1F_0 (Table 2).

4.1.2. Number of compound leaves per plant

Application of organic manures exhibited a significant influence on number of leaves of French bean plants at 15, 30, 45 days after sowing (Appendix I). At 15 DAS, the maximum number of leaves (4.53) was found with the application of poultry manure (F_3) and the minimum number of leaves (3.43) in control treatment (F_0). At 30 DAS, the maximum number of leaves (11.33) was recorded from F_3, while the minimum (7.93) was recorded from F_0. The maximum number of leaves (19.93) was recorded from F_3 and the minimum (12.37) was recorded from F_0 at 45 DAS. It was revealed that the number of leaves increased with the increased days after sowing (DAS) i.e., 15, 30, 45 DAS. Poultry manure is rich in its nitrogen and nutrient content. This favorable condition creates better nutrient absorption for vegetative growth and consequently, the maximum number of leaves was found by poultry manure. The cowdung and vermicompost showed the nearly distant number of leaves (12.73) and (15.57) respectively (Fig.1).

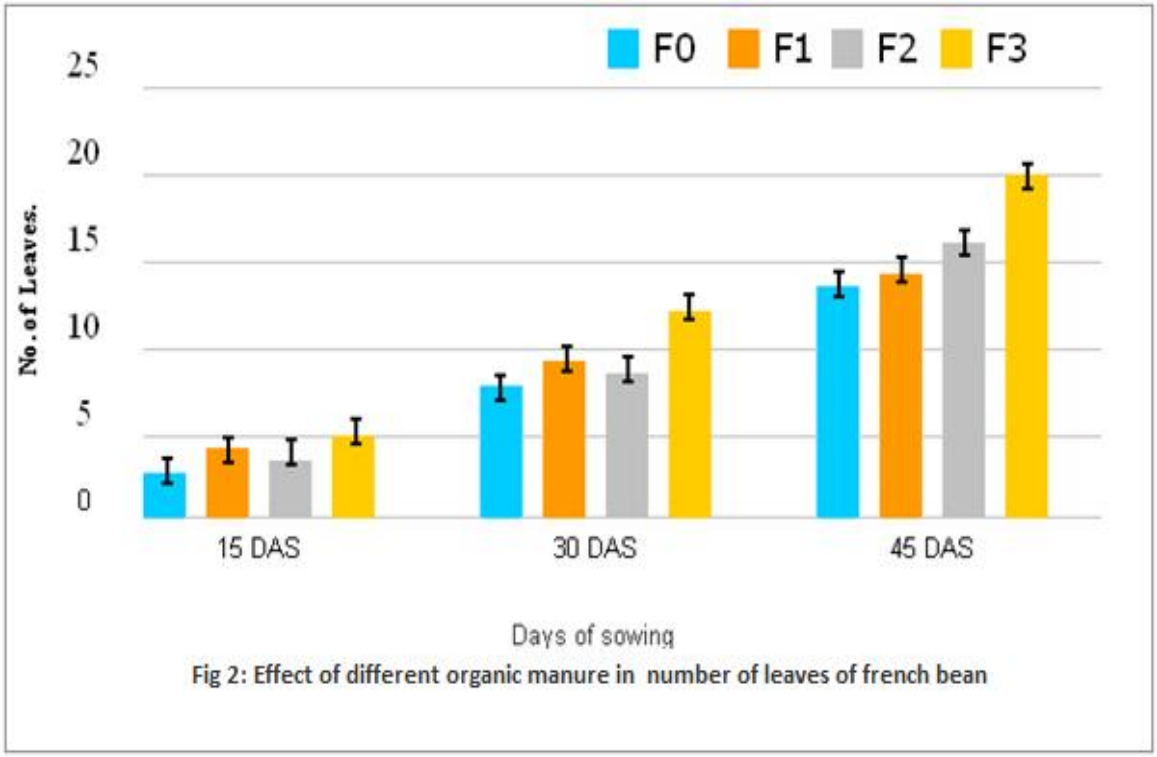

Fig 2: Effect of different organic manure in number of leaves of french bean

The effect of variety on number of leaves was statistically significant. The maximum (4.03) number of leaves per plant was recorded from V_1 and the minimum (3.90) number of leaves per plant was obtained from V_2 at 15 DAS. At 30 DAS, the maximum (10.00) number of leaves per plant was recorded from V_2 while the minimum (8.1) number of leaves per plant was found from V_1. The maximum (18.03) number of leaves per plant was obtained from V_2 while the minimum (12.21) number of leaves per plant was recorded from V_1 at 45 DAS (Table 1).

Interaction effect of organic manure and variety showed significant differences for number of leaves per plant at different days after sowing (Appendix II and table 2). The maximum (4.73) number of leaves per plant was recorded from treatment combination of V_2F_2, while the treatment combination of V_1F_0 gave the minimum (3.46) number of leaves per plant at 15 DAS. At 30 DAS significant differences in terms of number of leaves per plant was observed among the treatment combination and the maximum (12.27) number of leaves per plant was recorded from the treatment combination of V_2F_3 whereas the minimum (6.93) was recorded from the treatment combination of V_1F_0. At 45 DAS the maximum (22.93) number of leaves per plant was recorded from the treatment combination of V_3F_3, while the minimum (10.00) number of leaves per plant was recorded from the treatment combination of $V_1F_{0.}$

4.1.3. Leaf size (area-length × breadth basis)

Three organic manure had significant effect on leaf size (Table 1). The larger leaf (13.88×12.05 cm) was obtained from the plot fertilized with poultry manure and smaller leaf size (9.33×9.08 cm) was recorded from the control treatment. Cowdung and vermicompost give also significant effect of leaf size that is (11.09×9.29 cm) and (11.88 ×10.45 cm). The present observation

is similar to the result of that found by Amanullah *et al*. (2007).

There was no significant variation on leaf size under the present study (Table 1). The larger leaf size (12.20×10.00 cm) was recorded from V_2 (BARI French bean 2) and the smaller leaf size (10.89×10.33 cm) was found from V_1 (BARI French bean 1).

Three organic manure had significant effect of combination with two varieties on leaf size (Table 2). The larger leaf (14.50 x 11.55 cm) was obtained from 11 ton/ha poultry manure response of variety BARI French bean 2 (V_2F_3) and smaller leaf size (8.93 x 8.13 cm) was recorded from the control treatment with response of variety BARI French bean 1 (V_1F_0). On the other hand in combination of (V_1F_3) doesn't show the desire result (11.63 x 8.38 cm). Vermicompost give also significant effect on leaf size in combination with (V_2F_2) is (13.27 x 12.54 cm).

4.1.4. Number of branches per plant

Three organic manure had significant influence on the number of branches per plant. The number of branches per plant was the highest (31.27) in the plt with poultry manure and the lowest number of branches (20.30) was recorded in control treatment. Poultry manure enhances the secondary and tertiary branching of the legumes, so it increased the total number of branches per plant. Cowdung and vermicompost give also significant effect of branch number on per plant that is (21.50) and (23.73). The present observation is similar to the result of that found by Yadav and Vijayakumari *et al*. (2003).

Two varieties had significant influence on the number of branches per plant. The number of branches per plant was the highest (28.08) showed by variety BARI French bean 2 (V_2) and the lowest number of branches per

plant (25.83) was recorded in variety BARI French bean 1 (V_1).

Three organic manures had significant influence on the response of the two varieties on the number of branches per plant (Table 4). The number of branches per plant was the highest (35.20) in combination with (V_2F_3) at 11 ton ha^{-1} poultry manure with BARI French bean 2 and the lowest number of branches per plant (16.93) was recorded in control treatment with response of the variety BARI French bean 1 in combination (V_1F_0). Cowdung with the response of the variety BARI French bean 2 show prominent branch in the plant is (29.80) in combination with (V_2F_1).

4.1.5. Number of flowers per plant

The number of flowers per plant was significantly influenced by the application of three different organic manures (Table 1). The highest number of flowers per plant (19.52) was recorded for the poultry manure and the lowest number of flowers (13.53) was recorded for the control. Increased levels of phosphorus contained in poultry manure might have increased the branching and increased the activity of florigen. Cowdung and vermicompost also give significant effect on flower number that is (16.63) and (18.52).

There was no significant variation on number of flowers per plant for the effect of varieties under the present study (Appendix IV and table 1). The maximum number of flowers per plant (18.15) was recorded from V_1 (BARI French bean 1) and the minimum number of flowers per plant (16.94) was found from V_2 (BARI French bean 2).

The variation was found due to combined effect of organic manure and varieties on number of flowers per plant (Appendix IV and Table 2). The maximum number of flowers per plant (20.80) was recorded from the

treatment combination of V_2F_2 (Poultry manure + BARI French bean 2) while the treatment combination of V_1F_1 (Cowdung + BARI French bean 1) performed the minimum number of flowers per plant (12.67).

4.1.6. Number of pods per plant

Number of pods per plant differed significantly due to application of different organic manures (Table 1). The maximum number of pods per plant (16.07) was recorded from F_3 (poultry manure), while the minimum (9.85) was counted from F_0 (control). It was revealed that number of pods per plant increased by using poultry manure. This might be caused that poultry manure contents high amount of nitrogen which increased the number of leaves, cell division and cell enlargement. The present observation is similar to the result of that found by Varma and Saxena (1995), Subhan (1989).

Different varieties showed significant variation on number of flowers per plant under the present study (Table 1). The maximum number of pods per plant (20.01) was recorded from V_2 (BARI French bean 2) and the minimum number of flowers per plant (18.62) was found from V_1 (BARI French bean 1).

The variation was found due to combined effect of organic manure and varieties on number of pods per plant (Appendix V and Table 2). The maximum number of pods per plant (16.43) was recorded from the treatment combination of V_2F_2 (Vermicompost + BARI French bean 2) while the treatment combination of V_1F_1 (Cowdung + BARI French bean 1) performed the minimum number of pods per plant (9.80).

4.1.7. Length of green pod

Length of green pods differed non-significantly due to application of different organic manures (Table 1). The maximum length of pod (11.55) was recorded from F_3 (poultry manure), while the minimum (10.62) was counted from F_0 (control). It was revealed that the length of pods was increased by using poultry manure. This might be caused that poultry manure contents high amount of nitrogen which increased the number of leaves, cell division and cell enlargement. The present observation is similar to the result of that found by Varma and Saxena (1995), Subhan (1989).

The effect of variety on length of pod was significant (Table 1). The maximum length of pod (11.18) was recorded from V_2 (BARI French bean 2) and the minimum number of flowers per plant (10.92) was found from V_1 (BARI French bean 1).

The variation was found due to combined effect of organic manure and varieties on length of pods (Appendix V and Table 2). The maximum length of pod (11.98) was recorded from the treatment combination of V_1F_3(BARI French bean 1 + Poultry manure) while the treatment combination of V_1F_1 (BARI French bean 1 + Cowdung) performed the minimum length of pod (10.23).

4.1.8. Diameter of green pod

There was no significant variation on diameter of green pods per plant for the effect of different organic manures under the present study (Table 1). The maximum diameter of pod (1.08) was recorded from F_2 (Vermicompost), while the minimum (0.93) was counted from F_0 (Control). It was revealed that the diameter of pods increased by using poultry manure. This might be caused that poultry manure contents high amount of nitrogen which increased the number of leaves, cell division and cell enlargement.

The present observation is similar to the result of that found by Varma and Saxena (1995), Subhan (1989).

There was no significant variation on diameter of pods for the effect of two varieties under the present study (Table 1). The maximum diameter of pod (1.87) was recorded from V_2 (BARI French bean 2) and the minimum diameter of pod (0.96) was found from V_1 (BARI French bean 1).

Diameter of green pods significantly varied due to interaction effect of varieties and organic fertilizer (Appendix V and Table 2). The highest diameter of green pod (1.17 cm) was recorded from treatment combination of V_2F_1(BARI French bean 2 +Cowdung) . In contrast lowest diameter of green pod (0.92 cm) was recorded from treatment combination V_1F_0 (BARI French bean 1 +Control).

4.1.9. Number of seeds per green pod

There was no significant variation on number of seeds per green pod for the effect of different organic manures was (Table 1). The maximum number of seeds per green pod (5.50) was recorded from F_3 (poultry manure), while the minimum (5.11) was counted from F_2 (vermicompost). Cowdung showed significant effect on number of seeds per green pod that is (5.16). The present observation is similar to the result of that found by Alves *et al*. (2000) and Zamil *et al*. (2004).

There was no significant variation on number of seeds per green pod for the effect of different varieties (Table 1). The maximum number of seeds per green pod (5.02) was recorded from V_2 (BARI French bean 2) and the minimum number of seeds per green pod (4.79) was found from V_1 (BARI French bean 1).

The variation was found due to combined effect of organic manure and varieties on length of pods (Appendix VI and Table 2). The maximum number of seeds per green pod (5.55) was recorded from the treatment combination of V_2F_3(BARI French bean 2 + Poultry manure) while the treatment combination of V_1F_2 (BARI French bean 1 + Vermicompost) performed the minimum number of seeds per green pod (5.00).

4.1.10. Weight of fresh pods per plant

Weight of fresh pods per plant differed significantly due to application of different organic manures (Table 1). The maximum weight of fresh pod per plant (20.33 gm) was recorded from F_0 (control), while the minimum (19.37 gm) was counted from F_1 (cowdung).

The effect of variety on weight of fresh pods per plant was significant (Table 1). The maximum weight of fresh pod per plant (23.06 gm) was recorded from V_2 (BARI French bean 2) and the minimum weight of fresh pod per plant (12.85 gm) was found from V_1 (BARI French bean 1).

The variation was found due to combined effect of organic manure and varieties on weight of fresh pods per plant (Appendix VI and Table 2). The maximum weight of fresh pod per plant (22.80 gm) was recorded from the treatment combination of V_2F_0 (BARI French bean 2 +Control) while the treatment combination of V_1F_3 (BARI French bean 1 + Poultry manure) performed the minimum weight of fresh pod per plant (19.13 gm).

4.1.11. Pod yield per plot

Pod yield per plot differed significantly due to application of different organic manures (Table 1). The highest pod yield per plot (3.18 kg) was recorded from F_3 (poultry manure), while the lowest (2.88 kg) was counted

from F_1 (cowdung). Vermicompost showed significant effect on pod yield per plot that is (3.04 kg).

The effect of variety on pod yield per plot was significant (Table 1). The highest pod yield per plot (3.01 kg) was recorded from V_2 (BARI French bean 2) and the lowest pod yield per plot (2.11 kg) was found from V_1 (BARI French bean 1).

The variation was found due to combined effect of organic manure and varieties on yield of pods per plot (Appendix VI and Table 2).The highest pod yield per plot (3.27 kg) was recorded from the treatment combination of V_2F_3 (BARI French bean 2 + Poultry manure) while the treatment combination of V_1F_3 (BARI French bean 1 + Poultry manure) performed the lowest pod yield per plot (2.82 kg).

4.1.12. Pod yield per hectare

Pod yield per hectare differed significantly due to application of different organic manures (Table 1). The highest pod yield per hectare (10.62 ton) was recorded from F_3 (poultry manure), while the lowest (9.61 ton) was counted from F_1 (cowdung). Vermicompost showed significant effect on pod yield per hectare that is (10.13 ton).

The effect of variety on pod yield per hectare was significant (Table 1). The highest pod yield per hectare (11.75 ton) was recorded from V_2 (BARI French bean 2) and the lowest pod yield per hectare (10.01 ton) was found from V_1 (BARI French bean 1).

The variation was found due to combined effect of organic manure and varieties on pod yield per hectare (Appendix VI and Table 2).The highest pod yield per hectare (10.90 ton) was recorded from the treatment

combination of V_2F_3 (BARI French bean 2 + Poultry manure) while the treatment combination of V_1F_3 (BARI French bean 1 + Poultry manure) performed the lowest pod yield per hectare (9.40 ton).

Table 1: Effect of Organic Manure and variety on yield of French bean

Treatment	Leaf number			Branch number
	15 DAS	30DAS	45DAS	
F_0	3.43	7.93 b	12.37 b	20.30 b
F_1	4.13	8.76 b	12.73 b	21.50 b
F_2	3.76	8.16 b	15.57 b	23.73 b
F_3	4.53	11.13 a	19.93 a	31.27 a
LSD (0.05)	0.92	1.03	3.21	3.57
Level of Significance	NS	**	**	**
V_1	4.03	8.10 b	12.21 b	25.83
V_2	3.90	10.00 a	18.08 a	28.08
LSD (0.05)	0.25	1.80	3.10	3.25
Level of Significance	NS	**	**	NS
CV (%)	18.85	9.26	17.14	11.92

** = Significant on 1% level of probability

NS = non-significant

Continued

Treatment	Leaf Size		No. of flower	No. of pod / plant	Pod length (cm)	Pod diameter (cm)	No. of seed / pod	Weight of pod (g)	Yield / plot (kg)	Yield / ha (ton)
	Leaf length (cm)	Leaf breadth (cm)								
F_0	9.33 c	9.08 c	13.53 c	9.85 c	10.62	0.93	5.27	20.33	2.91	9.72 c
F_1	11.09 b	9.29 bc	16.63 b	14.47 b	11.21	0.98	5.16	19.37	2.88	9.61 c
F_2	11.88 b	10.45 b	18.52 a	14.92 ab	10.84	1.08	5.11	21.93	3.04	10.13 b
F_3	13.88 b	12.05 a	19.52 a	16.07 a	11.55	1.00	5.50	20.23	3.18	10.62 a
LSD (0.05)	1.43	1.24	1.81	1.58	1.051	0.17	0.52	2.56	0.92	0.29
Level of Significance	**	**	**	**	NS	NS	NS	NS	NS	**
V_1	11.89	10.33	18.15	18.62 b	10.92 b	0.96 b	4.79	12.85 b	2.11 b	10.01 b
V_2	12.20	10.10	16.94	20.01 a	11.18 a	1.87 a	5.02	23.06 a	3.01 a	11.75 a
LSD (0.05)	1.03	0.75	1.73	1.3	0.17	0.8	0.29	2.33	0.79	1.2
Level of Significance	NS	NS	NS	**	**	**	NS	**	**	**
CV (%)	10.03	9.81	8.60	9.23	7.68	11.31	8.12	10.11	2.40	2.39

F_0 = Control

F_1 = 12 ton ha^{-1} Cowdung

F_2 = 9 ton ha^{-1} Vermicompost

F_3 = 11 ton ha^{-1} Poultry Manure

V_1= BARI French bean 1

V_2= BARI French bean 2

** = Significant at 5% level of probability

NS = non-significant

%CV = Coefficient of variance

Table 2. Interaction effect of organic manure and variety responses

Factor A X Factor B	Plant height (cm)			No. of leaf			No. of branch
	15 DAS	30DAS	45DAS	15 DAS	30DAS	45DAS	
V_1F_0	11.75 d	36.27	39.87	3.46	6.93 d	10.00 e	16.93
V_1F_1	15.20 b	36.40	39.40	3.40	8.93 bc	14.73 cd	23.67
V_1F_2	13.33 c	41.53	46.07	4.33	7.93 cd	11.40 de	19.33
V_1F_3	15.90 ab	40.33	39.80	3.93	9.60 b	14.07 cde	23.67
V_2F_0	13.20 c	37.47	42.40	3.60	7.13 d	10.53 de	17.67
V_2F_1	16.70 a	40.20	41.80	3.93	9.20 bc	20.60 ab	29.80
V_2F_2	14.77 b	47.07	49.40	4.73	10.40 b	16.93 bc	27.33
V_2F_3	16.93 a	51.27	52.53	4.33	12.27 a	22.93 a	35.20
LSD (0.05)	1.43	5.31	7.64	1.30	1.46	4.54	5.05
CV (%)	5.56	7.34	9.94	18.85	9.26	17.14	11.92

Continued

Factor A × Factor B	Leaf length (cm)	Leaf breadth (cm)	No. of flower	No. of pod / plant	Pod length (cm)	Pod diameter (cm)	No. of seed / pod	Weight of pod (g)	Yield / plot (kg)	Yield / ha (ton)
V_1F_0	8.93 d	8.12 d	14.40 de	9.80 d	11.01 abc	0.92	5.44	19.47 ab	2.90	9.68 de
V_1F_1	9.73 cd	10.04 bc	12.67 e	9.99 d	10.23 c	0.94	5.11	21.20 ab	2.93	9.76 de
V_1F_2	10.55 cd	10.21 b	17.67 bc	16.33 ab	10.44 bc	1.01	5.00	19.60 ab	2.95	9.83 cd
V_1F_3	11.63 bc	8.38 cd	15.6 cd	12.60 c	11.98 a	0.96	5.33	19.13 b	2.82	9.40 e
V_2F_0	10.82 cd	10.47 b	19.77 ab	15.67 ab	10.52 abc	0.99	5.11	22.80 a	3.06	10.20 bc
V_2F_1	12.93 ab	10.44 b	17.27 bc	14.17 bc	11.16 abc	1.17	5.11	21.07 ab	3.02	10.06 bcd
V_2F_2	13.27 ab	12.54 a	20.80 a	16.43 a	11.74 ab	0.93	5.44	20.53 ab	3.10	10.34 b
V_2F_3	14.50 a	11.55 ab	18.23 b	15.70 ab	11.37 abc	1.07	5.55	19.93 ab	3.27	10.90 a
LSD (0.05)	2.02	1.75	2.56	2.23	1.48	0.24	0.74	3.62	1.31	0.41
CV (%)	10.03	9.81	8.60	9.23	7.68	14.11	8.12	10.11	2.40	2.39

In a column having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability analyzed by DMRT.

F_0 = Control

F_1 = 12 ton ha^{-1} Cowdung

F_2 = 9 ton ha^{-1} Vermicompost

F_3 = 11 ton ha^{-1} Poultry Manure

V_1= BARI French bean 1

V_2= BARI French bean 2

CHAPTER V

SUMMERY AND CONCLUSION

A field experiment was carried out at the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka during the period from November 2012 to February 2013 to evaluate the effect of three different organic manures and two varieties on the growth and yield of French bean. The experiment involved two factors such as four levels of Organic manure viz, 0, 12, 9 and 11 ton ha^{-1} of control, cowdung, vermicompost and poultry manure and two varieties of French bean viz, BARI French bean 1, BARI French bean 2 respectively. The experiment consisting of 8 treatment combinations that was laid out in Randomized complete Block Design (RCBD) with three replications. The size of each unit plot was 3 sq. m. (2 m × 1.5 m). The seeds of French bean were sown in each plot 19 November, 2012. The plants were randomly selected from each plot to record data on the growth parameters, yield components and yield of plants. The collected data were statistically analyzed and the differences among the means were evaluated by least significant difference (LSD) test. The results of this experiment have been summarized as follows:

The results of the experiment revealed that the effect of three organic manure had significant effect on plant height, number of compound leaves per plant, leaf size, number of branches per plant, number of flowers per plant, number of pods per plant, length of green pod, diameter of green pod, number of seeds per green pod, weight of fresh pod per plant and pod yield per plot. The maximum green pod yield (10.90 t ha^{-1}) was obtained from the plot where 11 ton ha^{-1} poultry manure was used.

The results showed that plant height, number of compound leaves per plant at 30 and 45 DAS, leaf size, number of branches per plant, number of

flowers per plant, number of pods per plant, length of green pod, diameter of green pod, number of seeds per green pod, weight of fresh pod per plant and pod yield per plot were significantly influenced by the effect of three organic manure but it had not significant effect on number of compound leaves at 15 DAS, number of pod, pod length, pod diameter, weight of pod. The highest green pod yield (10.90 t ha^{-1}) was obtained from the plot where poultry manure 11 t ha^{-1} was applied.

From the above results it might be concluded that organic manure and response of two varieties don't show significantly influenced the green pod yield of French bean. The following conclusion could be made from the results of the present experiment:

1. Such study is needed in different agro-ecological zones (AEZ) of Bangladesh for regional adaptability and other performance;
2. Another doses of organic manure may be included in the future program;
3. Other cultivars may be included in the further program.

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Appendix I: Monthly record of year temperature, rainfall, relative humidity, soil temperature and sunshine of the experimental site during the period from October 2012 to March 2013 (Site-Dhaka)

Year	Month	Air Temperature (^{0}C)			Relative Humidity (%)	Rainfall (mm)	Sunshine (hr)
		Maximum	Minimum	Mean			
2012	September	31.35	25.15	28.25	78.82	226	205.33
	October	30.60	24.20	27.40	75.87	204	206.90
	November	29.85	18.50	24.17	70.12	00	235.20
	December	26.76	16.72	21.74	70.63	00	290.50
2013	January	24.05	13.82	18.93	68.79	05	197.60
	February	28.90	18.03	23.46	62.04	03	220.50
	March	32.24	22.10	27.17	67.01	160	208.20

Source: Bangladesh Meteorological Department (Climatic Division), Agargaon, Dhaka-1212

Appendix II: Characteristics of Sher-e-Bangla Agricultural University from soil is analyzed by Soil Resources Development Institute (SRDI), Khamar Bari, Farmgate, Dhaka.

A. Morphological Characteristics of the experimental field

Morphological features	**Characteristics**
Location	Sher-e-Bangla Agricultural University
AEZ	Madhupur Tract (28)
General Soil Type	Shallow Red Brown Tarrace Soil
Land Type	High Land
Soil Series	Tejgaon
Topography	Fairly Leveled
Flood level	Above flood level
Drainage	Well drained
Cropping Pattern	Fellow - Tomato

B. Physical and chemical properties of initial soil

Characteristics	**Value**
Partial Size Analysis	
% Sand	28.00
% Silt	42.00
% Clay	30.00
Textural Class	
P^H	5.60
Organic carbon (%)	0.46
Organic matter (%)	0.80
Total N (%)	0.05
Available P (ppm)	20.00
Exchangeable K (meq/100 gm soil)	0.12
Available S (ppm)	46.00

Source: Soil Resources Development Institute (SRDI)

Appendix III. Analysis of variance of the data on plant height, number of leaf, number of branch of French bean as influenced by organic manures and different cultivars.

Treatment	Degrees of freedom (df)	Mean Square					
		Plant height (cm)			No. of leaf		
		15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
Replication	2	0.144	19.302	7.272	0.327	1.235	51.515
Organic manure (A)	3	5.773**	185.54**	144.633**	1.347**	14.642**	73.282**
Variety (B)	1	51.158	12.907**	6.615**	0.107	21.660**	206.507**
Interaction (A×B)	5	0.653**	8.982**	22.628**	0.182**	0.047**	14.591**
Error	14	0.669	9.197	19.047	0.559	0.702	6.742

**** : Significant at 0.01% level of probability; * : Significant at 0.05% level of probability**

Appendix IV. Analysis of variance of the data on leaf length, leaf breadth and number of flowers of French bean as influenced by organic manures and different cultivars.

Treatments	Mean Square				
	Degrees of freedom	**No. of branch**	**Leaf length (cm)**	**Leaf breadth (cm)**	**No. of flower**
Replication	2	68.505	1.242	0.137	11.554
Organic manure (A)	3	145.31**	21.336**	11.107**	41.552**
Variety (B)	1	361.927	10.270	0.324	29.482
Interaction (A×B)	5	15.967**	0.485**	3.887**	0.229**
Error	14	8.316	1.340	1.005	2.148

** : Significant at 0.01% level of probability; * : Significant at 0.05% level of probability

Appendix V. Analysis of variance of the data on number of pod per plant, pod length, pod diameter of French bean as influenced by organic manures and different cultivars.

Treatments	Mean Square			
	Degrees of freedom	No. of pod / plant	Pod length (cm)	Pod diameter (cm)
Replication	2	6.405	0.126	0.012
Organic manure (A)	3	44.858**	1.008	0.022
Variety (B)	1	12.907**	0.390**	0.033**
Interaction (A×B)	5	4.066**	1.624**	0.016**
Error	14	1.630	0.721	0.020

** : Significant at 0.01% level of probability; * : Significant at 0.05% level of probability

Appendix VI. Analysis of variance of the data on number of seed per pod, weight, yield, yield of French bean as influenced by organic manures and different cultivars.

Treatments	Mean Square				
	Degrees of freedom	No. of seed / pod	Weight of pod (g)	Yield / plot (kg)	Yield / ha (ton)
Replication	2	0.059	5.082	0.043	0.469
Organic manure (A)	3	0.179**	6.867	0.11**	1.241**
Variety (B)	1	0.005	0.427**	0.000**	0.002**
Interaction (A×B)	5	0.115**	3.151**	0.024**	0.265**
Error	14	0.183	4.284	0.005	0.057

** : Significant at 0.01% level of probability; * : Significant at 0.05% level of probability

Appendix VII: Chemical Properties of Vermicompost and Cowdung

Name of Element	Vermicompost	Cowdung
Organic matter	28.32%	27.2%
Nitrogen	1.57%	0.52%
Phsporous	1.26%	0.29%
Potasium	2.60%	0.75%
Calsium	2.00%	0.65%
Magnesium	0.66%	0.82%
Salfur	0.74%	0.16%
Ferrous	975 ppm	312 ppm
Manganse	712 ppm	254 ppm
Boron	0.06%	-
Zinc	400 ppm	68 ppm
Cupper	20 ppm	13 ppm

Source : Soil Resoures and Development Institute (SRDI)