EFFECT OF DIFFERENT ORGANIC MANURES AND VARIETIES ON GROWTH AND YIELD OF TOMATO

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CERTIFICATE

This is to certify that the thesis entitled, "EFFECT OF DIFFERENT ORGANIC MANURES AND VARIETIES ON GROWTH AND YIELD OF TOMATO" submitted to the ***Department*** *of Horticulture, 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. Shahadat Hossain Miah, Registration No. 08-3260*** *under my supervision and 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.

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BY

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ABSTRACT

An experiment was conducted in the Horticulture farm of Sher-e-Bangla Agricultural University, Dhaka, during the period from September 2009 to March 2010, to find out the effect of organic manures and different varieties on the growth and yield of tomato. The experiment consisted with two factors. Factor A: Four types of organic manure such as OM_0 = Control, OM_1= cowdung (30 t/ha), OM_2 = poultry manure (25 t/ha) and OM_3 = vermicompost (20 t/ha). Factor B: Three varieties such as V_1 = BARI tomato 8, V_2 = BARI tomato 3 and V_3 = BARI tomato 2. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. For, organic manure OM_2 gave the highest (94.22 t/ha) yield and lowest (25.63 t/ha) from OM_0. For, variety V_1 gave the the highest yield (88.06 t/ha) and V_3 gave the lowest (55.74 t/ha). For, combined effect OM_2V_1 gave the highest (95.16 t/ha) and the lowest (27.20 t/ha) from OM_0V_1. So, poultry manure with BARI Tomato 8 gave the best performance.

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LIST OF ABBREVIATED TERMS

ABBREVIATIONS	FULL WORD
%	Percent
@	At the rate of
^{0}C	Degree Celsius
$AgNO_3$	Silver nitrate
Agric.	Agriculture
Agril.	Agricultural
Agron.	Agronomy
ANOVA	Analysis of variance
BARI	Bangladesh Agricultural Research Institute
BSMRAU	Bangabandhu Sheikh Mujibur Rahman Agricultural University
cm	Centi-meter
CV%	Percentage of Coefficient of Variation
cv.	Cultivar (s)
DAS	Days After Sowing
Dept.	Department
df	Degrees of Freedom
DMRT	Duncan's Multiple Range Test
EM	Effective Microorganigm
et al.	And others
etc.	Etcetera
FAO	Food and Agricultural Organization
FYM	Farmyard manure
G	Gram (s)
g/sq.m	Gram per square meter
hr.	Hour (s)
HRC	Horticulture Research Centre
IARI	Indian Agricultural Research Institute
j.	Journal
K	Potasium
K/Kg	Potasium per kilogram
Kg	Kilogram
Km	Kilometer
L	Litre
m	Meter
m^2	Square meter

ABBREVIATIONS	FULL WORD
Max.	Maximum
Mg	Magnesium
mg/l	Miligram per litre
Min.	Minimum
ml	Mili-litre
ml/L	Mili-litre per litre
MOA	Ministry of Agriculture
MoP	Muriate of Potash
NARS	National Agricultural Research System
No.	Number
NS	Non Significant
OM	Organic manure
P	Phosphorus
ppm	Parts Per Million
R	Residual effect
RCBD	Randomized Complete Block Design
Rep.	Replication
Res.	Research
RH	Relative Humidity
SAU	Sher-e-Bangla Agricultural University
Sci.	Science
SE	Standard Error
t/ha	Tons per hectare
TSP	Triple Super Phosphate
Univ.	University
var.	Variety
Via	By way of
Viz.	Namely

CHAPTER I

INTRODUCTION

Tomato (*Lycopersicon esculentun* L.) belongs to the family Solanaceae. It was originated in tropical America (Salunkhe *et al.*, 1987), particularly in peru, Ecuador and Bolivia of the Andes (Kalloo, 1989). The leading tomato production countries of the world are China, the United States of America, India, Turkey, Iran, Italy, Mexico, Brazil and Indonesia (FAO, 1999). It was cultivated in almost all home gardens and also in the field due to its adaptability to wide ranges of soil and climate (Ahmed, 1986). It ranks next to potato and sweet potato in the world vegetable production. Tomato ranks third in terms of world vegetable production (FAO, 2000) and tops the list of canned vegetables. It is one of the most highly praised vegetables consumed widely and it is a major source of vitamins and minerals. It is one of the most popular salad vegetables and is taken with great relish. It is widely employed in cannery and made into soups, conserves, pickles, ketchup, sauces, juices etc. Tomato juice has become an exceedingly popular appetizer and beverage. In Bangladesh, half of the population is under the poverty level and suffering from various health problems. A large number of children have clinical sign of vitamin A deficiency and more than 9, 00,000 children under six years of age suffering from some degree of xerophthalmia and over 30,000 children go under blind each year due to vitamin A deficiency. Tomato has high nutritive value especially vitamin A and vitamin C (Thompson and Kelly, 1957). Therefore, it can be met up some degree of vitamin A and vitamin C requirement and can contribute to solve national malnutrition problem. The per capita consumption of vegetables in Bangladesh is very low as compared to that of other countries. In Bangladesh the daily requirement of vegetable for a person is 200 g.

Tomato can be grown on a wide range of soil types, ranging from light sand to heavy loam or, even clay that are well supplied with organic matter. Successful production of broccoli depends on various factors. Fertilizer management is one of the most important factors, which assured crop production. Use of chemical fertilizers in crop production is one of the important causes of environmental pollution. Now-a-days, there is growing awareness among the scientists in various parts of the world regarding the problems of environmental pollution through the use of chemicals in crop production. As an alternative to chemicals, scientists in the developed nations are trying to develop various bio-fertilizers for reducing environmental pollution and for obtaining pollution free crop production, especially vegetables. Use of organic manure in crop production has many advantages over chemical fertilizers. Organic manure saves the crop plants from adverse environment.

Organic manure is a source of food for the innumerable number of microorganisms and creatures like earthworm who breaks down these to micronutrients, which are easily absorbed by the plants. Organic manure plays a direct role in plant growth as a source of all necessary macro and micronutrients in available forms during mineralization, improving the physical and physiological properties of soils. Organic manures such as cowdung, poultry manure and vermicompost improves the soil structure, aeration, slow release nutrient which support root development leading to higher growth and yield of tomato plants. The macronutrients calcium and micronutrients boron, manganese, molybdenum and iron are important for tomato cultivation. Biologically active soils with adequate organic matter usually supply enough of these nutrients.

In Bangladesh, a large number of tomato varieties are grown, which are of exotic origin and were developed long before. Most of them lost their

potentiality due to genetic deterioration and disease contamination. Hence in order to improve the present situation of tomato production in Bangladesh, it is essential to promote better varieties to the growers of Bangladesh.

Considering the above-mentioned facts the present investigation was undertaken with the following objectives:

i) to find out the suitable organic manure for optimum growth and yield of tomato.

ii) to find out the suitable combination of organic manure and variety for ensuring the higher yield of tomato.

iii) to know the most economic combination of manure and variety of tomato.

CHAPTER II

REVIEW OF LITERATURE

Tomato is one of the most important vegetables crops grown under field and greenhouse condition, which received much attention to the researchers throughout the world. Among various research works, investigations have been made in various parts of the world to determine the suitable organic manure and variety for practices for its successful cultivation. The organic manure plays an important role in tomato production. In Bangladesh, there are a little study on the influence of organic manure and variety on the growth and yield in tomato. However, the relevant literature on tomato and some other related crops available in these connections have been reviewed here with the hope that this might contribute to the present study.

Jagadeesha (2008) conducted a field experiment at the University of Agricultural Sciences, Dharwad during kharif season of 2007 to study the effect of organic manures and biofertilziers on plant growth, seed yield and quality parameters in tomato. Results of field experiment in kharif 2007 revealed that, application of RDF (60:50:30 kg NPK/ha) + biofertilzier (*Azospirillum* and P solubilizing bacteria 2.5 kg/ha each) records higher plant height (64.37, 109.50 and 162.33 cm), number of leaves (92.50, 153.33 and 146.50), leaf area (898.05, 4314.31 and 4310.94 cm^2) and leaf area index (898.05, 4314.31 and 4310.94 cm^2) at 30, 60 and 90 DAT respectively and records lesser days to 50 per cent flowering (38.00) followed by FYM (50%) + vermicompost (50%) + biofertilzier. The application of RDF + biofertilziers records higher seed yield (106.87 kg/ha) followed by FYM (50%) + vermicompost (50%) (101.94 kg/ha) over FYM alone. The seed yield was significantly higher

with the application of RDF + biofertilziers was attributed to number of fruits per plant (45.22) number of seeds per fruit (109.45) fruit weight per plant (1280.98 g) and 1000 seed weight (2.84 g).

Among the treatments, application of RDF + biofertilzer recorded significantly higher germination (96.73%), root length (11.73 cm), shoot length (12.54 cm), seedling vigour index (2348), seedling dry weight (25.93 mg) and lower electrical conductivity (0.286 dSm^{-1}) followed by FYM (50%) + vermicompost (50%) over FYM alone.

Nileema and Sreenivasa (2011) conducted an experiment at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad to study the influence of liquid organic manures viz., panchagavya, jeevamruth and beejamruth on the growth, nutrient content and yield of tomato in the sterilized soil during kharif 2009. The various types of organic solutions prepared from plant and animal origin are effective in the promotion of growth and fruiting in tomato. The Panchagavya is an efficient plant growth stimulant that enhances the biological efficiency of crops. It is used to activate biological reactions in the soil and to protect the plants from disease incidence. Jeevamruth promotes immense biological activity in soil and enhance nutrient availability to crop. Beejamruth protect the crop from soil borne and seed borne pathogens and also improves seed germination. In the present study, significantly highest plant growth and root length was recorded with the application of RDF + Beejamruth + Jeevamruth + Panchagavya and it was found to be significantly superior over other treatments. The application of Beejamruth + Jeevamruth + Panchagavya was next best treatment and resulted in significantly highest yield as compared to RDF alone.

Oikeha and Asiegbu (1993) conducted an experiment where four types of organic manures and NPK fertilizer, each at four rates, were assessed

under field conditions for their comparative effects on the growth and yield of tomato. Tomato fruit yields (49 and 47 t ha^{-1}) were best with swine or poultry manure applied at the rate of 10 t ha^{-1}. Yields of 42–47 t ha^{-1} were obtained with sewage sludge or rabbit manure applied at the rate of 20 t ha^{-1}, while with NPK the best yield (35 t ha^{-1}) was obtained with the formulation of N 100 P 40 K 100 kg ha^{-1}. Very high manure application of 30 t ha^{-1} depressed growth and yield, irrespective of the manure source. The potential fertilizer values of the organic manures were not fully reflected by early growth parameters as they were with NPK treatment, apparently due to slow release of the elements that were still bound in organic forms in the manures. The ultimate yield advantages associated with the organic manures compared with NPK fertilizer were, in part, ascribed to their probable effects on the soil physical characteristics, and their supply of macro- and micronutrient elements not contained in NPK fertilizer.

Sathish *et al.* (2009) carried out an experiment to evaluate biological activity of organic manures against tomato fruit borer, *Helicoverpa armigera* (Hub.) and safety of otanicals and biopesticides against egg parasitoid, *Trichogramma chilonis Ishii* and biochemical effects of *Pseudomonas florescens* on tomato under pot culture conditions. The feeding and infestation of the larvae of *Helicoverpa armigera* were significantly low in farm yard manure (FYM) Azospirillum + silicate solubilising bacteria (SSB) + Phosphobacteria + neem cake applied plants followed by FYM + Azospirillum + SSB + Phosphobacteria + mahua cake applied plants. *Trichogramma parasitization* on *Helicoverpa armigera* eggs was adversely effected by neem oil 3% on treated plants followed by neem seed kernel extract (NSKE 5%) + spinosad 75 g a.i./ha. Under laboratory condition among the microbial pesticide tested

Spinosad (75 g a.i./ha), HaNPV + Spinosad + Bt (1.5×1012 POBs/ha + 75 g a.i./ha + 15000 IU/mg (2 lit/ha)), Spinosad + Bt (75 g a.i./ha + 15000 IU/mg^{-2} lit/ha) showed higher insecticidal toxicity (100 per cent mortality on 72 h) to all instars of *Helicoverpa armigera* larvae. Biochemical parameters like phenol content, peroxidase and phenyl alanine ammonialyase (PAL) activity recorded higher levels in *Pseudomonas florescens* seed treatment @ 30 g/kg of seed and its foliar spray @ 1 g/litre in treated tomato plants.

Handa *et al.* (2011) Field trials was conducted a field trials where using different fertilizers having equal concentration of nutrients to determine their impact on different growth parameters of tomato plants. Six types of experimental plots were prepared whereT_1 was kept as control and five others were treated by different category of fertilizers (T_2-Chemical fertilizers, T_3-Farm Yard Manure (FYM), T_4-Vermicompost, T_5 and T_6-FYM supplemented with chemical fertilizers and vermicompost supplemented with chemical fertilizer respectively).The treatment plots (T_6) showed 73% better yield of fruits than control, Besides, vermicompost supplemented with N. P. K treated plots (T_5) displayed better results with regard to fresh weight of leaves, dry weight of leaves, dry weight of fruits, number of branches and number of fruits per plant from other fertilizers treated plants.

Fioreze and Ceretta (2006) conducted a study was conducted in Rio Grande do Sul, Brazil to determine the organic sources of nutrients in potato production systems. The treatments include hen and hog residue and mineral fertilizers. Results indicated that organic sources are economical and technical alternatives to chemical fertilizers. However,

their efficiency is maximized when coupled with chemical fertilizers, mainly to maintain nitrogen supply along the crop cycle, especially in the case of using hog residues. Hen residue is better than hog residue because it has higher amount of nutrients.

Singh and Kushwah (2006) conducted a field experiment at Central Potato Research Station, Gwalior, Madhya Pradesh, India, during the winter seasons (rabi) of 2001- 02 and 2002 - 03 to study the effect of organic and inorganic sources of nutrients on potato (*Solanum tuberosum*) production. The treatments included 25, 50, 75 and 100% doses of NPK with and without organic manures (farmyard manure (FYM) and Nadep compost at 30 t/ha). Application of 100% NPK + 30 t FYM/ha resulted in significantly higher tuber yield of 456 q/ha compared with that of other treatments except 100% NPK + 30 t Nadep/ha and 75% NPK + 30 t FYM/ha. The effect of organic manures (FYM and Nadep compost) in combination with inorganic fertilizers was more pronounced compared with that of organic manures alone. However, FYM was more effective than Nadep compost in producing higher tuber yield. Maximum net return of Rs 63 627/ha was also obtained from 100% NPK + 30 t FYM/ha. However, benefit cost ratio was almost same under 75% NPK with 30 t/ha FYM or Nadep compost and 100% NPK with 30 t/ha FYM or Nadep compost.

Klikocka *et al.* (2006) conducted two experiments in Poland. In experiment 1 (1996-2001), the treatments consisted of: conventional soil tillage (ploughing at 20 cm depth, and pre-winter ploughing at 25 cm depth), autumn ridge tillage (ploughing at 20 cm depth, and establishment of 20 to 25 cm deep ridges with a furrow plough ridger), and spring ridge soil tillage (ploughing at 20 cm depth with planting of spring potato, and establishment of 25 cm deep ridges with a planting machine). For all

treatments, cattle manure was applied at 30 t/ha. In experiment 2 (2001-03), the treatments were: summer ridge soil tillage (plough skimming at 10-cm depth, establishment of 25 cm deep ridges, and sowing of white mustard or Sinapis alba as a catch crop), autumn ridge soil tillage (plough skimming at 10 cm depth, sowing of white mustard, cultivation at 15 cm depth, and establishment of ridges), and spring ridge soil tillage (plough skimming at 10 cm depth, sowing of white mustard during the planting of spring potato, and establishment of 20 to 25 cm deep ridges with a planting machine). For all treatments, 5 t triticale straw/ha and 1.0 kg N in the form of urea per 200 kg of straw were applied. Tillage with ridge establishment in the autumn resulted in the highest total and commercial tuber yields. The tillage treatments had no significant effects on the N content at the 0 to 25 cm soil layer. The formation of ridges in the autumn reduced the N content at the 25 to 40 cm soil layer. The use of straw as fertilizer and mulch, along with the planting of white mustard, reduced N leaching and prevented soil erosion.

El-Fakhrani (1999) conducted an experiment on the effects of N fertilizer (0, 300 or 600 kg/ha as urea) and poultry manure (0 or 10 t/ha) on the performance of potato (cv. Monaliza) irrigated with saline water (EC of 0.42, 1.56 or 2.85 dS/m) were studied in a pot experiment. N application significantly increased shoot dry weight per plant, and tuber fresh and dry weights over the control. N at 300 kg/ha resulted in the greatest tuber volume (241.2 cm^3), tuber fresh weight (257.9 g), tuber dry weight (48.8 g), and shoot dry weight (9.02 g) per plant. Poultry manure at 10 t/ha enhanced tuber volume (224.4 cm^3), tuber fresh weight (239.9 g), tuber dry weight (45.2 g), and shoot dry weight (8.12 g) per plant. The values of these parameters decreased with the increase in the salinity level. N at 300 kg/ha also registered the greatest P (12.37 mg per plant) and K (652.9 mg per plant) uptake, and total carbohydrate content (36.8 g per plant). Poultry manure also increased N (209.7 mg per plant), P (13.47 mg per plant) and K (602.3 mg per plant) uptake, and total carbohydrate content (34.6 g per plant). The interaction between 300 kg N and 10 t poultry manure/ha was optimum for all parameters.

Kushwah *et al*. (2005) conducted an experiment during rabi 2004/05 on silty clay loam soil at Gwalior, Madhya Pradesh, India to study the effect of farmyard manure (FYM), Nadep compost, vermicompost and inorganic NPK fertilizers on yield and economics of potato. Application of FYM, Nadep compost and vermicompost alone or in combination did not influence tuber yield significantly. However, organic manures at 7.5 t/ha in combination with 50% recommended dose of NPK significantly increased tuber yield. The highest tuber yield (321 q/ha) was recorded with 100% recommended dose of NPK fertilizers. The highest incremental benefit cost ratio (7.5) was obtained with 50% recommended dose of NPK.

In an experiment, Gomes *et al*. (1970 found that the variety Floradel was slightly superior to the other varieties, namely; Maca, Caqui and Manalucie as regards to yield and number of fruits.

In a performance trial of six varietiesof tomato conducted at the Bangladesh Agricultural Research Institute, Joydebpur, Hossain and Ahmed (1973) observed that cv. Sanmarzano was the highest yielder (28.98 t/ha), followed by Oxheart, Roma, Bulgaria, USA and Anabik. They also observed that Oxheart produce the longest fruits with the average weight of 87 g followed by the Bulgaria, Roma, USA, Anabik and Sanmarzano.

Ali and Siddique (1974) found that the plants of Oxheart variety were 190.8 cm in height and yield 26.6 t/ha. In the above study they observed that the plants took 23.1 DAT for flowering.

Norman (1974) carried out an experiment to observe the performance of 13 varieties of tomato in Ghana. He found significant differences between cultivars in plant height, fruit maturity, yield and quality. He also stated that in the dry season, Floradel, Ace VF, Floralon, Piacenza 0164, Red colour and Ife No. 1 were found to be high yielders and appeared promising.

A yield trial was conducted at the vegetable Division of Agricultural Research Institute, Dhaka in 1969-70, with five varieties of tomato (Oxheart, Sinkurihara, L-7, Marglobe and Bulgaria). The experiment was repeated in 1971-72. In both years, the varieties Oxheart and Sinkurihara were found to be similar and significantly higher yielder than the others (Hoque *et al.*, 1975).

Prasad and Prasad (1977) carried out an experiment with 8 varieties of tomato in India. The highest yield was obtained from Kalyanpur Angurlate followed by Kolyanpur T_1 and Sioux. The Kolyanpur T_1 had the largest fruit.

To compare the yielding ability and to assess the distinguishing external morphological characters of seven varieties of tomato an investigation was carried out by Sarker and Hoque (1980) during the period from October 1977 to March 1978. Thevarieties were, Master No.2, Ramulas, Roma, Rambo, Marmande, Bigo and World Champion. They reported that, the Rambo produced the highest yield (28.28 t/ha) followed by Bigo (24.63 t/ha), World Champion (23.38 t/ha), Master No.2 (21.98 t/ha), Roma (21.03 t/ha) and Ramulas (20.21 t/ha).

Ahmed *et al.* (1986) assessed eight F-7 lines of tomato at the Horticulture farm, Bangladesh Agricultural University, Mymensingh. They observed that all the lines had shown indifferences in plant height and fruit size. In contrast fruit number had shown significant difference among the varieties. The line 0014-60-3-9-1-0 gave the highest yield of fruits (56.9 t/ha), followed by 0013-52-10-27-32-0 (50.0 t/ha).

Kalloo (1989) worked with some tomato varieties (Pusa Early Dwarf, HS 102, Hisar Arun and Punjab Chhuhara) in northern India. The HS 102 and Punjab Chhuhara were fit for summer cultivation and Pusa Early Dwarf and Hisar Arun were suitable for getting early fruits.

A field experiment was carried out in 1990 and 1992 with some tomato cultivars, namely, Punjab Kesari, Punjab Chhuhara, Punjab Tropic, PNR-7,S-12 Pusa Ruby and the Hybrid THL- 2312 (Bhangu and Singh, 1993). They observed mean annual yield was highest in Punjab Tropic. Punjab

Tropic produced the largest fruits (66.69 g) and the highest number of fruits per plant was obtained Punjab Kesari (123).

Singh *et al. (*1994) conducted an experiment to evaluate the performance of tomato varieties(Arka Vikas, LE 79, BT 14, Punjab Chhuhara, BWRI and Pusa Ruby). They observed that BT 12 produced the tallest plant and BT 14 the shortest plant (mean values of 75.09 cm and 62.52 cm respectively).They also reported that Arka Vikas had the heaviest fruits (54.87 g) and Punjab Chhuhara the smallest (21.93 g). Arka Vikas gave the highest mean yield (157.55 q/ha) and BT 14 the lowest (119.79 q/ha).

Berry *et al.* (1995) conducted an experiment at Wooster, USA with Hybrid processing tomato Ohio Ox 38. It was observed that, the yield of variety in 1992 and 1993 were higher (70.3 and 80.4 t/ha, respectively) compared to other cultivars.

A field trial was conducted by Ajlouni *et al.* (1996) in Jordan to study the yield of 13 local and introduced open pollinated tomato cultivars, to compare the yields to that of 3 common hybrids (Maisara F_1, 898 $F_1$and GS 12 F_1) in relation to seasonal distribution of marketable and unmarketable yield and fruit number. The cultivars varied in their marketable yield during the harvesting period (10 weeks from 22 June 1993). The results indicated that the cultivars Rio Grande, Nagina and T_2 improved were superior to the hybrids.

An experiment was conducted with two summer tomato varieties (BINA Tomato 2 and BINA Tomato 3) to study the yield performance at 3 locations of Bangladesh (Magura, Comilla and Khulna) during the summer season (BINA, 1998). It was observed that BINA Tomato 2 produced higher fruit yield at Magura (38 t/ha) and Khulna (17 t/ha), while BINA Tomato 3 gave higher yield (29 t/ha) at Comilla. However mean fruit yield from three locations showed that, the variety BINA Tomato 2 produced higher fruit yield than BINA Tomato 3.

CHAPTER III

MATERIALS AND METHODS

A field experiment was conducted at the Horticulture Farm, Sher-e-Bangla Agricultural University (SAU), Dhaka-1207, Bangladesh during the period from September to March 2010 to find out effect of organic manures on growth and yield of different varieties of tomato. The materials and methods for the experiment were presented in this chapter under the following headings:

3.1 Experimental site

The experiment was conducted at the Horticulture Farm of Sher-e-Bangla Agricultural University (SAU), Dhaka-1207, Bangladesh. The experiment was carried out during rabi season (September 2009 to March 2010). It is located in $23^0 74^/$ N latitude and $90^0 35^/$ E longitude and an elevation of 8.2 m from the sea level (Anon., 1989).

3.2 Climate

The experimental area situated in the sub-tropical climatic zone, which characterized by heavy rainfall during the month of April to September and scanty rainfall during the rest period of the year. Details of weather data in respect of temperature (^{O}C), rainfall (cm) and relative humidity (%) for the study period were collected from the Meteorological Department of Bangladesh, Agargoan, Dhaka-1207 (Appendix IV).

3.3 Soil

The soil of the experimental area belongs to the Modhupur Tract (UNDP, 1988) under AEZ No.28 and was dark. It was medium high land and the soil series was Tejgoan (FAO, 1988). The soil was having a texture of sandy loam with pH and CEC were 5.6 and 2.64 meq/100g soil, respectively. The characteristics of the soil under the experimental plot were analyzed in the Soil Testing Laboratory, SRDI, Khamarbari, Dhakaand details of the recorded soil characteristics are presented in Appendix II.

3.4 Plant materials used in the experiment

Four varieties of tomato were used in the experiment. Tomato seeds were collected from vegetable division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur.

3.5 Seedbed preparation

Seedbed was prepared on 8 September 2009 for raising seedlings of tomato and the size of the seedbed was 3 m × 1 m. For making seedbed, the soil was well ploughed and converted into loose friable and dried masses to obtained good tilth. Weeds, stubbles and dead roots were removed from the seedbed. Cow dung was applied to the prepared seedbed at the rate of 10 t/ha. The soil was treated by seven 50 WP @ 5 kg/ha to protect the young plants from the attack of mole crickets, ants and cutworm.

3.6 Seed treatment

Seeds were treated by Vitavax 200 @ 5 g/1 kg seeds to protect various seed borne diseases like leaf spot, blight, anthracnose etc.

3.7 Seed sowing

Seeds were sown on 12 September 2009 in the seedbed. Sowing was done thinly in lines spaced at 3cm distance. Seeds were sown at a depth of 2 cm and covered with a fine layer of soil followed by light watering by watering can. After there the beds were covered with dry straw to maintain required temperature and moisture. The cover of dry straw was removed immediately after emergence of seed sprout. When the seeds were germinated, shade by bamboo mat (Chatai) was provided to protect the young seedlings from scorching sunshine and rain.

3.8 Raising of seedlings

Light watering and weeding were done several times. No chemical fertilizers were applied for raising of seedlings. Seedlings were not attacked by any kind of insect or disease. Seeds were sprouted and visible after 3 days of sowing. Healthy and 30 days old seedlings were transplanted into the experimental field on 15 October 2009.

3.9 Design and layout of the experiment

The two factors experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. An area of 29.1 m x 11.4 m was divided into three equal blocks. Each block consisted of 12 plots. Thus, the total numbers of plot were 36. The layout of the experiment was prepared for distributing the treatment combinations were allotted at random. The size of a unit plot was 2.4 m ×1.8 m. The distance

maintained between two blocks and two plots were kept 1.0 m and 0.5 m respectively. The layout of the experiment is shown in figure 1.

3.10 Treatment of the experiment

Two factors were used in the experiment, viz. four types of organic manure and three varieties of tomato.

Factor A. Four types of organic manure coded as

OM_0 = Control (No manure application)
OM_1 = Cowdung (30 t/ha)
OM_2 = Poultry manure (25 t/ha)
OM_3 = Vermicompost (20 t/ha)

Factor B. Three varieties coded as

V_1 = BARI tomato 8
V_2 = BARI tomato 3
V_3 = BARI tomato 2

There were 12 (4 x 3) treatment combinations as follows:

OM_0V_1, OM_1V_2, OM_2V_3, OM_0V_2, OM_1V_3, OM_3V_1, OM_0V_3, OM_2V_1, OM_3V_2, OM_1V_1, OM_2V_2, OM_3V_3

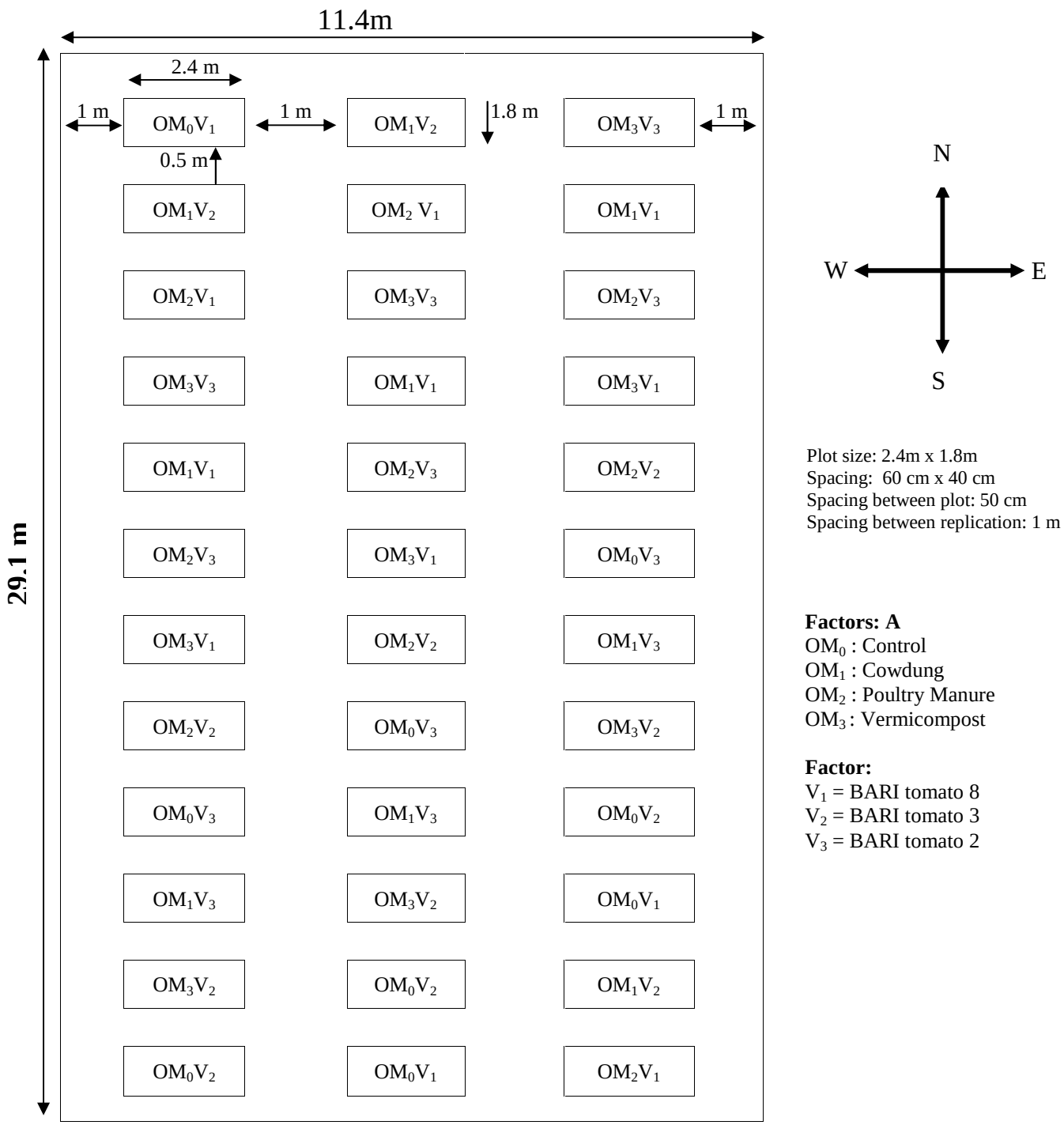

Fig. 1. Field layout of the experiment

3.11 Land preparation

The experimental area was first opened on 15 September 2009 by a disc plough to open direct sunshine to kill soil borne pathogens and soil inhabitant insects. It was prepared by several ploughing and cross ploughing with a power tiller followed by laddering to bring about a good tilth. The land was leveled, corners were shaped and the clods were broken into pieces. The weeds, crop residues and stables were removed from the field. The experimental field was partitioned onto the unit plots in accordance with the experimental design mentioned in figure 1. Total organic manures were applied according to their treatment and finally leveled. The soil of the plot was treated by Seven 50wp @ 5kg/ha to protect the young plants from the attack of mole cricket, ants and cutworm.

3.12 Transplanting

The seedbed was watered before uprooting the seedlings to minimize the damage of roots. At the time of uprooting, care was taken so that root damage become minimum and some soil remained with the roots. Thirty days-old healthy seedlings were transplanted at the spacing of 60cm × 40cm in the experimental plots on 12 October 2009. Thus the 18 plants were accommodated in each unit plot. Planting was done in the afternoon. Light irrigation was given immediately after transplanting around each seedling for their better establishment. The transplanted seedlings were shaded for five days with the help of banana leaf sheath to protect them from scorching sunlight, watering was done up to five days until they became capable of establishing on their own root system.

3.13 Intercultural operations

1. Gap filling

Very few seedlings were damaged after transplanting and new seedlings from the same stock replaced these.

2. Weeding

The plants were kept under careful observation. Three times weeding were done during cropping period, viz. 1st November, 15th November and 1st December, for proper growth and development of the plants.

3. Spading

After each irrigation, soils of each plot were pulverized by spade for easy aeration and breaking the crust of the soil.

4. Irrigation

Irrigation was given by observing the soil moisture condition. Five times irrigation were done during crop period, viz. 4th November, 14th November, 24th November , 5th December and 15th December for proper growth and development of plants.

5. Earthing up

Earthing up was done by taking soil from between two rows with the help of a spade on 2nd November 2009.

6. Insects and disease control

Few plants were damaged by mole crickets and cut worms after the seedlings were transplanted in the experimental plots. Seven 80 WP was dusted to the soil before irrigation to controlled mole crickets and cut worms on 1st November 2009. Some of the plants were infected by Alternaria leaf spot disease. Rovral 50 WP @ 20 g per 10 litre of water was sprayed to prevent the spread of the disease on 25th November 2009. No other pests were attacked the plants.

7. Harvesting

Fruits were harvested at 3 day intervals during early ripe stage when they attained slightly red color. Harvesting was started from 15 February 2009 and was continued up to 15 March 2009.

3.14 Data collection

Data were recorded on the following parameters from the sample plants during the course of experiment. Ten plants were selected randomly from each plot for data collection in such a way that the border effect could be avoided for the highest precision.

i) Plant height

Plant height at final harvest was measured from sample plants in centimeter from the ground level to the tip of the longest stem and the mean value for each treatment was calculated. Plant height was also recorded at 30, 45, 60 and at last harvest of fruits to observe the growth rate of plants.

ii) **Number of leaves per plant**

The number of leaves of the sample plant were counted at the time of harvesting and the average number of leaves produced per plant was recorded.

iii) **Number of flower clusters per plant**

The numbers of flower clusters per plant were counted from the sample plants and the average number of flower clusters produced per plant was recorded at the time of final harvest.

iv) **Number of flowers per cluster**

It was calculated by the following formula,

$$\text{Number of flowers per cluster} = \frac{\text{Sample plant}}{\text{Total number of flower clusters from 10 sample plant}}$$

v) **Number of flowers per plant**

Total number of flowers were counted from selected plants and their average was taken as the number of flowers per plant.

vi) **Number of fruits per plant**

It was recorded by the following formula:

$$\text{Number of fruits per plant} = \frac{\text{Total number of fruits from 10 sample plants upto final harves}}{10}$$

vii) Fresh weight of leaves

Leaves of the randomly selected plants were detached by a sharp knife and average fresh weight of leaves was recorded in gram at final harvested period.

viii) Dry matter of leaves (%)

After harvesting, randomly selected 100 gram of leaf sample previously sliced in to very thin pieces were put into envelop and placed in oven maintained at 60^0 C for 72 hrs. The sample was then transferred into desiccators and allowed to cool down to the room temperature. The final weight of the sample was taken. The dry matter was calculation by the following formula,

$$\text{Dry matter of leaf (\%)} = \frac{\text{Dry weight of leaf}}{\text{Fresh weight of leaf}} \text{ X } 100$$

ix) Fresh weight of individual fruit

Among the total number of fruits during the period from first to final harvest of fruits, except the first and final harvests, were considered for determining the individual fruit weight by the following formula and expressed in gram.

$$\text{Weight of individual fruit (g)} = \frac{\text{Total weight of fruits from 10 sample plants}}{\text{Total number of fruits from 10 sample plants}}$$

x) **Dry matter of fruits**

After harvesting, randomly selected 100 gram of fruit sample previously sliced into very thin pieces. The fruits were then dried in the sun for one day and followed by above mentioned procedure from the following formula was used to find out dry matter of fruits and expressed in percentage.

$$\text{Dry matter of fruit (\%)} = \frac{\text{Dry weight of fruit}}{\text{Fresh weight of fruit}} \times 100$$

xi) Yield of fruits per plant

It was measured by the following formula:

$$\text{Weight of fruits per plant (Kg)} = \frac{\text{Total weight of fruits in 10 sample plants}}{10}$$

xii) Yield of fruits per plot

A per scale balance was used to take the weight of fruits per plot. It was measured by totaling the fruit yield of each unit plot separately during the period from first to final harvest and was recorded in kilogram (kg).

xiii) Yield of fruits (t/ha)

It was measured by the following formula,

$$\text{Fruit yield (t/ha)} = \frac{\text{Fruit yield per plot (kg)} \times 10000}{\text{Area of plot in square meter} \times 1000}$$

3.15 Statistical analysis

The data in respect of yield, quality and yield components were statistically analyzed to find out the significance of the experimental results. The means of all the treatments were calculated and the analysis of variance for each of the characters under study was performed by "F" test. The difference among the treatment means were evaluated by Least Significant Difference (LSD) test and interpretation of the results were determined by Duncan's Multiple Range Test (DMRT) according to Gomez and Gomes, (1984).

3.16 Economic analysis

The cost of production was analyzed in order to find out the most economic treatment of organic manures and varieties of tomato. All the non-material and material input costs and interests on running capital were considered for computing the cost of production. The interests were calculated for six months @ 13% per year. The price of one kg tomato at harvest was considered to be Tk. 4.00.

The benefit cost ratio (BCR) was calculated by the following formula.

$$\text{Benefit cost ratio (BCR)} = \frac{\text{Gross return (Tk/ha)}}{\text{Total cost of production}}$$

CHAPTER IV

RESULTS AND DISCUSSIONS

4.1 Plant height

Application of organic manures exhibited a significant influence on plant height of tomato plants at 30, 45, 60 days after transplanting (DAT) and the final harvest (Figure 2). At 30 DAT, the longest plant (34.68 cm) was found in the application of poultry manure (OM_2) and the shortest plant (27.08 cm) in control treatment (OM_0). At 45 DAT, the highest plant height (54.76 cm) was recorded from OM_2, while the lowest (44.56 cm) was recorded from OM_0. The longest plant (77.24 cm) was recorded from OM_2 and the shortest plant (67.42 cm) was recorded from OM_0 at 60 DAT. At final harvest, the tallest plant (83.49 cm) was recorded from OM_2, while the lowest (71.96 cm) was recorded from OM_0. It was revealed that the plant height increased with the increased in days after transplanting (DAT) i.e., 30, 45, 60 DAT and the final harvest. 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. This is an agreement with the findings of Singh and Kushwah (2006).

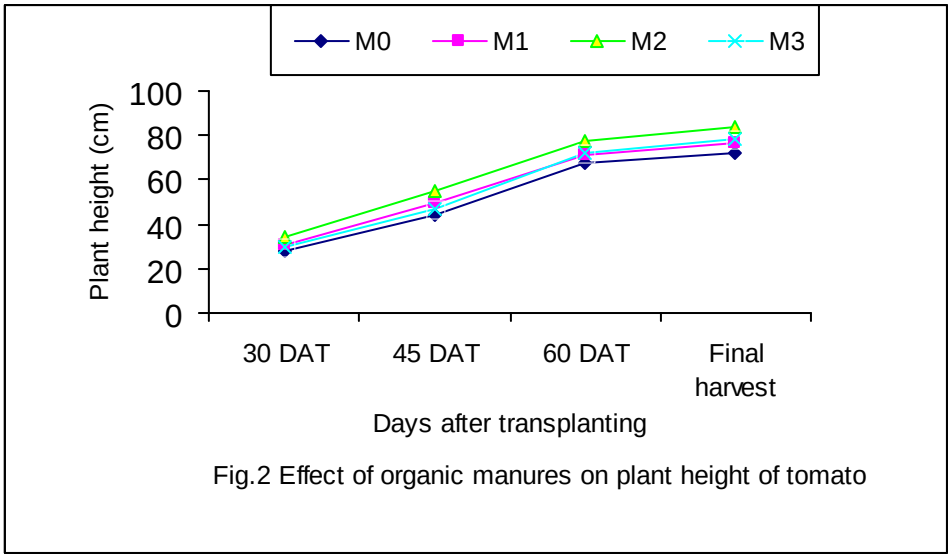

Fig.2 Effect of organic manures on plant height of tomato

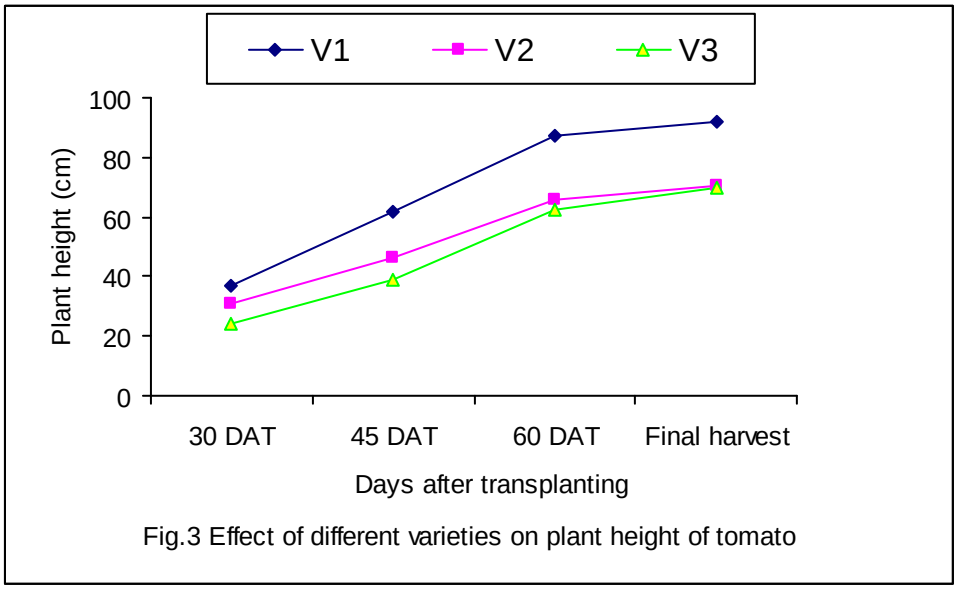

Fig.3 Effect of different varieties on plant height of tomato

Different varieties showed significant variation on plant height of tomato plants (Figure 3) at different DAT and at final harvest. At 30 DAT, the tallest plant (36.90 cm) was found from V_1 (BARI Tomato 8) and the shortest plant (24.3 7cm) was found in variety V_3 (BARI Tomato 2). At 45 DAT, the highest plant height (46.85 cm) was recorded from V_1, while the lowest (28.33 cm) was recorded from V_3. The longest plant (87.32 cm) was recorded from V_1 and the shortest plant (62.65 cm) was recorded from V_3 at 60 DAT. At final harvest, the highest plant (92.12 cm) was recorded from V_1, while the lowest (69.63 cm) was recorded from V_3. The results of this study are comparable to the findings Sarker and Hoque (1980).

The variation was found due to combined effect of organic manure and variety for plant height at different days after transplanting (Appendix III & Table 1). The maximum plant height (41.67 cm) was recorded from treatment combination of OM_2V_1, while the treatment combination OM_0V_3 gave the minimum plant height (21.07 cm) at 30 DAT. At 45 DAT significant differences in terms of plant height was observed among the treatment combinations and the maximum plant height (69.00 cm) was recorded from the treatment combination of OM_2V_1 whereas the minimum (35.13 cm) was noted from the treatment combination of OM_0V_3. At 60 DAT, the maximum plant height (92.73 cm) was obtained from the treatment combination of OM_2V_1, while the minimum plant height (58.47 cm) was recorded from the treatment combination of OM_0V_3. At harvest the maximum plant height (97.40 cm) was recorded from the treatment combination OM_2V_1 whereas the minimum (63.00 cm) was recorded from the treatment combination of OM_0V_3.

Table 1. Interaction effect of organic manures and varieties on plant height of tomato

Treatment	Plant height (cm)			
	30 DAT	45 DAT	60 DAT	Final harvest
OM_0V_1	24.13 d	39.80 gh	63.98 ef	68.53 g
OM_0V_2	29.47 c	44.87 ef	60.80 fg	65.20 hi
OM_0V_3	21.07 e	35.13 i	58.47 g	63.00 i
OM_1V_1	33.87 b	61.47 b	85.07 bc	89.87 c
OM_1V_2	33.20 b	47.47 e	64.20 ef	70.00 fg
OM_1V_3	39.67 a	59.60 bc	83.00 c	87.67 c
OM_2V_1	41.67 a	69.00 a	92.73 a	97.40 a
OM_2V_2	33.77 b	51.67 d	72.80 d	74.13 e
OM_2V_3	28.60 c	43.60 ef	66.20 e	78.93 d
OM_3V_1	32.40 b	56.53 c	88.47 b	93.53 b
OM_3V_2	27.33 c	40.67 fg	66.47 e	72.27 ef
OM_3V_3	23.67 de	36.47 hi	61.93 fg	68.07 gh
$LSD_{0.05}$	2.813	4.011	3.911	2.967
CV (%)	11.62	10.36	6.99	5.49

In the column followed by different letter(s) differed significantly by DMRT at 5% levels of significance.

Where,

Organic manures

OM_0 = Control
OM_1 = Cowdung (30 t/ha)
OM_2 = Poultry manure (25 t/ha)
OM_3 = Vermicompost (20 t/ha)

variety

V_1 = BARI tomato 8
V_2 = BARI tomato 3
V_3 = BARI tomato 2

4.2 Number of leaves per plant

Application of organic manures exhibited a significant influence on number of leaves per tomato plants at 30, 45, 60 days after transplanting (DAT) and the final harvest (Figure 4). At 30 DAT, the maximum (13.00) number of leaves per plant was obtained from OM_2, while the minimum (9.64) was obtained from OM_0. The maximum (21.33) number of leaves per plant was recorded from OM_2 and the minimum (17.94) was found from OM_0 at 45 DAT. At 60 DAT, the maximum (40.58) number of leaves per plant was recorded from OM_2 and the minimum (36.83) number of leaves per plant was obtained from OM_0. At harvest the maximum (60.94) number of leaves per plant was recorded from OM_2 and the minimum (50.47) was obtained from OM_0. Poultry manure is rich in its nitrogen and other nutrients. This favorable condition creates better nutrient absorption and favors for vegetative growth. Consequently, the highest number of leaves was found by poultry manure. The reports recorded by other investigators such as Jagadeesha (2008) and Sathish *et al.* (2009).

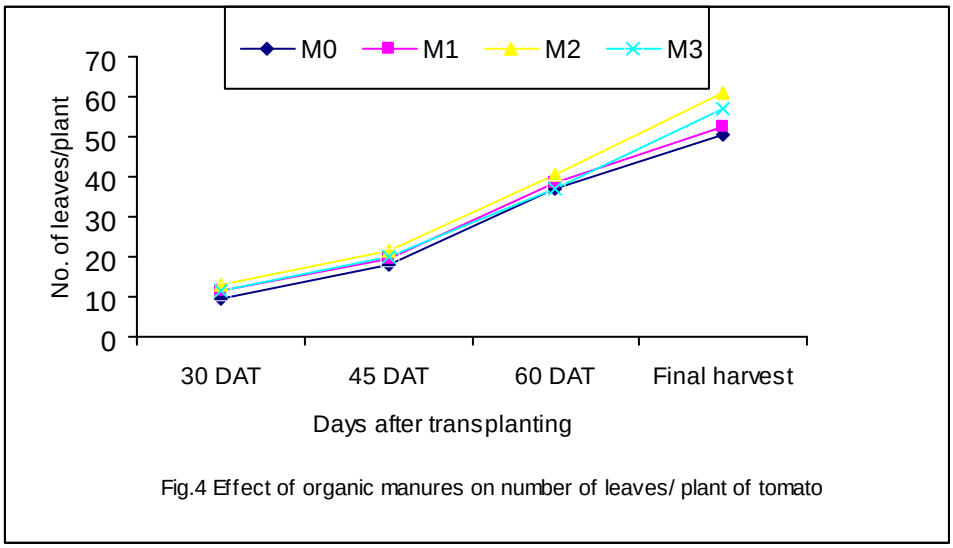

Fig.4 Effect of organic manures on number of leaves/ plant of tomato

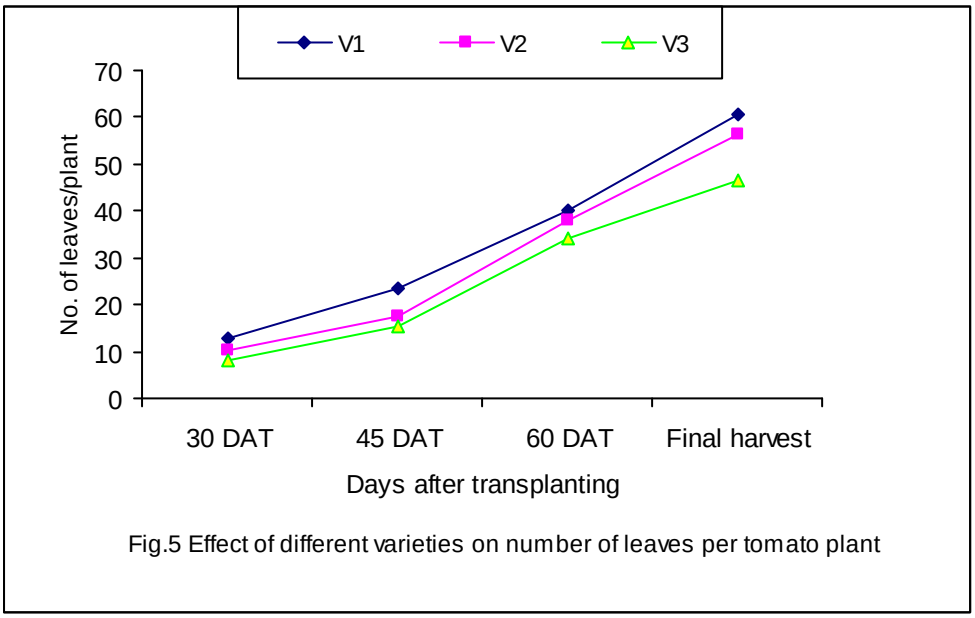

Fig.5 Effect of different varieties on number of leaves per tomato plant

Different varieties had significant variation on number of leaves per tomato plants at different DAT (Figure 5).The maximum (12.85) number

of leaves per plant was recorded from V_1 and the minimum (8.15) number of leaves per plant was obtained from V_3 at 30 DAT. At 45 DAT, the maximum (23.44) number of leaves per plant was recorded from V_1 while the minimum (15.44) number of leaves per plant was found from V_3. The maximum (40.19) number of leaves per plant was obtained from V_1 while the minimum (34.00) number of leaves per plant was recorded from V_3 at 60 DAT. At harvest the maximum (60.81) number of leaves per plant was recorded from V_1 while the minimum (46.52) number of leaves per plant was recorded from V_3. Similar trend of the results were found by Singh and Sahu (1998).

Interaction effect of organic manure and variety showed significant differences for number of leaves per plant at different days after transplanting (Appendix III & Table 2). The maximum (14.56) number of leaves per plant was recorded from treatment combination of OM_2V_1, while the treatment combination of OM_0V_3 gave the minimum (8.60) number of leaves per plant at 30 DAT. At 45 DAT significant differences in terms of number of leaves per plant was observed among the treatment combinations and the maximum (25.44) number of leaves per plant was recorded from the treatment combination of OM_2V_1 whereas the minimum (14.89) was recorded from the treatment combination of OM_0V_3. At 60 DAT the maximum (42.89) number of leaves per plant was recorded from the treatment combination of OM_2V_1, while the minimum (35.44) number of leaves per plant was recorded from treatment combination OM_0V_3. At harvest the maximum (62.00) number of leaves per plant was recorded from the treatment combination OM_2V_1 whereas the minimum (40.11) was recorded from treatment combination OM_0V_3.

Table 2. Interaction effect of organic manures and varieties on number of leaves/plant of tomato

Treatment	No. of leaves per plant

	30 DAT	45 DAT	60 DAT	Final harvest
OM_0V_1	10.00 ef	16.11 e	30.89 d	40.67 d
OM_0V_2	11.00 cd	18.33 d	28.67 de	53.28 c
OM_0V_3	8.60 f	14.89 e	26.44 e	40.11 d
OM_1V_1	9.62 de	20.33 cd	37.56 c	53.85 c
OM_1V_2	11.54 bc	22.78 b	40.67 ab	37.78 d
OM_1V_3	12.39 b	22.89 b	40.56 ab	59.11 ab
OM_2V_1	14.56 a	25.44 a	42.89 a	62.00 a
OM_2V_2	12.01 bc	22.11 bc	39.86 bc	56.8 9 bc
OM_2V_3	9.78 ef	20.55 bc	37.99 bc	57.22 bc
OM_3V_1	10.22 de	20.11 cd	37.44 c	55.05 c
OM_3V_2	12.19 bc	22.22 bc	40.00 ab	57.22 bc
OM_3V_3	11.00 de	19.67 d	37.22 c	56.00 c
$LSD_{0.05}$	2.047	2.183	2.677	3.242
CV (%)	8.95	6.01	7.79	9.12

In the column followed by different letter(s) differed significantly by DMRT at 5% levels of significance.

Where,

Organic manures

OM_0 = Control
OM_1 = Cowdung (30 t/ha)
OM_2 = Poultry manure (25 t/ha)
OM_3 = Vermicompost (20 t/ha)

variety

V_1 = BARI tomato 8
V_2 = BARI tomato 3
V_3 = BARI tomato 2

4.3 Number of flower clusters per plant

Application of organic manures exhibited a significant influence on number of flower cluster per tomato plants (Appendix IV & Table 3). The maximum number of flower clusters per plant (7.33) was recorded from

OM_2 (Poultry manure), which was statistically identical (6.33) to OM_1 while the minimum (5.0) was obtained from OM_0 (Control treatment).

A significant variation was recorded for different varieties on number of flower clusters per plant under the present investigation (Appendix IV & Table 4). The highest number of flower cluster per plant (6.75) was recorded from V_1 (BARI Tomato 8) which was statistically similar (6.08) to V_2 and the minimum number of flower cluster per plant (5.42) was obtained from V_3 (BARI Tomato 2).

The variation was also found due to combined effect of organic manure and varieties for number of flower cluster per plant (Appendix IV & Table 5). The maximum number of flower cluster per plant (8.33) was recorded from the treatment combination of OM_2V_1 (Poultry manure + BARI Tomato8) which was statistically identical OM_1V_1 (8.0) and OM_2V_2 (8.30) while the treatment combination of OM_0V_1 (Control + BARI Tomato 8) gave the minimum (5.02) number of flower clusters per plant.

4.4 Number of flowers per cluster

Number of flowers per cluster varied due to application of different types of organic manures under the present study (Appendix IV & Table 3). The maximum number of flower per cluster (7.00) was noted from OM_2 (Poultry manure), while the minimum (4.87) was counted from control (OM_0).

Different varieties showed significant variation on number of flowers per cluster (Table 4). The maximum number of flower per cluster (7.78) was recorded from V_1 (BARI Tomato 8) which was statistically similar to (6.83) V2 (BARI Tomato 3) and the minimum number of flowers per cluster (4.92) was found from V3 (BARI Tomato 2).

The variation was also found due to combined effect of organic manures and varieties on number of flowers per cluster per tomato plant (Appendix IV& Table 5). The maximum number of flower per cluster (8.80) was found from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination OM_2V_3 (Poultry manure + BARI Tomato 2) gave the minimum number of flowers per cluster (4.20).

4.5 Number of flowers per plant

Number of flowers per plant varied significantly for application of different organic manures (Appendix IV & Table 3). The maximum number of flowers per plant (51.31) was recorded from OM_2 (Poultry manure), while the minimum (24.35) was obtained from control treatment (OM_0).

Different varieties showed significant variation on number of flowers per plant under the present study (Appendix IV & Table 4). The maximum number of flower per plant (52.52) was recorded from V_1 (BARI Tomato 8) and the minimum number of flower per plant (26.67) was found from V_3 (BARI Tomato 2).

The variation was found due to combined effect of organic manures and varieties on number of flowers per plant (Appendix IV& Table 5). The maximum number of flower per plant (73.30) was recorded from the treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination of OM_0V_3 (Control +BARI Tomato 2) performed the minimum number of flower per plant (22.00).

4.6 Number of fruits per plant

Number of fruits per plant differed significantly due to application of different organic manures (Appendix IV & Table 3). The maximum (20.10) number of fruits per plant was recorded from OM_2 (Poultry manure) which is similar to OM_3 (19.52), while the minimum (10.25) was counted from OM_0 (Control). It was revealed that number of fruits per plant increased by using poultry manure. This might be caused that poultry manure contents high amount of nitrogen which increase the number of leaves and enhance photosynthesis, cell division and cell enlargement. Similar trend of the results were found by scientists like Kumar *et al.* (2011).

Different varieties showed significant variation on number of fruits per plant (Table 4). The maximum (20.01) number of fruit per plant was obtained from V_1 (BARI Tomato 8) and the minimum (15.52) number of fruits per plant was observed in V_3 (BARI Tomato 2). The reports recorded by other investigators such as Berry *et al.* (1995) and Ajlouni *et al.* (1996).

Combined effect of organic manures and varieties showed significant differences on number of fruits per plant (Appendix IV & Table 4). The maximum (20.10) number of fruit per plant was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination OM_0V_1 (Control +BARI Tomato 8) performed the minimum (10.02) number of fruits per plant.

4.7 Length of individual fruit (cm)

Due to application of different organic manures varied significantly on length of individual fruit (Appendix V & Table 4). The largest length of individual fruit (5.05 cm) was recorded from OM_2 (Poultry manure), while the lowest (4.778 cm) was recorded from OM_0 (Control) which was statistically identical (4.90 cm) to OM_3 (Vermicompost).

Different varieties showed significant variation on length of individual fruit (Table 4). The largest (5.025 cm) length of individual fruit was obtained from V_1 (BARI Tomato 8) and the lowest (4.792 cm) length of individual fruit was obtained from V_3 (BARI Tomato 2).

The variation was found due to combined effect of organic manures and varieties on length of individual fruit under the present trial (Appendix V & Table 5). The largest (5.60 cm) length of individual fruit was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI tomato 8), while the treatment combination of OM_0V_3 (Control treatment + BARI Tomato 2) gave the minimum (4.63 cm) length of individual fruit.

4.8 Diameter of individual fruit (cm)

Diameter of individual fruit differed significantly for different organic manures (Appendix V & Table 4). The maximum (5.60 cm) diameter of individual fruit was recorded from OM_2 (Poultry manure), which was statistically identical to OM_3 (5.51 cm) and OM_1 (5.48), while the control treatment OM_0 showed the minimum (5.15 cm) diameter of individual fruit.

Different varieties showed significant variation on diameter of individual fruit under the present investigation (Appendix V & Table 4). The maximum (5.66 cm) diameter of individual fruit was recorded from V_1 (BARI Tomato 8) which was statistically identical to V_2 (5.43 cm) and the minimum (5.34 cm) diameter of individual fruit was obtained from V_3 (BARI Tomato 2).

Combined effect of organic manure and varieties varied significantly on diameter of individual fruit (Appendix V & Table 5). The maximum (5.96 cm) diameter of individual fruit was recorded from treatment

combination of OM_2V_1 (Poultry manure +BARI Tomato 8) which was similar to OM_2V_2 (5.80 cm), while the treatment combination of OM_0V_3 (Control treatment + BARI Tomato 2) gave the minimum (4.86 cm) diameter of individual fruit.

4.9. Fresh weight of leaves

Fresh weight of leaves differed significantly due to application of different organic manures (Appendix V & Table 4). The maximum (496.23 g) fresh weight of leaves was recorded from OM_2 (Poultry manure), while the minimum (402.77 g) was recorded from OM_0 (Control treatment).

Different varieties showed significant variation on fresh weight of leaves under the present investigation (Appendix V & Table 4). The maximum (466.87 g) fresh weight of leaves was recorded from V_1 (BARI Tomato 8) and the minimum (379.26 g) fresh weight of leaves was obtained from V_3 (BARI Tomato 2).

Combined effect varied significantly for organic manure and varieties for fresh weight of leaves (Appendix V & Table 5). The maximum (481.55 g) fresh weight of leaves was recorded from treatment combination of OM_2V_1 (Poultry manure +BARI Tomato 8), while the treatment combination of OM_0V_3 (Control treatment + BARI Tomato 2) gave the minimum (404.01 g) fresh weight of leaves.

4.10 Dry matter (%) of leaves

Dry matter (%) of leaves varied significantly due to application of different organic manures (Appendix V & Table 4). The maximum (7.56

%) dry matter of leaves was recorded from OM_2 (Poultry manure), while the minimum (6.90 %)) was recorded from OM_0 (Control treatment).

A significant variation was recorded from different varieties on dry matter (%) of leaves (Appendix V & Table 4). The maximum (7.88 %) dry matter of leaves was recorded from V_3 (BARI Tomato 2) and the minimum (6.44 %) dry matter of leaves was recorded from V_1 (BARI Tomato 8).

The variation was found due to combined effect of organic manures and varieties for Dry matter percentage of leaves (Appendix V & Table 5). The maximum (8.06 %) dry matter of leaves was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination of OM_0V_1 (Poultry manure + no manure) performed the minimum (6.06 %) dry matter of leaves.

4.11 Fresh weight of individual fruit

Fresh weight of individual fruit varied significantly due to application of different organic manures (Appendix V & Table 4). The maximum (112.5 g) weight of individual fruit was recorded from OM_2 (Poultry manure), while the minimum (60 g) was recorded from OM_0 (Control treatment).

A significant variation was recorded from different varieties on weight of individual fruit under the present trial (Appendix V & Table 4). The maximum (105.62 g) weight of individual fruit was recorded from V_1 (BARI Tomato 8) and the minimum (86.2 g) weight of individual fruit was recorded from V_3 (BARI Tomato 2).

The variation was found due to interaction effect of organic manures and varieties for weight of individual fruit under the trial (Appendix V & Table 5). The maximum (113.62 g) weight of individual fruit was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination of OM_0V_1 (Poultry manure + no fertilizer) performed the minimum (65.15 g) weight of individual fruit.

4.12 Dry matter of fruit

Dry matter (%) of fruit varied significantly due to application of different organic manures (Appendix V & Table 4). The maximum (10.71 g) Dry matter (%) of fruit was recorded from OM_2 (Poultry manure), while the minimum (8.24 g) was recorded from OM_0 (Control treatment).

A significant variation was recorded from different varieties on Dry matter (%) of fruit (Appendix V & Table 4). The maximum (10.10 g) Dry matter (%) of fruit was recorded from V_3 (BARI Tomato 2) and the minimum (8.96 g) Dry matter (%) of fruit was recorded from V_1 (BARI Tomato 8).

The variation was found due to interaction effect of organic manures and varieties for Dry matter (%) of fruit (Appendix V & Table 4). The maximum (11.67 g) Dry matter (%) of fruit was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination of OM_0V_1 (Poultry manure + no manure) performed the minimum (7.15 g) weight of individual fruit.

4.13 Yield (kg/ plant)

Application of different organic manures showed significant variation on yield per plant (Appendix V & Table 6). The highest (2.26 kg/plant) yield was recorded from OM_2 (Poultry manure), while the lowest (0.62 kg/plant) was found from OM_0 (Control treatment). Poultry manure is rich in its nitrogen and nutrients content. These favorable conditions creates better nutrients absorption and favors the growth and development of root system which in true reflects better vegetative growth, photosynthetic activity. Consequently higher total yield would be obtained by poultry manure. The reports recorded by other investigator such as Kushwah *et al.* (2005).

Different varieties showed significant variation on yield per plant under the present investigation (Appendix V & Table 4). The highest (2.11 kg/plant) yield was recorded from V_1 (BARI Tomato 8) and the lowest(1.34 kg/plant) yield was obtained from V_3 (BARI Tomato 2). Similar trend of the results were found by scientists like Hossain and Ahmed (1973) and Berry *et al.* (1995).

The variation was found due to interaction effect of organic manures and varieties for yield per plant (Appendix V & Table 5). The highest (2.28 kg/plant) yield was noted from the treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination OM_0V_1 (Control treatment + BARI Tomato 8) gave the lowest yield (0.65 kg/plant).

4.14 Yield (kg/plot)

Yield per plot varied significantly due to application of different organic manures (Appendix V & Table 3). The highest (40.70 kg/plot) yield was obtained from OM_2 (Poultry manure), while the minimum (11.07 kg/plot) was recorded from OM_0 (Control treatment).

Different varieties showed significant variation on yield per plot (Table 4). The highest (38.04 kg/plot) yield was recorded from V_1 (BARI Tomato 8) and the minimum yield (24.08 kg/plot) was recorded from V_3 (BARI Tomato 2).

The variation was found due to combined effect of organic manures and varieties for yield per plot (Appendix V & Table 5). The highest (41.11 kg/plot) yield was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination of OM_0V_1 (Control treatment + BARI Tomato 8) gave the lowest yield (11.75 kg/plot).

4.15 Yield (t/ha)

Yield per hectare varied significantly due to application of different organic manures (Appendix V & Figure 6). The highest (94.22 t/ha) yield was obtained from OM_2 (Poultry manure), while the lowest (25.63 t/ha) was recorded from OM_0 (Control treatment).

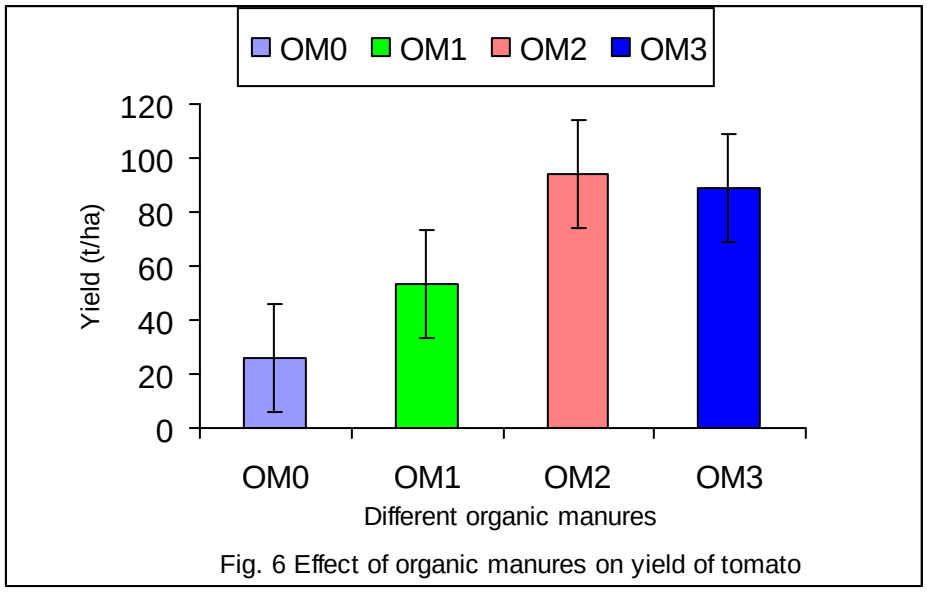

Fig. 6 Effect of organic manures on yield of tomato

Different varieties showed significant variation on yield per hectare under the present investigation (Appendix 5 & Figure 7). The highest yield (88.06 t/ha) was recorded from V_1 (BARI Tomato 8) and the lowest yield (55.74 t/ha) was found from V_3 (BARI Tomato 2).

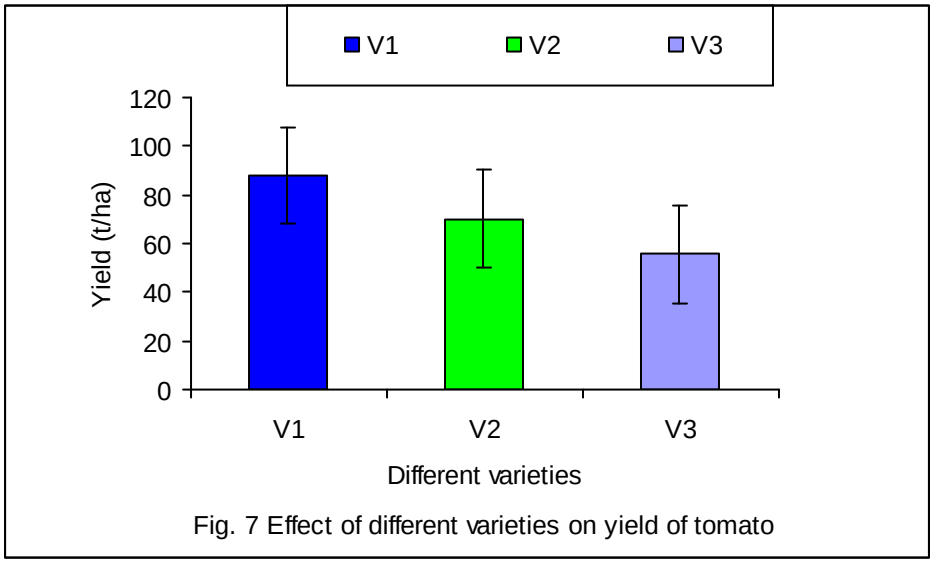

Fig. 7 Effect of different varieties on yield of tomato

Combined effect of organic manures and varieties varied significantly on yield per hectare (Appendix V & Table 5). The highest yield (95.16 t/ha) was recorded from the treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination of OM_0V_1 (Control treatment + BARI Tomato 8) perform the lowest yield (27.20 t/ha).

4.16 Economic Analysis

Economic analysis was done with a view to observing the comparative cost and benefit trend in tomato cultivation as influenced by organic manures and varieties to find out the gross return, net return and benefit cost ratio. The details of economic analysis have been presented in Appendix VI.

The total cost of production was noticed due to different treatment combinations comprising different organic manures and variety. The highest cost of production (Tk. 135926.50/ha) was involved in the treatment combination Vermicompost and BARI Tomato 2 and the lowest cost of production (Tk. 80176.50/ha) was involved in no manures with BARI Tomato 8 (Table 6).

The highest gross income (Tk. 380640/ha) was found from the treatment combination of poultry manure and BARI Tomato 8 and the gross income (Tk. 108800/ha) was obtained from the treatment combination no manures with BARI Tomato 8 (Table 6).

Poultry manure and BARI Tomato 8 gave the highest net return (Tk. 278163.50/ha) and the lowest net return (Tk. 28623.50/ha) was recorded from the treatment combination no manure with BARI Tomato 8 (Table 6).

The highest benefit cost ratio (3.71) was obtained from the treatment combination of poultry manure and BARI Tomato 8 and the lowest benefit cost ratio (1.32) was obtained from the treatment combination of vermicompost with BARI Tomato 2.

Table 6. Cost and return in tomato production as influenced by organic manures and variety

Treatment combination	Total cost of production (Tk./ha) [Input cost (A)+ overhead cost (B)]	Yield (t/ha)	Gross income (Tk)	Net return (Tk.)	Benefit cost ratio (BCR)
OM_0V_1	80176.5	27.2	108800	28623.5	1.36
OM_0V_2	80176.5	38.98	155920	75743.5	1.94
OM_0V_3	80176.5	47.28	189120	108943.5	2.36
OM_1V_1	93556.5	68.63	274520	180963.5	2.93
OM_1V_2	93556.5	37.73	150920	57363.5	1.61
OM_1V_3	93556.5	53.83	215320	121763.5	2.30
OM_2V_1	102476.5	95.16	380640	278163.5	3.71
OM_2V_2	115856.5	84.38	337520	221663.5	2.91
OM_2V_3	113626.5	65.54	262160	148533.5	2.31
OM_3V_1	135926.5	73.02	292080	156153.5	2.15
OM_3V_2	135926.5	55.78	223120	87193.5	1.64
OM_3V_3	135926.5	44.75	179000	43073.5	1.32

Price of tomato = Tk. 4000 per ton (rate of whole sale market at Karwan bazar, Dhaka during the pick harvest period).

Where,

Organic manures

OM_0 = Control
OM_1 = Cowdung (30 t/ha)
OM_2 = Poultry manure (25 t/ha)
OM_3 = Vermicompost (20 t/ha)

variety

V_1 = BARI tomato 8
V_2 = BARI tomato 3
V_3 = BARI tomato 2

CHAPTER V

SUMMERY AND CONCLUSIONS

The field experiment was conducted in the Horticulture farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka-1207 during the period from September 2009 to March 2010 to find out the effect of organic manures and different varieties on the growth and yield of tomato. Two factors were used in the experiment, viz. four types of organic manure and three types of variety. Factor A; Four types of organic manure such as OM_0 = Control (No fertilizer application), OM_1 = Cowdung (30 t/ha), OM_2 = Poultry manure (25 t/ha) and OM_3 = Vermicompost (20 t/ha). Factor B; Three types of variety such as V_1 = BARI tomato 8, V_2 = BARI tomato 3 and V_3 = BARI tomato 2. The experiment was laid out in a Randomized complete Block Design (RCBD) with three replications. Data on different yield contributing parameters and yield were recorded.

At final harvest, the largest plant (83.49 cm) was recorded from OM_2, while the lowest (71.96 cm) was recorded from OM_0. The maximum (60.94) number of leaves per plant was recorded from OM_2 and the minimum (50.47) was recorded from OM_0 at final harvest. The maximum number of flower clusters per plant (7.33) was recorded from OM_2 (poultry manure), while the minimum (5.0) was obtained from OM_0 (control treatment). The maximum number of flower per cluster (7.00) was recorded from OM_2 (Poultry manure), while the minimum (4.87) was obtained from control (OM_0). The maximum number of flowers per plant (51.31) was recorded from OM_2 (poultry manure), while the minimum (24.35) was obtained from control treatment (OM_0). The maximum (20.10) number of fruits per plant was recorded from OM_2 (poultry

manure), while the minimum (10.25) was recorded from OM_0 (control). The maximum length of individual fruit (5.056 cm) was recorded from OM_2 (Poultry manure), while the minimum (4.778 cm) was recorded from OM_0 (Control). The maximum (5.60 cm) diameter of individual fruit was recorded from OM_2 (poultry manure), while the minimum (5.15 cm) was recorded from OM_0 (control treatment). The maximum (112.5 g) weight of individual fruit was recorded from OM_2 (poultry manure), while the minimum (60 g) was recorded from OM_0 (control treatment). The maximum (496.23 g) fresh weight of leaves was recorded from OM_2 (poultry manure), while the minimum (402.77 g) was recorded from OM_0 (control treatment). The maximum (7.56 %) dry matter of leaves was recorded from OM_2 (poultry manure), while the minimum (6.90 g) was recorded from OM_0 (control treatment) The maximum (10.71%) dry matter (of fruit was recorded from OM_2 (poultry manure), while the minimum (8.24 g) was recorded from OM_0 (control treatment). The maximum (2.26 kg/plant) yield was recorded from OM_2 (Poultry manure), while the minimum (0.62 kg/plant) was found from OM_0 (control treatment). The maximum (40.70 kg/plot) yield was recorded from OM_2 (poultry manure), while the minimum (11.07 kg/plot) was recorded from OM_0 (control treatment). The maximum (94.22 t/ha) yield was obtained from OM_2 (poultry manure), while the minimum (25.63 t/ha) was recorded from OM_0 (control treatment).

At final harvest, the highest plant (92.12 cm) was recorded from V_1 (BARI Tomato 8), while the lowest (69.63 cm) was recorded from V_3 (BARI Tomato 2). The maximum (60.81) number of leaves per plant was recorded from V_1 while the minimum (46.52) number of leaves per plant was recorded from V_3 at harvest. The maximum number of flower cluster per plant (6.75) was recorded from V_1 (BARI Tomato 8) and the

minimum number of flower cluster per plant (5.42) was obtained from V_3 (BARI Tomato 2). The maximum number of flower per cluster (7.78) was recorded from V_1 (BARI Tomato 8) and the minimum number of flowers per cluster (4.92) was found from V_3 (BARI Tomato 2). The maximum number of flower per plant (52.52) was recorded from V_1 (BARI Tomato 8) and the minimum number of flower per plant (26.67) was found from V_3 (BARI Tomato 2). The maximum (20.01) number of fruit per plant was recorded from V_1 (BARI Tomato 8) and the minimum (15.52) number of fruits per plant was observed in V_3 (BARI Tomato 2). The maximum (5.025 cm) length of individual fruit was recorded from V_1 (BARI Tomato 8) and the minimum (4.792 cm) length of individual fruit was obtained from V_3 (BARI Tomato 2). The maximum (5.66 cm) diameter of individual fruit was recorded from V_1 (BARI Tomato 8) and the minimum (5.34 cm) diameter of individual fruit was obtained from V_3 (BARI Tomato 2). The maximum (466.87 g) fresh wt. of leaves was recorded from V_1 (BARI Tomato 8) and the minimum (379.26 g) fresh wt. of leaves was recorded from V_3 (BARI Tomato 2). The maximum (7.88%) dry matter of leaves was recorded from V_3 (BARI Tomato 2) and the minimum (6.44 %) dry matter of leaves was recorded from V_1 (BARI Tomato 8).The maximum (105.62 g) weight of individual fruit was recorded from V_1 (BARI Tomato 8) and the minimum (86.2 g) weight of individual fruit was recorded from V_3 (BARI Tomato 2). The maximum (10.10 %) Dry matter of fruit was recorded from V_3 (BARI Tomato 2) and the minimum (8.96 %) Dry matter of fruit was recorded from V_1 (BARI Tomato 8).The maximum (2.11 kg/plant) yield was recorded from V_1 (BARI Tomato 8) and the minimum (1.34 kg/plant) yield was obtained from V_3 (BARI Tomato 2). The maximum yield (88.06 t/ha) was recorded from V_1 (BARI Tomato 8) and the minimum yield (55.74 t/ha) was recorded from V_3 (BARI Tomato 2).

At harvest the maximum plant height (97.40 cm) was recorded from the treatment combination OM_2V_1 whereas the minimum (63.00 cm) was recorded from the treatment combination of OM_0V_3. The maximum (62.00) number of leaves per plant was recorded from the treatment combination OM_2V_1 whereas the minimum (40.11) was recorded from treatment combination OM_0V_3 At harvest. The maximum number of flower cluster per plant (14.33) was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination of OM_0V_1 (Control + BARI Tomato 8) gave the minimum (6.33) number of flower clusters per plant. The maximum number of flower per cluster (8.80) was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination OM_2V_3 (Poultry manure + BARI Tomato 2) gave the minimum number of flowers per cluster (4.33). The maximum number of flower per plant (73.30) was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination OM_0V_3 (Control +BARI Tomato 2) performed the minimum number of flower per plant (22.00). The maximum (20.10) number of fruit per plant was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination OM_0V_1 (Control +BARI Tomato 8) gave the minimum (10.02) number of fruits per plant. The maximum (5.60 cm) length of individual fruit was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI tomato 8), while the treatment combination of OM_0V_3 (Control treatment + BARI Tomato 2) performed the minimum (4.63 cm) length of individual fruit. The maximum (5.96 cm) diameter of individual fruit was recorded from treatment combination of OM_2V_1 (Poultry manure +BARI Tomato 8), while the treatment combination of OM_0V_3 (Control treatment + BARI Tomato 2) gave the minimum (4.86 cm) diameter of individual fruit. The maximum (481.55 g) fresh wt. of leaves was found from

treatment combination of OM_2V_1 (Poultry manure +BARI Tomato 8), while the treatment combination of OM_0V_3 (Control treatment + BARI Tomato 2) gave the minimum (404.01 g) fresh wt. of leaves. The maximum (8.06 %) dry matter of leaves was recorded from treatment combination of OM_2V_1 (Poultry manure +BARI Tomato 8), while the treatment combination of OM_0V_1 (Control treatment + BARI Tomato 8) gave the minimum (6.06 %) dry matter of leaves. The maximum (113.62 g) weight of individual fruit was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination of OM_0V_1 (Poultry manure + no fertilizer) performed the minimum (65.15 g) weight of individual fruit. The maximum (11.67 %) dry matter of fruit was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination of OM_0V_1 (Poultry manure + no fertilizer) performed the minimum (7.15%) dry matter of fruit. The maximum (2.28 kg/plant) yield was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination OM_0V_1 (Control treatment + BARI Tomato 8) gave the minimum yield (0.65 kg/plant). The maximum (41.11kg/plot) yield was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination of OM_0V_1 (Control treatment + BARI Tomato 8) gave the minimum yield (11.75 kg/plot). The maximum yield (95.16 t/ha) was recorded from treatment combination of OM_2V_1 (Poultry manure + BARI Tomato 8), while the treatment combination of OM_0V_1 (Control treatment + BARI Tomato 8) gave the minimum yield (27.20 t/ha). The maximum cost of production (Tk. 135926.50) was involved in the treatment combination Vermicompost and BARI Tomato 2 and minimum cost of production (Tk. 80176.50/ha) was involved in no fertilizer and BARI Tomato 8.The highest gross income (Tk. 380640/ha) was found from the treatment combination of Poultry manure and BARI Tomato 8 and the lowest gross income (Tk. 108800/ha) was obtained from the treatment combination no

manure and BARI Tomato 8. Poultry manure and BARI Tomato 8 gave the highest net return (Tk. 278163.50/ha) and the lowest net return (Tk. 28623.50) was found from the treatment combination no fertilizer with BARI Tomato 8. The highest benefit cost ratio (3.71) was obtained from the treatment combination of poultry manure and BARI Tomato 8 and the lowest benefit cost ratio (1.32) was obtained from the treatment combination of vermicompost with BARI Tomato 2.

Conclusion:

It may be concluded that the treatment combination of Poultry manure and "BARI Tomato 8" performed the best results. So, the treatment combination of poultry manure and "BARI Tomato 8" is the superior combination compared to other treatment combinations for tomato production. The experiment was conducted only one growing season. So, considering the situation of the present experiment, further studies in the following areas may be suggested:

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

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Table 3. Effect of organic manures on growth and yield of tomato

Treatment	Flower cluster /plant	Flower /cluster	Flower /plant	Fruit /Plant	Length of individual fruit (cm)	Diameter of individual fruit (cm)	Fresh wt. of leaves (g)	Dry matter content of leaves (%)	Dry con frui
OM_0	5.0c	4.87b	24.35d	10.25c	4.778c	5.15c	402.77 d	6.90 c	8.
OM_1	6.33ab	5.56ab	35.19bc	15.53b	4.801b	5.48b	448.06 c	7.30 b	9.
OM_2	7.33a	7a	51.31a	20.1a	5.056a	5.60a	496.23 a	7.56 a	10
OM_3	5.67bc	5.96ab	33.79c	19.52ab	4.90ab	5.51ab	477.15 b	7.51 a	9.
$LSD_{0.005}$	1.211	1.790	2.288	2.151	0.257	0.110	10.03	0.521	0.
CV (%)	7.68	8.81	10.54	10.64	7.89	6.27	7.78	5.25	2

Table 4. Effect of varieties on growth and yield of tomato

Treatment	Cluster /plant	Flower /cluster	Flower /plant	Fruit /plant	Length of individual fruit (cm)	Diameter of individual fruit (cm)	Fresh wt. of leaves (g)	Dry matter content of leaves (%)	D c f
V_1	6.75a	7.78a	52.52a	20.01a	5.025a	5.66a	466.87 a	6.44 b	
V_2	6.08ab	6.83a	41.53b	18.62b	4.95ab	5.43ab	412.90 b	7.65 a	
V_3	5.42b	4.92b	26.67c	15.52c	4.792b	5.34b	379.26 c	7.88 a	
$LSD_{0.05}$	1.064	1.548	1.950	1.873	0.297	0.128	17.03	0.127	
CV (%)	7.68	8.81	10.54	10.64	7.89	6.27	9.13	5.25	

In the column followed by different letter(s) differed significantly by DMRT at 5% levels of significance.

Where,

Organic manures

OM_0 = Control
OM_1 = Cowdung (30 t/ha)
OM_2 = Poultry manure (25 t/ha)
OM_3 = Vermicompost (20 t/ha)

variety

V_1 = BARI tomato 8
V_2 = BARI tomato 3
V_3 = BARI tomato 2

Table 5. Combined effect of organic manures and varieties on growth and yield of tomato

Treatment	Cluster /plant	Flower /cluster	Flower /plant	Fruit /Plant	Length of individual fruit (cm)	Diameter of individual fruit (cm)	Fresh wt. of leaves (g)	Dry matter content of leaves (%)	Dry matter content fruit (%
OM_0V_1	5.02c	4.73cd	23.74h	10.02d	4.86c	5.16d	414.82 f	6.06 g	7.
OM_0V_2	5.2c	5.87bc	30.52g	13.52c	4.76cd	4.98de	407.83 g	6.37 fg	9.
OM_0V_3	5.0c	4.40cd	22.00h	15.23bc	4.63d	4.86e	404.01 gh	6.54 efg	9.88
OM_1V_1	8.0ab	7.67ab	61.36c	19.12ab	4.96bc	5.21cd	454.46 b	6.79 def	10.4
OM_1V_2	5.33c	7.0ab	37.31ef	11.03cd	4.89c	5.41c	410.48 f	6.95 cdef	10.2
OM_1V_3	5.67bc	7.0ab	39.69e	16.52b	4.79cd	5.56bc	413.66 f	7.20 bcd	10.
OM_2V_1	8.33a	8.8a	73.30a	20.1a	5.60a	5.96a	481.55 a	8.06 a	11.
OM_2V_2	8.3ab	7.87ab	65.32b	19.42ab	5.42ab	5.80ab	454.56 b	8.05 a	9.83
OM_2V_3	5.33c	4.20d	23.08h	16.35b	5.31b	5.75b	446.74 cd	7.82 ab	9.5
OM_3V_1	5.97b	7.67ab	43.49d	17.42b	5.12bc	5.53bc	442.01 cd	7.94 a	9.63
OM_3V_2	5.6bc	6.6b	36.96ef	14.47bc	5.01c	5.39c	447.02 cd	7.70 ab	9.57
OM_3V_3	5.57bc	5.6c	31.19g	12.26c	4.98cd	5.21cd	428.20 e	7.50 abcd	9.16
$LSD_{0.05}$	2.134	2.04	3.964	3.385	0.269	0.221	5.01	0.642	0.795
CV (%)	7.68	8.81	10.54	10.64	7.89	6.27	7.71	5.25	2.71

In the column followed by different letter(s) differed significantly by DMRT at 5% levels of significance.

Where,

Organic manures

OM_0 = Control
OM_1 = Cowdung (30 t/ha)
OM_2 = Poultry manure (25 t/ha)
OM_3 = Vermicompost (20 t/ha)

variety

V_1 = BARI tomato 8
V_2 = BARI tomato 3
V_3 = BARI tomato 2