EFFECT OF DIFFERENT SOURCES OF ORGANIC MANURES ON THE GROWTH AND YIELD OF BROCCOLI

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CERTIFICATE

This is to certify that the thesis entitled, *'EFFECT OF DIFFERENT SOURCES OF ORGANIC MANURES ON THE GROWTH AND YIELD OF BROCCOLI "* **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 MD. IBNA FAYSAL Registration** *No.00541* **under my supervision and my guidance. No part of the thesis has been submitted for any other degree or diploma.**

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

Dated:
Dhaka, Bangladesh

(Dr. Md. Nazrul Islam)
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DEDICATED

TO

MY BELOVED

PARENTS

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The Author

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FULL NAME	ABBREVIATION
At the rate of	@
And others	et al.
Bangladesh Bureau of Statistics	BBS
Benefit cost ratio	BCR
Cultivar	cv.
Degree in Celsius	°C
Duncan's Multiple Range Test	DMRT
Date After Transplanting	DAT
Etcetera	etc
Food and Agricultural Organization	FAO
Hectare	ha
Hour	hr
Muriate of Potash	MP
Number	no.
Namely	Viz.
Randomized Complete Block Design	RCBD
Sher-e-Bangla Agricultural University	SAU
Ton per hectare	t/ha
Triple Super Phosphate	TSP
That is	i.e.
Least significant Difference	LSD

EFFECT OF DIFFERENT SOURCES OF ORGANIC MANURES ON THE GROWTH AND YIELD OF BROCCOLI

ABSTRACT

An experiment was conducted at the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka during the period from October 2005 to February 2006. The trial was conducted in Randomized Complete Block Design (RCBD) with three replications to study the effect of different sources of organic manures on the growth and yield of broccoli. The experiment consisted of five different sources of manures; control (no manure), cowdung (26.5 t/ha), water hyacinth compost (10.6 t/ha), poultry litter (16.56 t/ha) and vermicompost (12.26 t/ha), and two cultivars of broccoli; 'Sotomidori' and 'Premium crop'. Different sources of manures and cultivars had significant influence on plant height, height up to curd, number of leaves per plant, length of leaf, breadth of leaf, plant canopy, diameter of curd, diameter of stem, weight of primary curd, dry weight of curd, number of secondary curd, weight of secondary curd, yield per plant, yield per unit plot and yield per hectare. The maximum yield (14.50 t/ha) was obtained from poultry litter followed by vermicompost in 'Sotomidori' (14.12 t/ha) cultivar. The minimum yield (7.37 t/ha) was recorded by no manure in 'Premium crop'. Control treatment showed the lowest values for all the parameters studied. Combination of poultry litter and 'Sotomidori' cultivar was found the best among all other treatment combinations in respect of net return (Tk. 224381/ha) and BCR (4.41).

Chepter-I

INTRODUCTION

INTRODUCTION

Broccoli *{Brassica oleracea* var. *italica* L.) is a winter vegetable of Bangladesh, which was introduced to this country several years ago. Broccoli belongs to the family Cruciferae. Synonyms are *Brassica oleracea* var. *botrytis* L. sub var. *cymosa* and common names are sprouting broccoli, calabrese, asparagus broccoli, Italian broccoli and green sprouting broccoli. It is a hybrid closely related to cauliflower (Nonnecke, 1989). “Broccoli” is an Italian word derived from the Latin word "Brachium" meaning an arm or branch. There are three classes of sprouting broccoli, namely- green, white and purple, but the green type is the most popular (Shoemaker, 1962). Broccoli is an important cole crop of Europe and USA. However, in India, broccoli is hardly considered as a commercial crop (Tindall, 1983; Nonnecke, 1989).

Broccoli is fairly rich in vitamin A, ascorbic acid and contains appreciable amounts of calcium, phosphorus, thiamin, riboflavin, niacin and iron (Thompson and Kelly, 1988, Lincoln, 1987). Watt (1963) reported that broccoli is more nutritious than any other cole crop such as cabbage, cauliflower and kohlrabi. Many people consider this as the most tasteful among the coles.

It is grown in Bangladesh during the cool or rabi season. Its cultivation has not been expanded much beyond the farms of different agricultural organizations. This is mainly due to lack of awareness regarding its nutritional value and method of production.

Broccoli is environmentally better adapted than cauliflower and reported to withstand comparatively higher temperature than cauliflower (Rashid, 1976). Its preference to the consumers is increasing day by day.

Broccoli produces smaller flowering shoots (side curd) from the leaf axil after the harvest of main apical curd. Consequently, a broccoli may be harvested over a considerable period of time. Its wider environmental adaptability, higher nutritive value, good taste, less risk of crop failure and various biotic and abiotic factors indicate that there is enough scope for its large scale cultivation.

The cultivation of broccoli requires an ample supply of plant nutrient. Use of organic manure is essential for its proper growth and development. Organic manure improves soil structure as well as increases its water holding capacity. Moreover, it facilitates aeration in soil. Recently organic fanning is appreciated by vegetable consumers as it enhances quality of the produce.

Broccoli can be grown in a variety of soil types ranging from light sand to heavy loam or even clay that are well supplied with organic matter (Katyal, 1977). Its production can be increased by adopting improved cultural practices. Broccoli responds greatly to major essential elements like N, P, and K in respect of its growth and yield (Mital *et al.*, 1975; Singh *et al*., 1976; Thompson and Kelly, 1988) and storage life. Increased use of inorganic fertilizers in crop production causes health hazards, create problem to the environment including the pollution of soil, air and water. The continuous use of chemical fertilizer is badly affecting the texture and structure of soil, decreasing soil organic matter and soil microbial activities due to soil toxicity.

On the other hand, organic manures like cowdung, poultry litter and compost when applied, help improve the soil texture, structure, colour, aeration, water holding capacity and microbial activity of soil. Inorganic cultivation leaves residual effect in crops which is believed to cause hazard to public health and environment.

Considering the above facts, the present experiment was undertaken to study the effect of different sources of organic manures on the growth and yield of broccoli cv. ‘Sotomidori’ and ‘Premium crop’.

Objectives:

The present study was undertaken with the following objectives -

1) To assess the effect of different sources of organic manures on the growth and yield of broccoli.

ii) To find out the optimum sources of organic manure and cultivar for profitable broccoli production.

iii) To evaluate the relative cost and return in broccoli production with different sources of manures.

CHAPTER II

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Growth, yield and postharvest potentials of broccoli have been studied in various parts of the world. A very limited number of reports are available on sources of organic manures of broccoli. Organic manure influences the physical, chemical and biological properties of soil though its quantity in soil is very small. The response of crops to the applied organic manure is slow but the residual effect of these manures last for long time. However, available information relevant to this study is reviewed in this chapter.

Field experiments were undertaken by Schroeder, *et al.*, 1998, to determine whether cowpea crops residues could be used to reduce fertilizer N inputs with fall broccoli. Studies in 1992, 1993, and 1994 involved broccoli preceded by cowpeas, with or without factorial combinations of pre plant N and side dress N from urea on the broccoli. Control broccoli plants were grown on fallow ground and supplied with 168 kg/ha of N from urea. Cowpea crop residues alone did not provide sufficient N for optimum production of marketable broccoli. Marketable broccoli yields sometimes showed no significant differences between controls and cowpea residue treatments receiving only 84 kg/ha of fertilizer N. However, there was a tendency for increased broccoli transplant mortality in cowpea residue plots. A fourth study in 1994 indicated a negative main effect of cowpeas on broccoli stand establishment, and a complex interaction of cowpeas and trifluralin treatments on broccoli yield. Petiole N concentrations of broccoli plants with reduced fertilizer N inputs which succeeded cowpeas usually were lower than those of control plants. Soil nitrate levels at 15 to 30 cm soil depths at the time of broccoli planting were consistent indicators of apparent nitrate utilization by microbial decomposition of cowpea crop residues. They were unable to demonstrate a cowpea-broccoli succession cropping system which consistently reduced fertilizer N inputs without some type of adverse effect on the broccoli crop. Therefore, the use of cowpea crop residues to reduce fertilizer N inputs with fall broccoli was not recommended.

Steffen *et al.* (1994) carried out an experiment, on short-term and long-term impact of an initial large scale spent mushroom soil (SMS) amendment on vegetable crop productivity and resource use efficiency at Pennsylvania University, USA. They observed the effect of organic matter (spent mushroom compost at 64 mt/ha + rotten cattle manure at 57 mt/ha) applied in spring 1990 on growth and yield of broccoli. No fertilizer or other amendments were added to previously amended treatments, but 100 percent recommended NPK was added to all control treatments in all years. Broccoli yield and curd diameter were greater in the amended treatment.

Maynard (1994) stated that using spent mushroom and chicken manure compost in broccoli cultivation; composts were incorporated into the soil in 1989-1991 at rates of 56 and 112 t/ha. Yields of broccoli increased with increasing rate of compost application. Yields were higher in plots amended with chicken manure compost (nitrate-N content 54 ppm) than with spent mushroom concentrations in ground water beneath all compost amended plots remained below 10 ppm during the study.

Two rates of broiler litter (20 and 40 mt/ha) were compared to recommend rates of inorganic nitrogen (N), phosphorus (P), and potassium (K) in a double cropping system of spring sweet com (Zea mays L. cv., ‘Silverqueen’) and fall broccoli (Brassica oleracea L. cv. ‘southern Comet’). Sweet com matured one week earlier both years when fertilized with 40 mt/ha of broiler litter compared to commercial fertilizer. The early maturity may be due to improved P nutrition. Similar or higher yields of fall broccoli were produced with broiler litter following sweet com than with commercial fertilizer. (Brown *et al.,* 1994).

Maynard (1994) conducted an experiment on sustainable vegetable production for three years using composted animal manures. Intensive broccoli production trials in spring, summer and autumn were conducted for 3 years in Connecticut Windsor (sandy trace soil) and Mt. Carmel (Loamy upland soil) following annual application of spent mushroom compost (SMC) or chicken manure compost (CMC) applied at either 56 or 112 t/ha as the sole source of nutrients. Yields of broccoli from these amended plots were compared with yields from control plots receiving NPK fertilizer. Yields of broccoli increased with the rate of compost. Compost analysis and broccoli on all CMC amended plots at both rates and sites in all three years, were equal to or greater than yields from the control plots.

The benefits of compost applications on various soil types were demonstrated in greenhouse studies. Compost prepared from yard waste feedstock co composted with biosolids at a 1:1 ratio was used to grow broccoli at 0, 15, 30, and 60 dry tons per acre. Surface soil from three dominant regional soil types (Arnold loamy sand, Goleta loam and Todos-Lodos clay loam) was used in plastic pots in the greenhouse studies. All rates of compost applications increased the height and dry weight of broccoli. In loam and clay loam soil, optimal rates of compost application were 30 to 60 t/ha for broccoli. In loamy sand soil, optimal rates for broccoli was 30 t/a. Broccoli showed less phytotoxicity symptoms to higher compost loads, probably because of more tolerance to greater salt concentrations (Shiralipour *et al*., 1996).

Organic manures increase the yield of crop. Application of 10 t/acre of fresh cattle manure increased the yield of pimento, eggplant and Chinese cabbage but reduced the yield of cucumber and tomato compared with normal (rate unspecified) applications. Fresh chicken manure at the rate of 5-10 t/acre could be used for pimento, eggplant and Chinese cabbage without deleterious effect. In the field cultivation without irrigation, organic fertilization and liming increased total and marketable yield of cabbage cv. Salva at the optimum level of mineral fertilization (Omori *et al.,* 1972).

Response of cabbage yields, head quality and leaf nutrient status to poultry manure fertilization was investigated by Hochmuth *et al.* (1993) and was found that the marketable yield of cabbage responded quadratically to increasing rates of poultry manure during 1990, with the maximum yield (28.4 t/ha) being obtained with 18.8 t/ha).

Vogtmann et al. (1993) pointed out that as a general trend, compost positively affected food quality, improved storage performance and yielded a somewhat superior sensory quality of tomato in particular. Compost significantly reduced nitrates and improved the nitrate to vitamin C ratio of vegetables.

Abedin *et al.* (1994) tried to find out a sustainable practice, using data collected from 85 selected farmers in the Cameron, involved pest (insect, disease, weed) control, fertilization and soil erosion and inorganic fertilizers were of more sustainable practices and did not suffer yield sacrifices. A sftategy to help farmers for spread adoption and sustainable practices was the most effective approach for sustainability.

In a 3 years field experiment, Suchorska (1991) tested the sustainability of some unconventional fertilizers, obtained from brown coal and brown coal ash as well as poultry manure, cattle manure and fertilizer made from mushroom substrate. The yield and content of P, K, Ca and Mg in cabbages, carrots and spinach were determined. He reported that the highest yield of white cabbage and spinach was obtained from plots fertilized with brown coal ash. The mineral organic fertilizers tested increased the P content of vegetables.

The effects of GFT compost (vegetable, fruit and garden waste), Humotex (anaerobically digested GFT) and Groencompost (garden waste), applied at 15 t dry matter/ha in early cauliflowers followed by leeks. Total crop yields increased by 10 percent (GFT and Humotex) and 6 percent (Groencompost) compared with no compost use. Another field study with leeks investigated the effects of compost application (25 t dry matter/ha) and mineral fertilization. A soil analysis was carried out and showed no differences in soil nitrate concentrations in plots with and without compost application. Extra fertilizer was applied and crop yields were 3 to 4 percent higher in plots treated with compost (Rooster and Devliegher, 1998).

Sumiati (1988) stated that seedlings of broccoli cultivars Green King and Mikado were transplanted into Jiffy pots or into a 1:1 mixture of stable manure and soil supplemented or not supplemented with NPK compound fertilizer (15 : 15 : 15) and/or Metalik. There were no differences between cultivars in plant height, root length, LAI, NAR and RGR at 2, 3 or 4 weeks after transplanting. These factors were all maximum at all stages in plants grown in manure + soil supplemented with NPK + Metalik and were generally minimum in plants grown in Jiffy pots. Interactions between cultivars and treatments on LAI, NAR and K uptake at 4 weeks after transplanting were noted.

Cutcliffe *et al.* (1968) during three successive cropping seasons investigated the effects of nitrogen, phosphorus, potassium and manure on the yield and maturity of broccoli [Brassica oleracea L. var. italica Plenck.]. Terminal (central inflorescence), lateral (axillary stalk) and total yields were substantially increased by the applications of nitrogen and phosphorus. For maximum yields, rates of 175 to 250 kg/ha of N and 100 to 150 kg/ha P were necessary. Increases in lateral yields and total yields from high rates of nitrogen were obtained only when nitrogen was accompanied by adequate phosphorus. Yields of terminals were increased in only one of three seasons by added potassium. A manure treatment increased lateral and total yields in two seasons and terminal yields in one season. Maturity was delayed by increasing the rates of nitrogen and where no phosphorus was applied.

Cavazza and Bianco (1975) applied composed town refuge, FYM and inorganic fertilizer at similar N rates after sowing or transplanting radish, Swiss chard, spinach, cauliflower, Florence fennel and lettuce. They obtained highest yield with inorganic fertilizer whereas yields of crop receiving no fertilizer or the 2 organic did not usually differ significantly, although fennel yielded better with composted town refuge. After hot dry weather crusting occurred 011 the surface of control plots and inorganic fertilizer plots but not on those receiving organic fertilizer, so radish roots were not damaged on such plots.

Silva (1986) planted cabbage in hydromorphic soil and treated with 100 kg N/ha, 100 P_20_5/ ha or 50 t/ha cattle manure, atone or in combination. Nitrogen increased the total yield but decreased commercial to total yield ratio. K_20 alone decreased total yields. Cattle manure increased commercial and total yields but decreased commercial to total yield ratio. The highest commercial yield (49 t/ha) was obtained with cattle manure or N + K_20 but there was no response to $P20_5$.

Farooque and Islam (1989) showed in an experiment that application of cowdung, oil cake, urea, triple superphosphate and muriate of potash combinedly gave better growth and maximum yield of cabbage. Similarly in another experiment maximum yield of cabbage was obtained (76.6 t/ha) from the combined effect of 180 kg N/ha, 60 kg P/ha and cowdung @ 5 t/ha and it was also stated a combination of the fertilizer was important rather than application of that single fertilizer for the production of cabbage (Anonymous, 1990).

The effects of compost and inorganic fertilizer on the growth, yield and pest damage on cabbage intercropped with tomatoes were investigated by Busayong (1996). He observed no significant differences in yield, growth and pest damage of cabbage applied with compost only or inorganic fertilizers only or mixture of composts and inorganic fertilizers.

Dixit (1997) investigated the effects of N (0, 40, 80, 120 or 160 kg/ha) and farmyard manure (FYM) (0 or 20 t/ha) on the growth of cabbages (cv. Pride of India) in Himachal Pradesh, India, in 1994. The yield increased with increasing N rate (from 136.8 to 175.1 q/ha after addition of 0 and 160 kg N/ha, respectively) and increasing FYM rate (from 129.5 to 144 q/ha). Addition of FYM to N treatments further increased yield (yield of 1761 q/ha in presence of FYM + 160 kgN/ha).

At the Horticulture Farm, Bangladesh Agricultural University, Mymensing, Rahman (2000) carried out an experiment and found that plant height of True Potato Seeds (TPS) seedlings was significantly influenced by the application of cowdung. The highest plant height (75.28cm) at 100 days was obtained from the highest dose of cowdung (100 t/ha).

Bohec (1990) studied the use of urban compost and sewage sludge coppost for vegetable crops in 1980-86. Various vegetable crops were grown in rotation on land with annual application of composted FYM, composted urban waste or composted sewage sludge. In 1981, the highest total yield of celery and yield trimmed to 40 cm. were given by compost Hydromer or by composted FYM while other composts gave lower yields. In 1982, the yield of leeks was similar in all treatments except the control without added organic manure and composted household was from Auray. Yields of celery in 1986 were the highest with FYM than that of any other treatments. Lettuce and celery showed accumulation of Cd while carrot and celery leaves accumulation Pb. In all treatments, including the control, soil Cu and Cd increased from 1980 to 1986.

Koddus and Morgans (1986) worked on Spent Mushroom Compost (SMC) and deep litter fowl manure (FM) as a soil ameliorant for vegetable. Spent Mushroom Compost and litter fowl manure were applied at 0,10,20,40 and 80 t/ha prior to sowing or transplanting celery, lettuce, cauliflower, broccoli and carrot in a ration. The thermal conductance and bulk density of soil decreased and its water stable aggregates (>0, 25 mm) hydraulic conductivity, water retention, N, P, K and organic C (OC) increased with increasing rates of Spent Mushroom Compost and litter fowl manure. Neither material increased soil salinity to a harmful level. Spent Mushroom Compost was superior to deep litter fowl manure in increasing soil pH and organic carbon. Both materials decreased the yields of the first three crops but not the fourth crop. Concentration of N, P, and K in the plant tissue increased as the rates of Spent Mushroom Compost and deep litter fowl manure increased. Deep litter fowl manure significantly increased the levels of Zn and Mn in the plant tissue.

Krupkin *et al.* (1994) made an investigation using poultry manure, a mixture of poultry manure plus hydrolysis lignin, and a compost of poulny manure plus hydrolysis lignin as organic fertilizers for potatoes, carrots, cabbage etc. with and without irrigation. The result should that these organic fertilizers improved the yield and quality of the crop, especially on soil having a low content of nitrate N, but had only litter effect on soils well supplied with nitrate N. the lignin based fertilizers i.e. mixture of poultry manure and hydrolysis lignin and a compost of poultry manure plus hydrolysis lignin were similar in their effect to poultry manure.

Flynn *et al.* (1995) carried out an experiment to evaluate the stability of composted broiler chicken manure as a potting substrate using lettuce plants. They mentioned that the broiler manure containing peanut hulls as breeding material was composted and then combined with a commercially available potting substrate. The highest fresh weight yield was obtained when broiler chicken litter compost was mixed with commercially available potting substrate at 3:1 ratio. There was no evidence of physiological disorders resulting from excessive nutrient concentration.

Roe (1998) carried out an experiment by using compost obtained from daiiy manure and municipal solid waste to find out the beneficial effects on broccoli. He found beneficial effects on growth, yield and nutrient component with compost application in the broccoli production.

An experiment was carried out by Zarate *et al.* (1997) in Brazil to evaluate the rates and methods of application of poultry manure on lettuce. The soil was supplied with 0, 7, or 14 t/ha semi-rotted poultry manure incorporated into the soil. They found in the absence of incorporated manure, surface application of manure 14 t/ha gave significantly higher yield (17.8 t fresh matter per ha) than other nutrients. When 7 t/ha was incorporated, the rate of surface application had no significant effect on yields (13.3-17 t/ha), whereas when 14 t/ha was incorporated, surface application of 7 t/ha manure gave the significantly highest yields (20 t/ha fresh matter).

An experiment carried out by Gaweda *et al.* (1995) in a pot trial, lettuce and carrot seedlings were grown in soil containing 0, 3 or 8% organic manure (peat) and 0, 300 or 600 mg Pb dm^3 (as lead acetate). The inclusion of organic manure in the soil reduced the Pb content of lettuce leaves and carrot roots in the Pb treatments. In the experimental conditions, no external symptoms of the Pb toxicity were observe but differences in the mineral and organic composition of lettuce leaves and carrot roots retarding Pb contamination was found, particularly in the soil with no organic manure.

Wright (1960) studied that Horse and cow manure contains approximately 0.5% N, 0.55% K and 0.25% Phosphoric acid. It thus supplies three of main elements needed by fruit plants.

Dumitrescu (1965) from his experiment on "composts as organic manures of high fertilizing value" reported that application of FYM at the rate of 20 t/ha gave higher total yield.

Gaur *et al.* (1971) found that FYM and organic residues were effective in increasing the level of organic matter even under tropical conditions.

Edmond *et al.* (1977) reported that organic matter increased the pore space of the soil and thus improved the rate of gas exchange. Application of compost to the soil increased water-holding capacity, reduced soil erosion and improved the physio-chemical and biological condition of the soil besides providing the plant nutrients.

Mustard oil cake (MOC) is a good source of N and S. Among different oil cakes, mustard oil cake is the most common in Bangladesh which contains 4.7% N, 1.8% P and 1.3% K (Ahmed, 1980).

Organic manures like cowdung, compost, farmyard manure, green manure and oil cake supply more or less complete food for plants. (Ahmed, 1982).

Prezotti *et al.* (1988) suggested that organic manure applications increased total productivity by 48% and improved the proportion of large fruits in the total yield.

CHAPTER-III

MATERIALS AND METHODS

CHAPTER-III

MATERIALS AND METHODS

This chapter deals with the materials and methods that were used in execution of the experiment. It includes a short description of experimental site, characteristics of soil, climate, materials used, data collection, statistical analysis and cost and return analysis. The details of these are described below.

3.1 Experimental Site

The experiment was conducted at the Horticulture Farm of Sher-e- Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, during the period from October 2005 to February 2006. The experimental site was previously used as vegetable garden and recently developed for research work. The location of the site is 23° 74'N latitude and 90° 35 E longitude with an elevation of 8.2 meter from sea level (Anon 1981).

3.2 Climate

The climate of the experimental site is subtropical, characterized by heavy rainfall during the months from April to September (Kharif season) and scanty rainfall during rest of the year (Rabi season). The total rainfall of the experimental site was 218 mm during the period of the experiment. The average maximum and the minimum temperatures were 29.45°C and 13.86° C respectively. Rabi season is characterized by plenty of sunshine. The maximum and minimum temperatures, humidity and rainfall during the study period were collected from the Bangladesh Meteorological Department (climate division) and have been presented in Appendix I.

3.3 Soil

The soil of the experimental area belongs to the Modhupur Tract. The analytical data of the soil sample collected from the experimental area were determined in SRDI, Soil Testing Laboratoiy, Dhaka and presented in appendix II.

The experimental site was a medium high land and pH of the soil was 5.6. The morphological characters of soil of the experimental plots as indicated by FAO (1988) are given below –

AEZ No. 28

Soil series - Tejgaon

General soil- Non-calcarious dark grey.

3.4 Plant Materials

Two Broccoli cultivars, ‘Sotomidori’ and ‘Premium crop’ (Takki company of Japan) was used in the experiment which was collected from Dhaka seed store and Kustia seed store, Miipur, Dhaka.

3.5 Raising of seedlings

For raising seedlings, the soil was ploughed and converted into loose friable and dried masses. All weeds, stubbles and dead roots were removed. Cowdung was applied to the prepared seed beds at the rate of 10 t/ha. The seeds were sown in the seed beds of 2.5m x lm size on 26 October 2005. After sowing, the seeds were covered with a thin layer of soil. When the seeds germinated, shade by bamboo mat (Chatai) was provided to protect the young seedlings from scorching sun-shine and rain. Light watering, weeding and mulching were done as and when necessary. No chemical fertilizers were applied for raising the seedlings. Seedlings were not attacked by any kind of insects or diseases. The healthy 27 days old seeldings were transplanted in the experimental field on 22 November 2005.

3.6 Land preparation

The experimental plot was opened first on the 2nd week of November 2005 by a power tiller for growing the desired crop. It was then thoroughly prepared by ploughing and cross ploughing was provide several times with a power tiller followed by laddering to bring until good tilth suitable for establishing the seedlings. Then the land was leveled and the corners of the experimental plot were shaped and the clods were broken into pieces. The land was cleaned of weeds and stubbles and was finally leveled.

3.7 Treatments of the experiment

The experiment was undertaken to study the effects of 5 different sources of organic manures on the growth and yield of broccoli. Thus the experiments included two factors as follows :

Factor A : Organic manure (five types)

1) Control (M_0); (No organic manure)

2) Cowdung (Mi); (26.5 t/ha)

3) Water hyacinth compost (M2); (10.6 t/ha)

4) Poultry litter (M_3); (16.56 t/ha)

5) Vermicompost (M4); (12.26 t/ha)

Factor B : cultivar (two)

1) 'Sotomidori' (V_1)

2) 'Premium crop' (V_2)

There were altogether 10 treatment combinations such as : M_0Vi, M_0V_2, M_1V_1, M_1V_5, M_2Vi, M_2V_2, M_3Vi, M_3V_2, M_4V_1 and M_4V_2.

3.8 Experimental design and layout

The two factors experiment was laid out following Randomized Complete Block Desgin (RCBD) with three replications. An area of 258.50 m^2 was first divided into three equal blocks. Each block consisted of 10 plots. Thus the total number of plots were 30. Different combinations of organic manures and cultivers were assigned randomly to each block as per design of the experiment. The size of a unit plot was 3m xl.8111 and the spacing was 0.5m x 0.6m. The distance between the two blocks and the plots were kept 0.75m and 0.50m respectively. A layout of the experiment has been shown in figure 1.

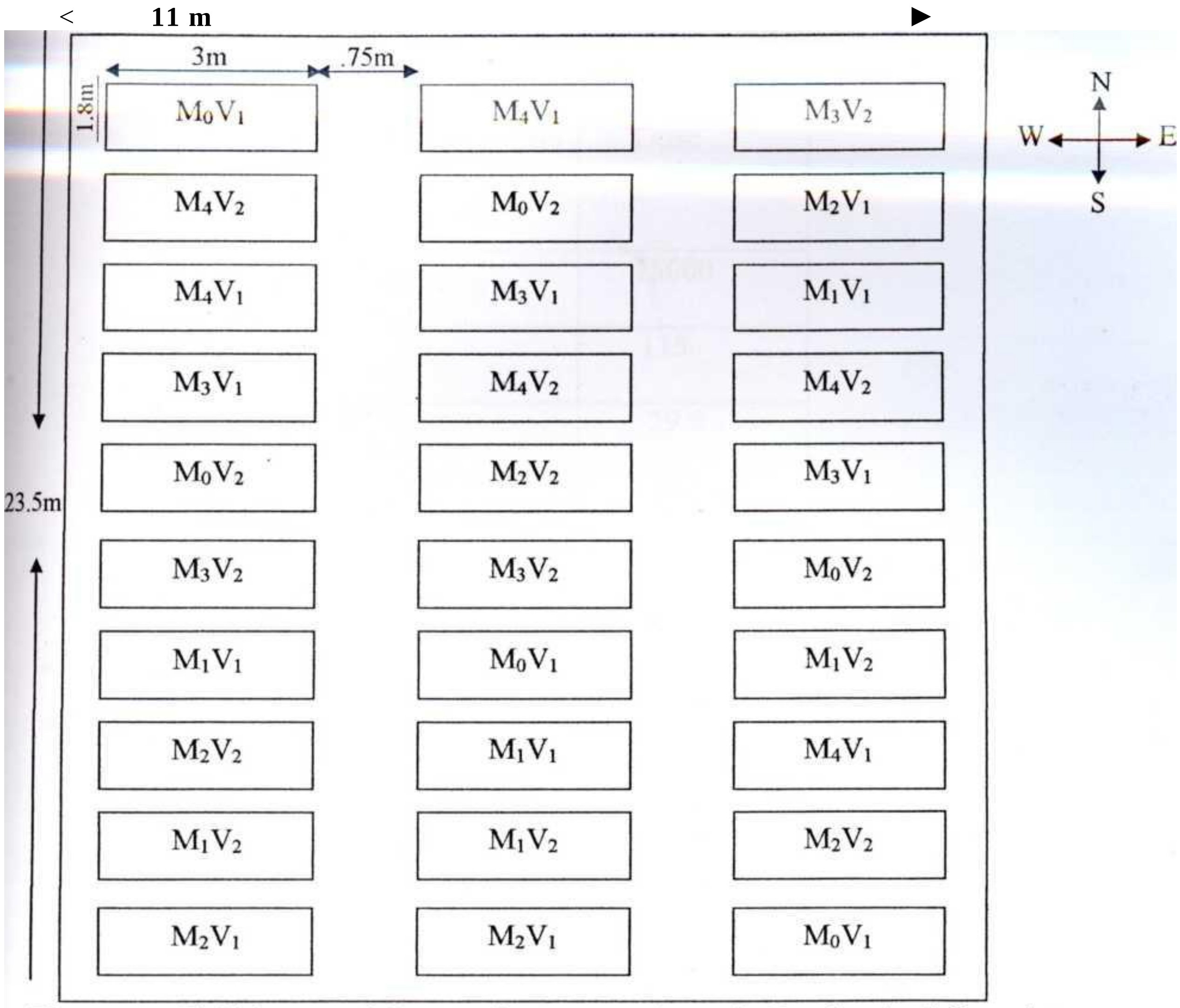

Figure 1. Field layout of the two-factor experiment in Randomized Complete Block Design (RCBD).

Number of treatments combination = 10,
Unit Plot size = 1.8m x 3m,
Plot spacing = 0.5in,
Between replication = 0.75m Spacing = 0.5m * 0.6m

Manures:
M_0 : Control (No organic manure)
M_1 : Cowdung (26.5 t/ha)
M_2 : Water hyacinth compost (10.6 t/ha)
M_3 : Poultry litter (16.56 t/ha)
M_4 : Vermicompost (12.26 t/ha)

Cultivars:
V_1 : 'Sotomidori'
V_2 : 'Premium crop'

3.9 Application of manures

The following doses of manures and fertilizers were recommended for broccoli production by Rashid (1993).

Manures and Fertilizers	Dose (kg / hectare)
Cowdung	15000
N	115
P	29.5
K	100

The above doses of manures and fertilizers were converted into manures as per treatment of the experiment so that almost same amount of N is supplied by each type of manure. The number in parentheses is the rate of nutrient in sources of manures used in the research. After conversion the dose of each manure used in the experiment was as follows.

Manures	Dose (ton/ha)	Dose (kg/plot)	Nutrient content of different manures (%)		
			N	P	K
Cowdung	26.50	14.31	0.5-1.5 (1)	0.4-0.8 (0.6)	0.5-1.9 (1.2)
Water hyacinth compost	10.60	5.72	2-3 (2.5)	1-2 (1.5)	3-4 (2.5)
Poultry litter	16.56	8.91	1.6	1.5	0.85
Vermicompost	12.26	6.58	2.16	1.44	2.55

* Plot size: 3 m * 1.8 m Source: Fertilizer Recommendation Guide, BARC (1997)

3.10 Transplanting and after care

Healthy 27 days old seedlings were transplanted on 22nd November, 2005 in the afternoon and light irrigation was given around each seedlings for their better establishment. Each unit plot accommodated 18 plants. The transplanted seedlings were protected from scorching sunlight early in the morning by providing shed using banana leaf sheath and remove just before sun set daily, until the seedlings were good established. A number of seedlings were planted in the border of the experimental plots for gap filling.

3.11 Gap filing

Dead, injured and weak seedlings were replaced by new healthy seedlings from the stock kept on the border line of the experiment.

3.12 Intercultural operation

3.12.1 Weeding

Weeding was done three times in each plot to keep clear.

3.12.2 Irrigation

Light irrigation was given just after transplanting of the seedlings. A week after transplanting the requirement of irrigation was envisaged through visual estimation. Wherever the plants of a plot had shown the symptoms of wilting the plots were irrigated on the same day with a hosepipe until the entire plot was properly wet.

3.13 Pest and Disease control

Few plants were damaged by mole crickets and cut worms after the seedlings were transplanted in the experimental plots. Cut worms were controlled both mechanically and spraying Diazinon 60 EC @ 0.55 Kg per hectare. Some of the plants were infected by *Alternaria brassicae.* To prevent the spread of the disease Rovral @ 2g /liter of water was sprayed in the field. Bird pests such as Nightingale (Common Bulbuli) visited the fields from 8 to 11 a.m. and 4 to 6 p.m. The birds were found to make puncture in the soft leaves and initiating curd and they were controlled by striking of a metalic container.

3.14 Harvesting

The harvesting was not possible on a particular date because curd initiation as well as curd maturation period in different plants were not similar probably due to use of different manures and genetic characters of varieties. The compact mature curds were only harvested. After harvesting the main curd, secondary shoots were developed from the leaf axils, and produced small secondary curds. Those were harvested over a period of time. The crop under investigation was harvested for the first time on January 24, 2006 and the last harvesting was done on February 20, 2006. The curds were harvested in compact condition before the flower buds opened (Thompson and Kelly, 1988).

3.15 Methods of Data collection

The data pertaining to the following characters were recorded from ten (10) plants randomly selected from each unit plot, except yield of curds which was recorded plot wise. Data on plant height was collected on 30, 40, 50 and 60 days after transplanting and also at harvest. All other parameters were recorded at harvest.

Data were collected on the following parameters :

0. Plant height
1. Number of leaves per plant
2. Length of leaf
3. Breadth of leaf
4. Diameter of curd
5. Diameter of stem
6. Plant canopy
7. Height upto curd from ground level
8. Weight of primary curd
9. Weight of secondary curd
10. Number of secondary curd
11. Yield per plant
12. Yield per unit plot
13. Yield per hectare
14. Dry weight of curd

3.15.1 Plant height (cm)

Plant height was measured in centimeter (cm) by a meter scale at 30, 40, 50, 60 days after transplanting (DAT) and at harvested from the ground level up to the tip of the longest leaf.

3.15.2 Number of leaves per plant

Number of leaves per plant of ten randomly selected plants were counted at harvest. All the leaves of each plant were counted seperately. Only the smallest young leaves at the growing point of the plant were excluded from counting.

3.15.3 Length of leaf (cm)

A meter scale was used to measure the length of leaves. Leaf length of ten randomly selected plants were measured in centimeter (cm) at harvest. It was measured from the base of the petiol to the tip of the leaf. All the leaves of each plant were measured seperately. Only the smallest young leaves at the growing point of the plant were excluded from measuring.

3.15.4 Breadth of leaf (cm)

Leaf breadth of ten randomly selected plants were measured in centimeter (cm) at harvest from the widest part of the lamina with a meter scale and average breadth was recorded in centimeter (cm). All the leaves of each plant were measured seperately. Only the smallest young leaves at the growing point of the plant were excluded from measuring.

3.15.5 Diameter of curd (cm)

Curd diameter was recorded in several directions with a meter scale at matured stage from ten randomly selected plants and each of plant was measured seperately.

3.15.6 Diameter of stem (cm)

The diameter of the stem was measured at the point where the central curd was cut off Stem diameter was recorded in three dimensions with scale and the average of the three values was taken in centimeter (cm).

3.15.7 Plant canopy (cm)

Plant canopy was measured by taking the diameter of the canopy of an individual plant in several directions with a meter scale and finally the average was taken and was expressed in centimeter (cm).

3.15.8 Height upto curd from ground level (cm)

The plant height upto curd was measured with a meter scale from the ground level to the top of the central curd and was recorded in centimeter(cm).

3.15.9 Weight of primary curd (g)

Weight of the central curd was recorded excluding the weight of all secondary curds and was expressed in gram (g).

3.15.10 Weight of secondary curd (g)

Weight of secondary curd was recorded by weighing the total axillary curds of an individual plant and was expressed in gram (g).

3.15.11 Number of secondary curds

When the secondary curds reached marketable size. They were counted; the small shoots were not taken into consideration.

3.15.12 Yield per plant (g)

The yield per plant was calculated by adding the weight of central curd and the weight of the secondary curds harvested and the yield was weighed in gram (g).

3.15.13 Yield per unit plot (kg)

The yield per unit plot was calculated by adding the weight of central curds and the weight of the secondary curds. The yield of all plants in each unit plot was recorded and was expressed in kilogram (kg).

3.15.14 Yield per hectare (ton)

The yield per hectare was calculated by converting the per plot yield data to per hectare and was expressed in ton (t).

3.15.15 Dry weight of broccoli curd (%)

A sample of 100 g of curd was collected and was dried under direct sunshine for 72 hours and then dried in an oven at 70 C for 3 days. After oven drying, curds were weighed. The dry weight was recorded in gram (g) with an electric balance. The percentage of dry matter was calculated by the following formula:

$$\text{Percent dry matter} = \frac{\text{Weight of dry matter}}{\text{Fresh weight}} \times 100$$

3.16 Statistical analysis

The data obtained from the characters were statistically analyzed to find out the variation resulting from experimental treatments following F variance test. The difference between treatments was adjusted by Duncan’s Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

3.17 Cost and return analysis

Cost and return analysis was done in details following the procedure of Alam *et al.* (1989) which was given in Appendix V.

CHAPTER-IV

RESULTS AMD DISCUSSION

CHAPTER-IV

RESULTS AND DISCUSSION

This chapter comprises of the presentation and discussion of the results obtained due to the influence of different sources of organic manures and cultivars and their possible combined effect on the growth and yield of broccoli. The results are presented in tables 1 to 10, figures 2 to 4 and necessary discussions have been presented under the following sub-headings. The analysis of variances for different characters is given in tables 1 to 10 and appendix III.

4.1 Plant height

Highly significant differences were found among the different sources of manures in respect of plant height of broccoli (Table 1). The highest plant height (64.9 cm) was recorded from M_3 treatment followed by M4 (63.0 cm) treatment and the shortest plant (56.6 cm) was given by M_0 treatment at the time of harvest. During the period of plant growth, at 30, 40, 50, and 60 days after transplanting (DAT), the highest plant height 40.3cm, 49.5cm, 59.0cm and 62.2cm respectively, were found from M_3 treatment and followed by M_1, M_2, and M4 treatments. The shortest plant height 30.9cm, 39.1cm, 51.6cm and 55.1cm were found at 30, 40, 50, and 60 days after transplanting in M_0 treatment respectively. The plant height increased with the increase of period of time. The plant height reached to its maximum at harvesting time in all the treatments. The might be due to the fact that manures supplied adequate plant nutrients for better vegetative growth of the broccoli plants which ultimately increased plant height. The findings of the present study corroborates with the findings of Thompson and Kelly (1988). They reported that manure is of value as a source of humus, a source of both major and minor nutrients as a carrier and promoter of beneficial organisms and possibly as a source of growth promoting substances. On decomposition of the organic matter carbon dioxide is set free and this may be of direct value in increasing the carbon dioxide content of the air and of indirect value in making available some of the mineral elements in the soil.

The plant height was significantly different due to the use of different cultivars of broccoli (Table 2).The maximum (63.2 cm) plant height was obtained in 'Premium crop' (V_2) cultivar and the minimum (59.1 cm) plant height was found in 'Sotomidori' (V_1) cultivar at harvest time respectively.

Plant height was found to be significantly different due to the combined effect of different sources of manures and cultivars at different days after transplanting (Table 3). The maximum plant height (65.2 cm) was measured from plants grown under M_3V_2 treatment combination and followed by M_1V_2, M_2V_2, M_3V_1, M_4V_1 and M_4V_2 treatment combinations respectively. The minimum plant height (53.5 cm) was recorded from M_0V_1 treatment combination. Thompson and Kelly (1988) reported that the rate of release of nitrogen from the manure is higher in poultry litter than other sources of manures which ultimately was reflected in higher plant growth.

4.2 Height upto curd

A significant variation was observed in height from ground level upto curd among the different sources of manures (Table l).The maximum (31.5 cm) height upto curd was recorded from M3 treatment. This was identically followed by M_4 treatment (30.4 cm) and the minimum (28.5cm) was found in M_0 treatment.

The height upto curd from ground level was significantly different due to the use of different cultivars of broccoli (Table 2). 'Premium crop' cultivar produced the maximum (30.9 cm) height upto curd level which was identically followed by the 'Sotomidori' cultivar (29.2 cm).

The height upto curd from the ground level was found to be significantly different due to the combined effect of different sources of manures and cultivars (Table 3). The highest (31.5 cm) height upto curd from ground level was found from M_3V_2 treatment combination followed by M_4V_2 (31.4 cm) and M_3V_1 (31.3 cm) treatment combinations respectively and the lowest (27.7 cm) was found from M_0V_1 treatment combination.

Table 1. Main effect of different sources of manures on the height of broccoli

Sources of Manures	Plant height (cm) at				Plant height at harvest (cm)	Height up to curd from ground level (cm)
	30 DAT	40 DAT	50 DAT	60 DAT		
M_0	30.9c	39.1c	51.6c	55.1b	56.6b	28.5b
Mj	35.5b	43.2b	53.7bc	57.9ab	60.2ab	29.8ab
m_2	35.7b	45.0b	56.2ab	58.7ab	61.1ab	29.9ab
m_3	40.3a	49.5a	59.0a	62.2a	64.9a	31.5a
m_4	37.6b	45.5b	57.2b	60.1a	63.0a	30.4ab
LSD(o.o5)	1.99	2.90	3.22	4.21	4.78	2.67
CV (%)	4.55	5.39	4.78	5.90	6.45	5.18

Mean in the column followed by different letters differed significantly by DMRT at 5% level of significance

M_0: No manure
M_1: Cowdung
M2: Water hyacinth compost
M3 : Poultry litter
M4: Vermicompost

Table 2. Main effect of cultivars on the height of broccoli

Cultivars	Plant height (cm) at				Plant height at harvest (cm)	Height up to curd from ground level (cm)
	30 DAT	40 DAT	50 DAT	60 DAT		
V,	34.8b	43.0b	53.5b	56.6b	59.1b	29.2b
v_2	37.2a	45.9a	57.6a	61.0a	63.2a	30.9a
LSD (0.05)	1.25	1.83	2.03	2.66	3.02	1.19
CV(%)	4.55	5.39	4.78	5.90	6.45	5.18

Mean in the column followed by different letters differed significantly by DMRT at 5% level of significance

Vi= Sotomidori

V2 = Premium crop

Table 3. Combined effect of sources of manures and cultivars on the height of broccoli

Sources of manures x cultivars	Plant height (cm) at				Plant height at harvest (cm)	Height up to curd from ground level (cm)
	30 DAT	40 DAT	50 DAT	60 DAT		
M_0V_1	30.9f	38.5e	50.7d	52.1c	53.5c	27.7c
M_0V_2	31.Of	39.6de	52.5cd	58.0abc	59.6abc	29.4abc
M_1V_1	33.0ef	40.8de	51.2cd	55.1bc	57.2bc	28.5bc
M_1V_2	38. labc	45.5abc	56.2bc	60.Sab	63.lab	31.2ab
M_2Vi	34.5de	43.9bcd	53.5cd	56.2abc	58. labc	28.6bc
m_2v_2	36.9bcd	46. labc	58.8ab	61.3ab	64. lab	31.lab
M_3V_1	39.6ab	48.9a	55.7bcd	61.5ab	64.6ab	31.3ab
m_3v_2	41.0a	50.1a	58.8ab	62.9a	65.2a	31.5a
M_4V_1	36.2cd	42.7cde	56.3bc	58.0abc	61.2ab	29.5abc
M_4V_2	39.0abc	48.4ab	61.8a	62.2a	64.8ab	31.4ab
LSD (0.05)	2.81	4.11	4.55	5.95	6.77	2.67
CV (%)	4.55	5.39	4.78	5.90	6.45	5.18

Mean in the column followed by different letters differed significantly by DMRT at 5% level of significance

M_0: No manure

M1 : Cowdung
M_2: Water hyacinth compost

M_3 : Poultry litter

M_4 : Vermicompost

V1= Sotomidori
V2=Premium crop

4.3 Number of leaves per plant

The sources of manures showed significant variation on number of leaves per plant (Table 4). The maximum number of leaves per plant (19.4) was observed in the plants having poultry litter. This was followed by water hyacinth compost (18.8) treatment and the lowest (16.9) was found from the control treatment.

Broccoli cultivars were significantly influenced due to number of leaves per plant (Table 5). The maximum (18.8) number of leaves per plant was obtained in 'Premium crop' cultivar and the lowest (17.7) number of leaves was found in 'Sotomidori' cultivar.

The combined effect of different sources of manures and cultivars were significantly influenced on the number of leaves per plant and the results have been presented in table 6. The maximum number of leaves (20.3) was recorded in the treatment M_3V_2 followed by M_2V_2 (19.6). The minimum number of leaves per plant (16.6) was found from M_0Vi treatment.

4.4 Length of leaf

There was significant variation on the length of leaf due to different sources of manures (Table 4). The application of M_3 treatment produced the longest (48.3 cm) leaf and the lowest (38.4 cm) leaf length was produced by M_0 treatment. Balyan *et al.* (1988) observed that nitrogen fertilizer improved the number of leaves per plant and leaf size index over the control. Poultry litter releases nitrogen fast. Organic manures which increase the water holding capacity of the soil are desirable for the broccoli crop whenever they can be used.

The length of leaf varied significantly due to use of different cultivars (Table 5). The maximum length of leaf (43.9 cm) was obtained in V_2 cultivar and it was identically followed by V_1 cultivar (38.4 cm).

The treatment combinations of different sources of manures and cultivars significantly influenced the length of leaf. The longest leaf (51.3 cm) was found from the plants in treatment combination M_3V_2. On the other hand, the shortest leaf (38.1 cm) was obtained from M_0V_1 treatment.

4.5 Breadth of leaf

The breadth of leaf significantly varied with the application of different sources of manures (Table 4). The maximum (21.2 cm) breadth of leaf was obtained from poultry litter and the lowest (18.2 cm) was found from the control treatment.

There was a significant variation due to the use of different cultivars of broccoli (Table 5). The maximum (19.4 cm) breadth of leaf was found from the 'Premium crop' cultivar and this was identically followed by the use of 'Sotomidori' cultivar (18.2 cm).

The variation due to the combined effect of different sources of manures and cultivars were significant on the breadth of leaf (Table 6). It was observed that the breadth of leaf was the highest (21.6 cm) in the plant having a treatment combination of M_3V_2 and the lowest (18.1 cm) leaf breadth was recorded from the treatment combination M_0V_1.

4.6 Plant canopy

Statistically significant difference was observed in spread of plant canopy as affected by different sources of manures (Table 4). The spread of plant canopy was equally better in all the treatments of manures except in the control, where it showed the lowest spread. This might be due to the fact that the treatments with different sources of manures received adequate nutrients and resulted in maximum vegetative growth and increased plant canopy. Soil organic matter is the key to soil fertility. It regulates the soil water and air supply, which in turn controls the rate at which nutrients are absorbed by the root. In this study, organic manure increased the activity of microorganisms which ultimately made more availability and absorption of essential plant nutrients resulting in increased plant canopy.

There was no significant variation in the plant canopy due to the use of different cultivars of broccoli (Table 5). The 'Premium crop' cultivar gave the maximum (68.5 cm) plant canopy which was statistically similar with 'Sotomidori' cultivar (65.4 cm).

Plant canopy was found to be significantly different due to the combined effect of different sources of manures and cultivars. The results have been presented in table 6. The widest plant canopy (87.2 cm) was produced by M_3V_2 treatment combination while the narrowest (61.2 cm) plant canopy was noticed in M_0Vi treatment combination.

4.7 Diameter of curd

The effect of different sources of manures was significant for curd diameter in broccoli (Table 4). The maximum (16.8 cm) diameter of curd was recorded from M_3 treatment. This was identically followed by M_2 (16.0 cm) and M_4 (15.8 cm) treatments respectively. The lowest (12.3 cm) diameter of curd was measured from M_0 treatment.

Steffen *et al.* (1994) observed the effect of organic matter (spent mushroom compost at 64mt/ha + rotten cattle manure at 57mt/ha) on the growth and yield of broccoli. They concluded that broccoli yield and curd diameter were greater in the amended treatment.

There was a significant variation in the diameter of curd due to the use of different cultivars of broccoli (Table 5). 'Premium crop' cultivar gave the highest diameter (14.9 cm) of broccoli curd which was significantly different from 'Sotomidori' (12.3cm) cultivar.

The combined effect of different sources of manures and cultivars were also significant in respect of diameter of curd of broccoli (Table 6). The maximum diameter of curd (17.6 cm) was obtained from the treatment combination M_3V_2 and it was statistically identical with the combination M_2V_2 (16.8 cm). However, the lowest diameter of curd (12.3 cm) was obtained from the treatment combination $M_0V_{1.}$

4.8 Diameter of stem

Significant variation among the different sources of manures had been observed in the diameter of stem (Table 4). The diameter of stem was equally better in all the treatments of the sources of manures except in the control, where it showed significantly the lowest (3.6 cm) diameter of stem.

It appeared from table 5 that the diameter of stem differed significantly due to the use of different broccoli cultivars. The highest (4.3 cm) diameter was found from V_2 cultivar and the lowest (3.6 cm) diameter was found from *W*\ cultivar.

The treatment combinations of different sources of manures and cultivars significantly influenced the thickness of stem (Table 6). The thickest stem (5.1 cm) was recorded from the treatment combination M4V2 followed by M3V2 treatment combination (4.7 cm). On the other hand, the lowest (3.2 cm) stem diameter was found from M_0Vi treatment combination.

Table 4. Main effect of different sources of manures on the number of leaves per plant, length of leaf, breadth of leaf, plant canopy, diameter of curd and diameter of stem of broccoli

Sources of manures	No. of leaves per plant	Length of leaf (cm)	Breadth of leaf (cm)	Plant canopy (cm)	Diameter of curd (cm)	Diameter of Stem (cm)
Mo	16.9b	38.4c	18.2c	65.4b	12.3c	3.6c
Mi	17.4b	43.9ab	19.4b	68.5b	14.9b	4.3b
m_2	18.8a	42.8bc	20.8a	81.5a	16.0ab	4.1b
m_3	19.4a	48.3a	21.2a	84.6a	16.8a	4.5ab
MU	18.6a	41.7bc	19.0bc	86.9a	15.8ab	4.8a
LSD (0.05)	1.02	4.85	1.03	6.75	1.98	0.43
CV (%)	4.60	9.30	4.30	7.19	5.55	8.25

Mean in the column followed by different letters differed significantly by DMRT at 5% level of significance

M_0: No manure

Mj : Cowdung

M_2: Water hyacinth compost

M_3: Poultry litter

M_4 : Vermicompost

Table 5. Main effect of cultivars on the number of leaves per plant, length of leaf, breadth of leaf, plant canopy, diameter of curd and diameter of stem of broccoli

Sources of manures	No. of leaves per plant	Length of leaf (cm)	Breadth of leaf (cm)	Plant canopy (cm)	Diameter of curd (cm)	Diameter of Stem (cm)
V,	17.7b	38.4b	18.2b	65.4a	12.3b	3.6b
V_2	18.8a	43.9a	19.4a	68.5a	14.9a	4.3a
LSD (0.05)	0.64	3.07	0.65	4.27	0.64	0.27
CV (%)	4.60	9.30	4.30	7.19	5.55	8.25

Mean in the column followed by different letters differed significantly by DMRT at 5% level of significance

V1= Sotomidori

V_2 = Premium crop

Table 6. Combined effect of sources of manures and cultivars on the number of leaves per plant, length of leaf, breadth of leaf, plant canopy, diameter of curd and diameter of stem of broccoli

Sources of manures x cultivars	No. of leaf/ plant	Length of leaf (cm)	Breadth of leaf (cm)	Plant canopy (cm)	Diameter of curd (cm)	Diameter of Stem (cm)
M_0V]	16.6f	38.1c	18.le	61.2d	12.3d	3.2e
M_0V_2	17.3def	38.7bc	18.3de	67.5cd	12.4d	3.9cd
M_1V_1	17.0ef	41.2bc	19.1cde	61.6d	14.6c	4.2bcd
M!V_2	17.9cdef	46.5ab	19.8bcd	75.4bc	15.2bc	4.4abcd
M_2Vj	18.0cdef	41.3bc	20.5abc	80.7ab	15.1c	3.8de
m_2v_2	19.6ab	44.2abc	21.0ab	82.2ab	16.8ab	4.5abc
m_3v,	18.6bcd	45.4abc	20.9ab	82.0ab	15.9bc	4.3bcd
m_3v_2	20.3a	51.3a	21.6a	87.2a	17.6a	4.7ab
M4V1	18.3bcde	41.2bc	18.7de	86.7a	15.5bc	4.6abc
M4V_2	19.0abc	42.3bc	19.3cde	87.0a	16.1abc	5.1a
LSD(O.O5>	1.44	6.87	1.45	9.55	1.44	0.60
CV (%)	4.60	9.30	4.30	7.19	5.55	8.25

Mean in the column follow ed by different letters differed significantly by DMRT at 5% level of significance

Mo: No manure
Mi : Cowdung
M_2: Water hyacinth compost
M_3: Poultry litter
M_4 :Vermicompost

Vi= Sotomidori
V_2 = Premium crop

4.9 Weight of primary curd

Different sources of manures showed significant effect on the weight of primary curd of broccoli (Table 7). The maximum (213.4 g) primary curd weight was recorded from M_3 treatment followed by M4 (202.7 g) and M_2 (175.2 g) treatments respectively. The lowest (140.5 g) primary curd weight was found from M_0 treatment.

There was significant influence of different cultivars of broccoli on the primary curd weight (Table 8). The primary curd attained the maximum (200.8 g) weight observed from Vi cultivar. The lowest (154.3 g) primary curd weight was found from V_2 cultivar.

The combined effect of different sources of manures and cultivars had significant influenced on the primary curd weight of broccoli (Table 9). The highest (245.9 g) central curd weight was recorded from M3V1. This was followed by the treatment combinations M4V1 (221.2 g) and M_2Vi (216.2 g) respectively. The lowest (134.9 g) weight of primary curd was measured from M_0V_2 treatment combination.

4.10 Number of Secondary curd

The number of secondary curds per plant varied significantly among different sources of manures (Table 7). The maximum (7.0) number of secondary curds was obtained when the plants were supplied M_3 treatment and this was followed by M4 (6.3) treatment. M_0 treatment gave the lowest (5.5) number of secondary curds.

The number of secondary curds had significant difference due to the use of different cultivars of broccoli (Table 8). The highest (6.4) number of secondary curd per plant was counted from Vi cultivar. The lowest (5.8) number of secondary curds was found from V_2 cultivar.

The results on combined effect of different sources of manures and cultivars on secondary curds per plant have been presented in table 9.

The highest (7.5) number of secondary curds was obtained from the plants grown under treatment combination M_3V_1. This was followed by treatment combinations M4V1 (7.3) and M4V2 (6.6) respectively. The lowest number of secondary curds (5.2) was observed in M0V2 treatment combination.

4.11 Weight of secondary curd

The effect of different sources of manures on secondary curd weight was statistically significant (Table 7). The maximum (184.2 g) weight of secondary curd was recorded from the plants which received M3 treatment. This was followed by M4 (171.7 g) treatment. The minimum (88.1 g) weight of secondary curd was recorded from control (M_0) treatment.

The weight of secondary curd was found to vary due to the use of different cultivars of broccoli (Table 8). The maximum (144.1 g) weight of secondary curd per plant was recorded from V_t cultivar. The lowest (126.2 g) weight of secondary curd was observed from V_2 cultivar.

The interaction effect of different sources of manures and cultivars were highly significant for secondary curd weight (Table 9). The highest (202.6 g) weight of secondary curd was recorded from the combination M4V1 followed by the treatment combination M3V1 (189.6 g). The lowest secondary curd weight (86.8 g) was measured from the combination MoV_2 treatment combination.

4.12 Dry weight of broccoli curd

The results 011 main effects of sources of manures on the production of dry weight of broccoli curd have been presented in table 7. The sources of manures had significant influence 011 the production of dry matter of broccoli curd. The maximum (8.2%) dry weight of broccoli curd was recorded from the application of M_3 treatment and Mo treatment gave the minimum (6%) dry weight.

In the present study, cultivars had no significant influenced on the dry weight of broccoli curd. The maximum (7.6%) dry weight of broccoli curd was measured from V_1 cultivar. The minimum (7.1%) dry weight of broccoli curd was found from V_2 cultivar.

The results of the combined effect of different sources of manures and cultivars on the production of dry weight of broccoli curd have been presented in table 9. The maximum (8.2%) dry weight of broccoli curd was recorded from the treatment combination M_3V_1, while the minimum (5.3%) dry weight was obtained from the treatment combination M_0V_2.

4.13 Yield per plant

Yield per plant varied significantly among different sources of manures (Table 7). The maximum (397.6 g) yield per plant was recorded from M_3 treatment. This was followed by M4 treatment (374.4 g), while M_0 treatment gave the lowest (228.6 g) yield per plant. It was possible that poultry litter provided good soil condition for growth as well as supplied sufficient plant nutrients that helped the production of highest yield per plant.

The curd yield per plant was significantly influenced due to the use of different cultivars of broccoli (Table 8). The highest (344.9 g) yield per plant was produced from V_1 cultivar and the lowest (280.6 g) yield per plant was noted from V_2 cultivar.

The combined effect of different sources of manures and cultivars on yield per plant was significantly influenced. The highest (435.6 g) yield per plant was recorded from M_3Vj treatment combination followed by M4V1 (423.9g) treatment combination. The lowest (221.6 g) yield per plant was observed in M_0V_2 treatment combination.

4.14 Yield per plot and hectare

The yield per plot as well as per hectare was found to be significantly influenced by the different sources of manures (Table 7 and Figure 2). The highest (6.93 kg) curd yield per plot and yield per hectare (12.83 ton) were recorded from M_3 treatment. These were followed by M* treatment which gave (6.52 kg) per plot and (12.09 ton) broccoli curd per hectare, while the lowest (4.11 kg) curd yield per plot and per hectare (7.61 ton) were obtained from the plants having M_0 treatment.

Yield of broccoli per plot and per hectare was significantly influenced by using different cultivars of broccoli (Table 8 and Figure 3). The highest (6.20 kg) yield of broccoli per plot and per hectare (11.48 ton) was found from Vi cultivar. The lowest (5.04 kg) yield per plot and per hectare (9.33 ton) was recorded in V_2 cultivar.

There was an interaction between different sources of manures and cultivars on the yield of broccoli (t/ha) (Appendix IV). The yield of broccoli per plot and per hectare was influenced significantly due to the combined application of manures from different sources and cultivars (Table 9 and Figure 4). The highest (7.83 kg) yield per plot and per hectare (14.50 ton) were produced by the treatment combination M3V1, followed by treatment combination M_4Vi which produced (7.63 kg/plot) and (14.12 ton/ha). The lowest (3.98 kg/plot) and (7.37 ton/ha) yield were recorded from the combination M_0V_2.

Table 7. Main effect of different sources of manures on the yield of broccoli

Sources of manures	No. of secondary curd	Weight of Secondary curd (g)	Weight of primary curd (g)	Dry weight of curd (%)	Yield/plant (g)	Yield/plot (kg)
M_0	5.5d	88.Id	140.5d	6.0c	228.6c	4.11b
M_1	5.6cd	112.9c	155.9c	7.1b	268.8bc	4.83b
m_2	6.2bc	118.8c	175.2b	7.4ab	294.0b	5.28b
m_3	7.0a	184.2a	213.4a	8.2a	397.6a	6.93a
m_4	6.3b	171.7b	202.7a	8.1a	374.4a	6.52a
LSD (0.05)	0.66	11.58	13.53	0.70	44.14	1.23
CV (%)	8.98	7.06	6.28	7.81	11.76	18.13

Mean in the column followed by different letters differed significantly by DMRT at 5% level of significance

M_0: No manure

Mi : Cowdung

M_2: Water hyacinth compost

M_3: Poultry litter

M4: Vermicompost

Table 8. Main effect of cultivars on the yield of broccoli

Cultivars	No. of secondary curd	Weight of Secondary curd (g)	Weight of primary curd (g)	Dry weight of curd (%)	Yield/plant (g)	Yield/plot (kg)
v,	6.4a	144.1a	200.8a	7.6a	344.9a	6.20a
V_2	5.8b	126.2b	154.3b	7.1a	280.6b	5.04b
LSD (0.05)	0.42	7.32	8.56	0.44	27.91	0.78
CV (%)	8.98	7.06	6.28	7.81	11.76	18.13

Mean in the column followed by different letters differed significantly by DMRT at 5% level of significance

Vi : Sotomidori

V_2: Premium crop

Table 9. Combined effect of sources of manures and cultivars on the yield of broccoli

Sources of manures x cultivars	No. of secondary curd	Weight of Secondary curd (g)	Weight of primary curd (g)	Dry weight of curd (%)	Yield/plant (g)	Yield/plot (kg)
M_0V_1	5.7bc	89.5d	146. Id	6.7d	235.6c	4.23cd
m_0v_2	5.2c	86.8d	134.9d	5.3e	221.6c	3.98d
M_IV_1	5.9bc	113.1c	174.5c	7.2bcd	254.3c	5.17bcd
m,v_2	5.4c	112.7c	137.4d	7.0cd	250.2c	4.50bcd
M_2V_1	6.5ab	126.1c	216.2b	7.6abcd	342.3b	6.15abc
m_2v_2	5.9bc	111.6c	135.2d	7.2abcd	246.8c	4.42bcd
M_3V_1	7.5a	189.6a	245.9a	8.2a	435.6a	7.83a
m_3v_2	6.0bc	153.9b	181.0c	8.0abc	334.9b	6.02abc
M_4V_1	7.3a	202.6a	221.2b	8. lab	423.9a	7.63a
M_4V_2	6.6ab	165.8b	184.3c	8.0abc	350.2b	6.30ab
LSD (o.o5)	0.94	16.37	19.14	0.99	62.43	1.75
CV (%)	8.98	7.06	6.28	7.81	11.76	18.13

Mean in the column followed by different letters differed significantly by DMRT at 5% level of significance

M_0 : No manure
Mi : Cowdung
M_2 :Watcr hyacinth compost
M_3: Poultry litter
M_4: Vcrmicompost

V_1= Sotomidori
V_2 = Premium crop

Main effect of the different sources of manures on the yield of broccoli

M_0: No manure

Mi . Cowdung

M_2 :Water hyacinth compost

M_3: Poultry litter

M_4: Vermicompost

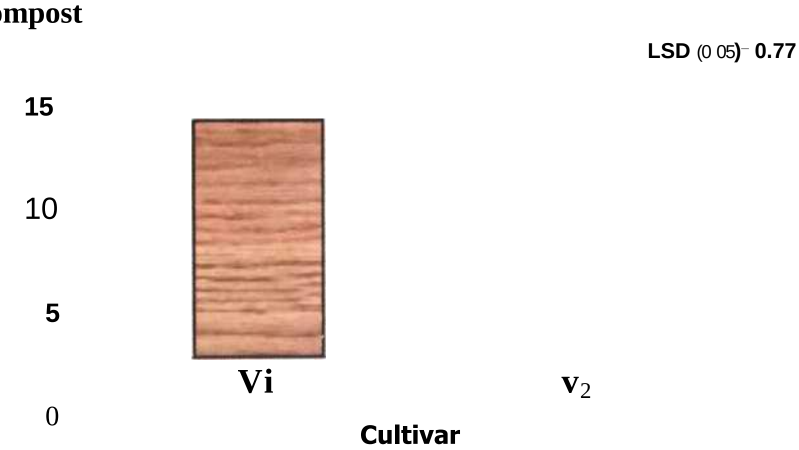

Figure 3. Main effect of the cultivars on the yield of broccoli

V_1= Sotomidori

V_2 = Premium crop

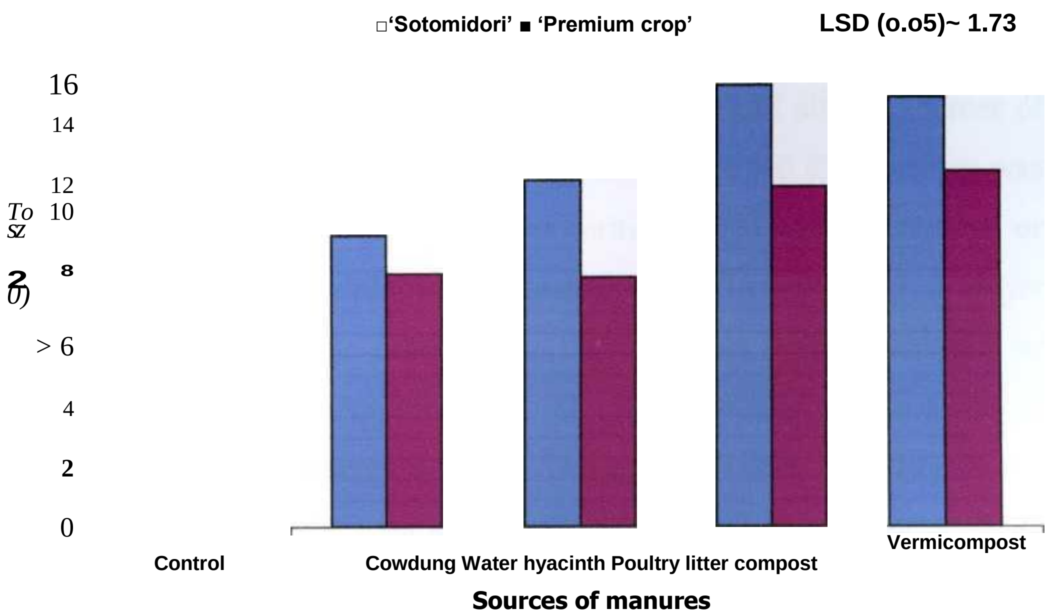

Figure 4. Combined effect of sources of manures and cultivars on the yield of broccoli

4.15 Cost and return analysis

The cost and return analysis was done and has been presented in table 10 and Appendix V. Materials, non-materials and overhead cost were recorded for all the treatments of unit plot and calculated on per hectare basis. The price of broccoli at the local market rate was considered.

The total cost of production ranged between Tk. 50122.00 to Tk. 132866.00 per hectare among the different treatment combinations. The variation was due to different cost of broccoli cultivar and different sources of organic manures. The highest cost of production Tk 132866.00 per hectare was recorded in the treatment combinations of vermicompost with ‘Sotomidori’ or ‘Premium crop’ cultivar; while the lowest cost of production TK.50122.00 per hectare was recorded in the combination of no manure with ‘Sotomidori’ or ‘Premium crop’ cultivar (Appendix V). The gross return from the different treatment combinations ranged between Tk. 147400.00 and Tk.290000.00 per hectare. The return was the total income through sale of harvested broccoli @ Tk. 20,000 per ton.

Among the different combinations, poultry litter with ‘Sotomidori’ cultivar gave the highest net return (Tk.224381.00 per hectare) while the lowest net return Tk. (97277.00 per hectare) was obtained from the treatment combination of no manure with ‘Premium crop’ cultivar.

The benefit cost ratio (BCR) was found to be the highest (4.41) in the treatment combination M3V1 (Poultry litter with ‘Sotomidori’ cultivar).While the second highest was recorded from M_2Vj (4.09) combination where water hyacinth compost with ‘Sotomidori’ cultivar were used. On the other hand, the lowest BCR (1.75) was recorded from M_4V_2 (Vermicompost with ‘Premium crop’ cultivar). The present experiment revealed that the application of poultry litter manure with ‘Sotomidori’ cultivar was found to be conducive to higher economic return from broccoli and from soil under the Modhupur Tract of Bangladesh.

Table 10. Cost and return of broccoli due to organic manures and cultivars

Treatment Combination	Yield t/ha	Gross return (Tk./ha)	Total cost of production (Tk./ha)	Net return (Tk./ha)	Benefit cost ratio (BCR)
M_0V,	7.84	156800.00	50122.50	106677.50	3.12
m_0v_2	7.37	147400.00	50122.50	97277.50	2.94
MiVj	9.57	191400.00	62666.25	128733.75	3.05
M!V_2	8.32	166400.00	62666.25	103733.75	2.65
M_2V!	11.39	227800.00	55574.85	172225.15	4.09
m_2v_2	8.18	163600.00	55574.85	108025.15	2.49
M_3V,	14.50	290000.00	65618.77	224381.23	4.41
m_3v_2	11.15	223000.00	65618.77	157381.23	3.39
M_4Vi	14.12	282400.00	132866.65	149533.35	2.12
m_4v_2	11.66	233200.00	132866.65	100333.35	1.75

M_0 : No organic manure

Mi : Cowdung

M_2: Water hyacinth compost

M_3: Poultry litter

M_4 : Vermicompost

Vj = Sotomidori

V_2 = Premium crop

Note: Sale of broccoli @ Tk.20000.00/t

Total income = Yield (t/ha) x Tk. 20000.00;

BCR = Gross return -*• Total cost of production

CHAPTER V

SUMMARY AND CONCLUSION

CHAPTER-V

SUMMARY AND CONCLUSION

Ail experiment was conducted at the Horticulture Farm of Sher-e-Bangla Agriculture University, Dhaka to evaluate the effect of different sources of organic manures on the growth and yield of broccoli during the period from October 2005 to February 2006. The experiment consisted of five different sources of organic manures viz., no organic manure (control), cowdung (26.5 t/lia), water hyacinth compost (10.6 t/ha), poultry litter (16.56 t/ha) and vermicompost (12.26 t/ha) and two different cultivars viz., ‘Sotomidori’ and ‘Premium crop’.

The two-factor experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. There were altogether 10 treatment combinations in this experiment. Unit plot size was of 3.0 x 1.8 m where 0.75 m and 0.50 m gap between the blocks and plots, respectively were maintained. The experimental plots were fertilized either with cowdung or with water hyacinth compost or with poultry litter or with vermicompost as per treatment to maintain a recommended dose of more or less 15 ton of cowdung, 115 kg of N, 29.5 kg of P, and 100 kg of K per hectare. All organic manures were applied during the final land preparation. The broccoli seed of cv. ‘Sotomidorr and ‘Premium crop’ were used as per treatment. Data were collected from 10 randomly selected plants in each plot. Yield was recorded from all plants of each plot. Data on plant height, height upto curd, number of leaves per plant, length of leaf, breadth of leaf, plant canopy, diameter of stem, diameter of curd , weight of curd, number of secondary curd, weight of secondary curd, dry weight of 100 g curd, yield per plant, yield per plot and yield per hectare were recorded. All collected data of the present study were analyzed statistically and the mean differences were adjudged by Least Significant Difference (LSD) test.

The result of the experiment revealed that almost all the parameters studied were significantly influenced by different sources of organic manures. More or less, all the characters attained highest values when poultry litter was applied. The control gave the lowest value in all the characters studied. Maximum yield/plant 397.6 g, yield/plot 6.93 kg and yield/ha 12.83 ton were obtained by poultry litter and the minimum yield/plant 228.6 g, yield/plot 4.11 kg, and yield/ha 7.61 ton were found in the control plot.

Different cultivars played vital role on the growth and yield of broccoli. Cultivars had significant effect on more or less all the characters. The maximum yield/ plant 344.9 g, yield/plot 6.20 kg and yield/ha 11.48 ton were obtained from 'Sotomidori' cultivar.

The combined effect of different sources of organic manures and cultivars exhibited significant variation for all the parameters under study. The maximum yield/plant 435.6 g, yield/plot 7.83 kg and yield/ha 14.50 ton was recorded from the treatment combination of poultry litter with 'Sotomidori' cultivar (M_3Vi). The minimum yield/plant 221.6 g, yield/plot 3.98 kg and yield/ha 7.37 ton were found from no manure with 'Premium crop' (M_0V_2) treatment combination.

The highest cost Tk. 132866/ha was involved with vermicompost in 'Premium crop' treatment combination but the highest net return Tk.224381/ha was obtained from poultry litter with 'Sotomidori' treatment combination. The maximum benefit cost ratio 4.41 was recorded for poultry litter with 'Sotomidori' (M_3V]) treatment combination.

From the present experiment it may be concluded that the application of poultry litter along with 'Sotomidori' cultivar was conducive to higher economic return from broccoli cultivation under the Modhupur Tract (AEZ 28) of Bangladesh.

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APPENDIX

Appendix I. Monthly record of air temperature, rainfall, relative humidity and sunshine of the experimental site during the period from October 2005 to February 2006

Year	Month	Air temperature (°c)			Relative humidity (%)	Rainfall (mm)
		Maximum	Minimum	Mean		
2005	October	30.97	23.31	27.14	75.25	208
	November	29.45	18.63	24.04	69.52	00
	December	26.85	16.23	21.54	70.61	00
2006	January	24.52	13.86	19.19	68.46	04
	February	28.88	17.98	23.43	61.04	06

Source: Bangladesh Meteorological Department (climate division) Agargoan, Dhaka-1212

Appendix II. Characteristics of Horticulture Farm soil as analyzed by Soil Resources Development Institute (SRDI), Khamar Bari, Farmgate, Dhaka.

A. **Morphological characteristics of the experimental field**

Morphological features	Characteristics
Location	Horticulture Garden ,SAU, Dhaka
AEZ	Madhupur Tract (28)
General Soil Type	Shallow red brown terrace soil
Land t}pe	High land
Soil scries	Tejgaon
Topography	Fairly leveled
Flood level	Above flood level
Drainage	Well drained
Cropping pattern	Fallow - Broccoli

Appendix II (contd.)
B. Physical and chemical properties of the initial soil

Characteristics	Value
Partical size analysis	
% Sand	27
% Silt	43
% clay	30
Textural class	silty-clay
pH	5.6
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total N (%)	0.03
Available P (ppm)	20.00
Exchangeable K (mc/100 g soil)	0.10
Available S (ppm)	45

Source: SRDI

Appendix III. Analysis of variance for different characters of broccoli

Source of variation (SV)	Degree of freedom (df)	Mean square values						
		Plant height at different DAT					Number of leaves/ Plant	Length of leaves
		30	40	50	60	At harvest		
Replication	2	13.213	82.868	28.541	64.863	34.457	3.594	67.544
Treatment	9	37.9451	48.515**	39.027**	37.4572	46.244*	4.031**	46.801**
Factor- A (organic manure)	4	69.907**	85.909**	51.371**	41.949**	59.405*	6.313**	77.868**
Factor- B (cultivar)	1	41.985**	67.081**	129.501**	149.009**	129.418**	9.487**	75.208*
A x B	4	4.975ns	6.480ns	4.065ns	5.077ns	12.291ns	0.386ns	8.635ns
Error	18	2.693	5.749	7.061	12.054	15.579	0.710	16.042

1 Significant at 1% level of probability ns: Not significant
2 Significant at 5% level of probability

Appendix III.(Contd.) Analysis of variance for different characters of broccoli

Source of variation (SV)	Degree of freedom (df)	Mean square values				
		Plant canopy (cm)	Diameter of stem (cm)	Diameter of curd (cm)	No. of secondary curd	Weight of primary curd (g)
Replication	2	17.538	1.059	3.600	0.797	631.585
Treatment	9	295.523	0.850**	8.900**	1.320**	4812.847**
Factor A	4	574.889**	1.344**	17.576**	2.257**	5653.503**
Factor B	1	194.311ns	1.997**	6.599**	2.785**	16163.907**
A x B	4	41.459ns	0.070ns	0.801ns	0.018ns	1134.427**
Error	18	31.017	0.126	0.711	0.304	124.510

* Significant at 5% level of probability ** Significant at

1% level of probability ns: Not significant

Appendix III. (Contd.) Analysis of variance for different characters of broccoli

Source of variation (SV)	Degree of freedom (df)	Mean square values			
		Wt. of secondary curd (g)	Yield / Plant (g)	Yield/Unit plot (kg)	Yield (t / ha)
Replication	2	701.382	6337.518	6.471	6.565
Treatment	9	4948.935**	18708.539**	5.782**	19.822**
Factor A	4	10070.867**	32694.470**	9.796**	33.567**
Factor B	1	2426.041**	25017.008**	10.080**	34.624**
A x B	4	457.728**	3145.490ns	0.695ns	2.377ns
Error	18	91.120	1324.430	1.041	1.026

3 Significant at 1% level of probability ns: Not significant

Appendix IV. Effect of different sources of manures, cultivars and sources of manures * cultivars on the yield of broccoli (t/ha)

Main effect of different sources of manures and cultivars on the yield of broccoli (t/ha)

Sources of manures							Cultivars			
Mo	M,	m_2	M_3	m_4	LSD(o.o5)	CV (%)	V,	v_2	LSD(o.o5)	CV (%)
7.61	8.94	9.78	12.83	12.09	1.55	9.73	11.48	9 33	0.77	9.73

Sources of manures x cultivars on the yield of broccoli (t/ha)

M_0V,	m_0v_2	M,Vi	MiV_2	M_2V,	M_2V_2	M_3Vi	m_3v_2	M_4V_1	$m_4v.$	LSD (o.os)	CV (%)
7.84	7.37	9.57	8.32	11.39	8.18	14.50	11.15	14.12	11.66	1.73	9.73

Mo: No manure

Mi : Cowdung

M_2: Water hyacinth compost

M_3: Poultry litter

M_4 : Vermicompost

Vi= Sotomidori

V_2 = Premium crop

Appendix V. Cost of production of broccoli per hectare under different treatment combinations

(A) Material cost (Tk.)

Treatment combination	Seed (400g./ha)	Organic manures			Vermicompost (12.26 t/ha)	Pesticide	Sub Total 1(A)
		Cowdung (26.5 t/ha)	Water hyacinth compost (10.6 t/ha)	Poultiy Litter (16.56 t/ha)			
MoV,	6000					4000	10000
MoV_2	6000					4000	10000
MJV,	6000	10600				4000	20600
M,V_2	6000	10600				4000	20600
M_2V,	6000		4240			4000	14240
M_2V_2	6000		4240			4000	14240
M_3V,	6000			13248		4000	23248
M_3V_2	6000			13248		4000	23248
M_4V,	6000				73560	4000	83560
M_4V_2	6000				73560	4000	83560

Broccoli seed @ Tk. I500/100g
Cowdung @ Tk. 0.40/kg
Water hyacinth Compost @ Tk. 0.40/kg
Poultry' Litter @ Tk. 0.80/kg
Vermicompost @ Tk. 6.0/kg

Appendix V. (Contd.)

(B) Non-Material cost (Tk.)

Treatment Combination	Land *preparation*	Organic manure application	Seed sow ing in	Seedling transplant ng	Intercultural operation	Harvesting	Sub-total 1 (B)	Total input cost l(A}f1(B)
M_0V,	*7000*		500	2000	7000	5000	21500	31500
MOV_2	*7000*		500	2000	7000	5000	21500	31500
M,V,	7000	650	500	2000	7000	5000	22150	42750
M,V_2	7000	650	500	2000	7000	5000	22150	42750
M->V]	7000	650	500	2000	7000	5000	22150	36390
M_2V_2	7000	650	500	2000	7000	5000	22150	36390
M,V,	7000	650	500	2000	7000	5000	22150	45398
M,V,	7000	650	500	2000	7000	5000	22150	45398
M_4V,	**7000**	**650**	**500**	2000	**7000**	**5000**	**22150**	**105710**
M_4V_2	7000	650	500	2000	7000	5000	22150	105710

Lobour cost @ Tk. 70/day

M_0 : No organic manure
Mi : Cowdung
M_2: Water hyacinth compost M_3 : Poultry litter M_4 : Vermicompost

Vj = Sotomidori
V_2 = Premium crop

Appendix V. (Contd)

(C) Overhead cost and total cost of production (Tk.)

Treatment Combination	Cost of lease of land	Miscellaneous cost (5% of input cost)	Interest on running capital for 6 months (13% of total input cost)	Total	Total cost of production (Input cost + Total) (Tk./ha)
MoV,	15000	1575.00	2047.50	18622.50	50122.50
M_0V_2	15000	1575.00	2047.50	18622.50	50122.50
M,V,	15000	2137.50	2778.75	19916.25	62666.25
M,V_2	15000	2137.50	2778.75	19916.25	62666.25
m_2v,	15000	1819.50	2365.35	19184.85	55574.85
m_2v_2	15000	1819.50	2365.35	19184.85	55574.85
m_3v,	15000	2269.90	2950.87	20220.77	65618.77
m_3v_2	15000	2269.90	2950.87	20220.77	65618.77
m_4v,	15000	5285.50	6871.15	27156.65	132866.65
m_4v_2	15000	5285.50	6871.15	27156.65	132866.65

Lobour cost @ Tk. 70/dav

Mo : No organic manure
Mi : Cowdung
M_2 : Water hyacinth compost
M_3 : Poultry litter
M.i : Vermicompost

Vi = Sotomidori V_2 =
Premium crop

* Significant at 5% level of probability