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Study on Growth, Yield and Yield Contributing Characters of Tomato Varieties in Rainfed Area

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University of Rajshahi

Ph.D. Thesis

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STUDY ON GROWTH, YIELD AND YIELD CONTRIBUTING CHARACTERS OF TOMATO VARIETIES IN RAINFED AREA

A thesis submitted for the degree of

Doctor of Philosophy

In the
Department of Crop Science and Technology
University of Rajshahi, Bangladesh

BY

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DEPARTMENT OF CROP SCIENCE AND TECHNOLOGY
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JUNE 2019

DEDICATED

TO My

BELOVED PARENTS

DECLARATION

I do hereby declare that the entire work now submitted as a thesis entitled "**STUDY ON GROWTH, YIELD AND YIELD CONTRIBUTING CHARACTERS OF TOMATO VARIETIES IN RAINFED AREA**" in the Department of Crop Science and Technology, University of Rajshahi for the degree of Doctor of philosophy is the result of my own investigation. The thesis contains no materials which has been accepted for the award of any other degree or diploma elsewhere, and to the best of my knowledge, thesis contains no material previously published or written by another person, except where due reference is made in the text.

(M. Ekramul Hoque)
Ph. D. Research Fellow

CERTIFICATE

I have pleasure in certifying the thesis entitled **"STUDY ON GROWTH, YIELD AND YIELD CONTRIBUTING CHARACTERS OF TOMATO VARIETIES IN RAINFED AREA''** submitted to the Department of Crop Science and Technology, Faculty of Agriculture, University of Rajshahi for the degree of Doctor of Philosophy. I hereby certify that the candidate has fulfilled the requirements and the research work embodied in the thesis was carried out by the candidate. To the best of my knowledge, all the data and materials are genuine and original. No part of the research work has been submitted for any other degree.

Supervisor

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June 2019 The Author

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ABSTRACT

The experiment was conducted to evaluate the "Study on growth, yield and yield contributing characters of tomato varieties in rainfed area" during October 2013 to March 2017 at the experiment field of Kalikapur, Baraigram Upazila, Natore and laboratory of Crop Science of Technology, Rajshahi University, Bangladesh. Four different experiments were conducted and laid out in Randomized Complete Block Design with three replications. Four tomato varieties BARI-2, BARI-8, BARI-14, and BARI-15 were used as planting material. A series of experiment were laid out in order to develop suitable variety, better management practices and to get high quality tomato production to overcome the adverse condition. Experiments were conducted mainly effect on staking and non-staking, pest and disease management practices, pruning and non-pruning & organic and inorganic fertilizer combination level of growth, yield and yield contributing characters of tomato variety. In case of quality tomato production, the results revealed that the plant height, number of leaves, number of branches per plant, number of fruits per plant, yield ton per hectare were significantly influenced by treatments except few cases. Results revealed that the effects of Staking and Non-staking and their co-ordinate interactions of tomato have been investigated and produced the highest yield (54.85 t/ha) was observed in staking practices and the highest yield was found (63.03 t/ha) in combination and vitamin C content highest in fresh stage (30.00 mg/100gm) as obtained from the treatment S_1V_1 (S_1= Staking; V_1= BARI-2). The effects of pest and disease management practices produced the highest yield (53.26 t/ha) was observed in C_1 (Chemical use) and very closest yield was found (50.88 t/ha) in NL_1 (Neem leaf extract & Bordeaux mixture). The treatment combination of pruning and non-pruning practices observed the maximum yield (53.25 t/ha) in used pruning practices and the highest yield was found (61.43 t/ha) in the treatment P_1V_1 combination (P_1= Pruning; V_1= BARI-2). On the other hand, among different organic and inorganic fertilizer combination the highest yield of tomato (57.47 t/ha) was found in treatment T_2= ½ Cowdung + ½ chemical fertilizer (7.5ton/ha + Urea-250kg/ha, TSP-200kg/ha, MOP-100kg/ha) with variety BARI-2 (Ratan) followed by poultry litter and chemical fertilizer.

CHAPTER-I

INTRODUCTION

CHAPTER - I

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important and popular vegetables in Bangladesh. Tomato is normally self-pollinated annual crop which belongs to the family solanaceae with chromosome number 2n=24 (Jenkins, 1948). Tomato is the third in world's largest vegetable crop after potato (Rashid, 1993). It is popular of its diversified use like salad, stewed, juices, sauce, pickles and preserved.

Tomato is generally accepted to have originated in new world (America) i.e. the Andean region composed of part of Bolivia, Chile, Colombia, Ecuador and Peru. Evidence from the diversity of cultivated type culinary use and from the abundance of the names of the tomato was originally domesticated in Mexico (Jenkins, 1948). Soon after discovery of the new world, tomato was taken to Europe and then gradually it was spreaded throughout the rest of the world (Heiser, 1969).

At present, tomato is one of the widest grown vegetable in the world. Tomatoes are rich in nutrients, especially potassium, folic acid, vitamin C and contain a mixture of different carotenoids, including vitamin A, effective B-carotene, as well as lycopene (Wilcox et al. 2003).

Lycopene one of nature's most powerful antioxidant, is present in tomatoes, and especially when tomatoes are cooked, had been found beneficial in preventing prostate cancer. The consumption of tomatoes rich in lycopene leads directly to a decreased incidence of cancer in mouth, pharynx, esophagus, stomach, large intestine, and

rectum (Franceschi et al. 1994). Americans use the fresh fruit, orally for kidney and liver problems and to keep good digestion.

The tomato plays an important role in human nutrition by providing essential amino acids, vitamins and minerals (Sainju *et al.*, 2003). Its vitamin C content is particularly high (Kanyomeka and Shivute, 2005). It also contains lycopene, a very potent antioxidant that may be an important contributor to the prevention of cancers (Agarwal and Rao, 2000).

Tomato is one of the most important vegetable crop in Bangladesh because of its nutritive value and diverse use both in fresh and processed form. Optimum fruit setting requires a night temperature of 15 to 20°C (Charles and Harris, 1972). Bright sunshine at the time of fruit set helps to develop dark red colored fruits. Tomato grows very well on most mineral soils, but they prefer deep, well-drained sandy loams. Tomato is a moderately tolerant crop to a wide pH (5.5-6.8) range.

Staking refers to support of plants with sturdy material to keep the fruits and foliage off the ground. Staking increases fruit yield, reduces the proportion of unmarketable fruit, enhances the production of high quality fruits, prevents disease and fruit rot, allows better aeration and better exposure of the foliage to sunlight and photosynthetic activities (Anon., 2007). Akoroda *et al*. (1990) and Amina *et al*. (2012) recommended staking of crops for higher yield, quality fruits, easy harvesting and exposure of leaves for effective light reception.

Tomatoes are usually staked and supported off the ground, in an effort to minimize losses from rots when the fruit is in contact with the soil. The pruning of staked tomatoes is a cultural practice that greatly influences yield, according to Davis and Esters (1993). Pruning is practiced by

farmers to enhance quality and increase yield of tomato. Pruning involves the selective removal of side shoots to limit plant growth and to divert nutrients to the flower clusters of the main stem (Chen and Lal, 1999).

Ahmad and Singh (2005) demonstrated that yield increases can be obtained in tomatoes with the use of staking, while Navarrete and Jeannequin (2000) established that fruit quality is enhanced with pruning. In an earlier study, Wurster and Nganga (1971) demonstrated that the quality and size of tomato fruit improved with pruning. They also emphasized that, when properly staked and pruned, tomato plants produced earlier fruit that were larger and higher in yield than non-pruned and non-staked plants of the same variety. Muhammad and Singh (2007b) have also reported a significant increase in quality and yield of tomatoes with pruning.

Staking and pruning have also proven to be effective in reducing the incidence of pest problems, thereby increasing yields (Saunyama and Knapp, 2003). Chen and Lal (1999) demonstrated that staking allowed for better coverage of chemical sprays and prevented fruit clusters from touching the soil, resulting in a reduction of rots and soil-borne diseases. According to Kanyomeka and Shivute (2005), pruned tomatoes are less prune to pest attack than those which were not pruned.

There have been conflicting reports, however, on the effects of pruning and staking practices on the quality and yield of tomatoes. The research of Kanyomeka and Shivute (2005) show that pruning results in low quality production and yield losses, while the only benefits obtained from this practice were increased fruit quality and plant health. Other researchers have recorded earlier yields from pruning, but with a

reduction in total yields (Sikes and Coffey 1976). Olson (1989) also recorded a significant reduction in yields with heavy pruning, but fruit size increased as the degree of pruning increased. Reducing the fruit number from six to three fruits per truss increased the fruit weight by 42%, while the marketable yield was reduced by 15 to 25% (Fanasca *et al.,* 2007).

In a fertile soil with favorable environment conditions, tomato plants particularly indeterminate type grow continuously and produce large number of brunches. In that case, pruning is necessary because the branch bend down to the ground due to heavy load of fruits. Proper pruning practices may lead to the production of relatively large sized fruits with better quality, increase yield, early harvest, easy harvesting of fruits and conveniences in intercultural operations without damage to the fruits or plants. Pruning also reduces productions costs (Davis and Estes, 1993).

Considering the demand and nutritive value of tomato, Bangladesh Agricultural Research Institute (BARI) recently introduced various (winter and heat tolerant) high yielding tomato varieties. However, comparative performance, yield and quality of all the promising tomato varieties have not yet been done properly.

Organic farming is a production system, which avoids or largely excludes the use of synthetic chemical fertilizers. The continued use of organic fertilizers increases soil organic matter, better water infiltration and aeration, higher soil biological activity as the materials decompose in soil and increases yields after the year of application (Ceglarek *et al*., 2002). The effectiveness of such materials can be improved by combining them with chemical fertilizers.

Chemical fertilizers may be used more efficiently by crops growing on soils with adequate amounts of soil organic matter supplied by organic fertilizers (Chadha *et al*., 2006). Integrated use of cowdung as organic fertilizer and chemical fertilizers would be quite promising in soil fertility improvement. The present-day-concern about global environmental pollution can be reduced to a considerable extent by either judicious use of chemical fertilizers or increase the use of manures. The use of manures and their proper management may reduce the need for chemical fertilizers, thus allowing the small farmers to save in part the cost of production. In Bangladesh, there is a great possibility of increasing tomato yield per unit area with the judicious use of organic fertilizers. For this reason, the effect of cowdung along with chemical fertilizers on tomato (*Lycopersicon esculentum*) as one of the important vegetable crops is considered in this study.

Considering the above facts, the current investigation is aimed to observe with the following objectives:

1. To identify the better variety in rainfed situation in Bangladesh.
2. To find out the best management practices on growth, yield and yield contributing characters of tomato.
3. To observe the Vit. C Content is high which optimum stages of tomato.
4. To assess the safe vegetable production of tomato by organic method compare to chemical method.
5. To determine the appropriate dose of organic and inorganic fertilizer combination on growth, yield and yield contributing characters of tomato.

CHAPTER-II

REVIEW OF LITERATURE

CHAPTER-II
REVIEW OF LITERATURE

Several research works also have been done to find out the growth, yield and other characters for screening, selection and development of better tomato varieties in different countries of the world but those works are little relevant to agro- ecological situation of Bangladesh. However, literature available in this respect at home and abroad have been reviewed below will contribute to the present study.

2.1 Effect of staking and non-staking on growth, yield and yield contributing characters of tomato varieties

Gojeh *et al.* (2012) carried out an experiment to show the effect of different staking methods on yield and quality of indeterminate tomato varieties in Jimma University, Ethiopia. Staking methods used were: single post staking, single string, French type and non-staking. The result revealed; French type gave the highest number of flowers per plant. Highest number of marketable fruit was found from French type, the lowest was observed from the un-staked plants.

Olasantana (1985) showed the effects of intercropping, mulching and staking on growth and yield of three tomato varieties to evaluate in four field trials in 1982 and 1983. Mulching and staking significantly increased vegetative growth, yield and yield components of the tomato plants. Mulched plants grew taller and had more branches and a greater number and weight of fruits than staked plants. Growing improved varieties of tomato in sole stands with proper mulching and staking is therefore recommended.

Hussainie *et al.* (2013) conducted a field experiment during 2007 /2008, 2008/2009 and 2009/2010 dry seasons at the Irrigation Research Station farm of the Institute for Agricultural Research Kadawa in the Sudan Savannah to evaluate yield and yield components of trained tomato *(Lycopersicon lycopersicum* Karst) varieties under varied irrigation interval and poultry manure rates. The treatments evaluated consist of two training methods (staked and unstaked), three irrigation intervals (10, 15 and 20 days), two tomato varieties (UC 82B and Petomech VF) and three poultry manure rates (0, 6 and 12 t/ha). Staked tomato had higher fresh fruit yield with large sized fruits that were less in number compared to unstaked crop.

Sowley *et al*. (2013) carried out an experiment to determine the effect of staking and pruning on the growth and yield of tomato. Pruning affected plant height negatively and unstaked-unpruned plants were significantly higher than unstaked- pruned and staked pruned plants. Staking did not show significant differences among treatments. At harvest, unstaked-unpruned and staked-unpruned plants indicated higher number of fruits per plant with small fruit size as compared to the other plants. Stake - prune and unstake - prune plants few number of fruit per plant but fruits size bigger than staked-unpruned and unstaked - unpruned. The local cultivar riped earlier than F_1 Titao and Pectomech cultivars. Marketable fruit yield was obtained in staked- pruned of local and F_1 Titao cultivars similar to staked - unpruned.

The study concluded that the effect of staking and pruning on growth and yield of tomato was cultivar depended. Staking and pruning gave clean and bigger fruits with an increase in total marketable fruit yield by weight. The study therefore recommends that tomato farmers should

adopt staking and pruning to obtain higher marketable yields that will fetch them good prices but must be guided in their cultivar selection.

2.2 Effect of pest and disease management practices on growth, yield and yield contributing characters of tomato

Tomato is susceptible to insect pests and all parts of the plant including leaves, stems, flowers and fruits are subjected to attack. This crop is mainly attacked by Tomato Fruit worm, Potato Aphid, Stink Bugs and Leaf footed Bugs, Hornworms, Silver leaf, Whitefly etc. Among them tomato fruit borer *Heliothis armigera* (Hub.) is one of the major pests of tomato and damage by this pest may be up to 85-93.7% (Haque, 1995).

A number of fungicides have been tried the past for the control early blight of tomato. Ramkrishnan *et al.* (1971) reported Dithane Z- 78 (0.15%) and Duter (0.2%) were superior in minimizing the leaf infection and increasing the yield while, Bordeaux mixture, Dithane M-45, Dithane Z-78 and Blitox-50 in terms of disease control and yield.

Datar and Mayee (1985) also found that fungicides Duter and Dithane M-45 were superior in reducing severity of early blight and increasing yield.

The concentrated culture filtrates (50% dilution) produce highly susceptible reaction on aloe-vera destroying the gel after 72-96 hours of treatment (Shukla et al., 2008).

Chemical used in the control of disease pollute the atmosphere and affect the properties of medicinal plants. To avoid the hazardous effects of chemicals, natural products of some plants have been used to control the disease (Bhatia and Awasthi, 2007). A number of reports are available showing the efficacy of plant extracts especially neem (*A. indica* and *Ocimum sanctum*) showing the antifungal properties (Mesta *et al.*, 2009).

In fact, in normal farming systems, a wide range of pesticides are being used to manage/suppress the progression of several target pathogens, pests and weeds, however, the application of such toxicant may exert deleterious impact on environment, animals and human health. Neem (*Azadirachta indica* A. Juss), belonging to the family Meliaceae a versatile and common tree has been exploited as a pesticides commercially in the recent years.

2.3 Effect of stem pruning and non-pruning on growth, yield and yield contributing characters of tomato

Muhammad *et al.* (2014) conducted a field experiment at the Usmanu Danfodiyo University Fadama Teaching and Research Farm, Sokoto, to study the effects of training, intra-row spacing and pruning on the growth of tomato *(Lycopersicon lycopersicum* var. Roma VFN) in the semi-arid zone of Nigeria. Treatments consisted of a factorial combination of two levels of training (staked and unstaked) and three pruning levels (three-stem, two-stem and unpruned) laid out in a split-plot design replicated three times. Training was allocated to the main plots while pruning was allocated to the sub-plots. Results revealed that Plant height, Leaf Area Index (LAI) and Days to 50% flowering were favored by unstaking. Unpruned plants produced higher LAI, Shoot Dry Weight (SDW) and took longer Days to 50% flowering. Thus, pruning and staking (Training) may reduce growth of tomato. Higher growth in unstaked and unpruned plants may translate to higher total fruit yield (marketable +unmarketable). Pruning and training resulted is early flowering of tomato.

Hossain (2007) study the effect of nitrogen and stem pruning on the yield of tomato. The experiment consisted of four doses of nitrogen, viz., 85,

171, 256 and 342 kg N/ha and threee levels of pruning, viz., single stem, double stem and triple stem. Maximum yield (82.21 t/ha) was obtained from double stem pruned plants and the minimum yield (68.15 t/ha) was obtained from single stem pruned plants. The combination of nitrogen and stem pruning also exhibited significant variation in all the yield components and yield. The combination of 256 kg N/ha and double stem pruning produced the highest yield of tomato (90.70 t/ha).

Mitra *et al.* (2014) found significant variation on yield components and yield of tomato. The maximum number of flower clusters per plant, flowers per cluster, flowers per plant, fruit clusters per plant, individual fruit weight, length and diameter of fruit and yield (61.72 t/ha) were obtained from three stemmed plants. The individual fruit weight, fruit length and fruit diameter were maximum in 8 fruits per plant but the highest yield (60.26 t/ha) were obtained from 20 fruits per plant. The combined effect of stem pruning and fruit thinning were significantly influenced on individual fruit weight, length and diameter of fruit and yield. The combination of three stemmed plants with 20 fruits per plant produced the highest yield (75.60 t/ha) of tomato.

Ara *et al.* (2007) conducted a field experiment at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh in order to study the effects of nitrogen and stem pruning on the yield of tomato. They found different methods showed significant effect and maximum yield (82.21 t/ha) was obtained from double stem pruned plants and the minimum yield (68.15 t/ha) was obtained from single stem pruned plants. And combination of 256 kg N/ha and double stem pruning produced the highest yield of tomato (90.70 t/ha).

Arin and Ankara (2001) carried out an experiment to determine the effect of low tunnel, mulch and pruning treatments on yield and earliness of tomato cv. Fuji F_1 tomato *(Lycopersicon esculentum* Mill.) in unheated glasshouse. Plant height, stem diameter, days to first harvest, early yield (g/plant), total yield (g/plant) and fruit weight (g/fruit) were determined during the growing period. Low-tunnel and mulching had a positive effect on plant growth development. The highest early yield was obtained from the plants pruned from the 4th truss and mulched with any mulch under low-tunnel. Total yield was highest in plants pruned from 8th truss and mulched with wheat straw.

Akand *et al.* (2013) conducted an experiment in the farm of Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh during October 2012 to March 2013 to determine the effect of potassium and stem pruning on growth and yield of tomato. For pruning, P_3 produced the maximum fruits per plant (35.33) and highest yield per plot (42.79 kg) while the minimum fruits per plant (27.05) and yield per plot (33.49 kg) were obtained from P_1. For combined effect, K_3 P_3 produced the highest yield (47.85 kg) while the minimum yield per plot (20.88 kg) was found from K_0P_0. It may be concluded that 170 kg K_2O/ha with three stem pruning was found suitable for growth and yield of tomato.

Dhar *et al.* (1993) studied the effect of pruning and number of plants per hill on tomato production at ARS, Khagrachari during rabi season of 1991-92 using the variety "Ratan". Unpruned plants produced significantly higher number of leaves, total and effective inflorescence and number of fruits per hill than pruned plants. Single branched plants produced the largest (4.91 cm x 4.89 cm) and the heaviest (66.59 g) fruits followed by double branch. Highest yield (66.21 t/ha)

was recorded in the double branched plants followed by that in unpruned (66.25 t/ha) and single branched (61.29 t/ha) plants. Total and effective inflorescence, fruit number and yield of tomato increased significantly with the increased number of plants per hill. The highest yield (75.51 t/ha) was obtained from three plants per hill followed by that from two plants (62.58 t/ha). The interaction of pruning and number of plants per hill had significant influence on fruit number per hill**,** fruit size, weight and yield of tomato. Highest yield (81.21 t/ha) was recorded in double branched three plants per hill.

Hesami *et al.* (2012) carried out two experiments to determine the effect of shoot pruning and flower thinning on quality and quantity of fruits of semi-determinate tomato in a greenhouse of the Faculty of Agriculture and Natural Resources, Persian Gulf University of Bushehr. Experimental design was randomized complete block designs in which the effect of shoot pruning (single branch pruning, double branch pruning, pyramidal pruning and control) or flower thinning (Cluster with 4 and 5 remained flowers and control) were studied separately. Results showed that, leaf area and plants yield were higher in treatments which were pruned than control. Yields from pyramidal pruning and cluster thinning with 5 remaining flowers were significantly higher than other treatments. On the other hand, qualitative study identified that pyramidal pruning increases vitamin C in fruits, but had no significant effect on total soluble solids.

2.4 Effect of organic and inorganic fertilizer combination on growth, yield and yield characters of tomato

Ogundare *et al.* (2015) conducted an experiment involved five treatments which are as follows: 125 kg/ha NPK+3 t/ha poultry

manure, 125 kg/ha NPK+3 t/ha cow dung, 125 kg/ha NPK+3 t/ha kitchen waste, 125 kg/ha NPK 15:15:15 and Control. Result obtained from parameters studied (Plant height, leaf numbers, branch number, stem girth, fruit number per plant and fruits weight) revealed that tomato performed better ($P<0.05$) with the application of 125 kg/ha NPK+3 t/ha poultry manure application. The also, study showed that use of inorganic and organic fertilizer had better effects on growth and yield of tomato. Therefore, for good yield and better productivity of tomato, a combination of 125 kg/ha NPK fertilizer + 3 t/ha poultry waste is recommended for tomato production in the study area.

Ewulo *et al.* (2015) investigated the effect of organic and inorganic fertilizer on growth and yield parameters of tomato. An experiment was conducted at the Teaching and Research Farm of the Federal University of Technology, Akure. The treatments applied involved combination of reduced level of poultry manure and NPK, which gives six treatments viz: 100% Poultry Manure (PM)= (360 g/plant), 100% NPK 15:15:15 = (7.2 g/plant), 25% PM+ 75% NPK = (90 g PM+ 5.4 g NPK/plant), 50% PM+ 50% NPK = (180 g PM + 3.6 g NPK/plant), 75% PM + 25% NPK = (270 g PM + 1.8 g NPK/plant) and Control (no fertilizer). Growth parameter were collected once every two weeks on plant height, leaf number, branch number, and stem girth. The yield was computed on fresh weight basis. Based on the research outcome the combination of 50%PM (180g) + 50% NPK (3.6g) gave the overall best result. Sole application of poultry manure is found to be the best for tomato production as against sole application of inorganic (NPK 15:15:15) fertilizer.

Siato *et al.* (2014) carried out an experiment and found that fertilizers had non-significant effect on fruit number per cluster. The combined

application of 105 kg N/ha + 92 kg P_2O_5/ha + 10 ton manure/ha resulted in the highest (97.09 ton/ha) fruit yield per hectare. Therefore, the results of this study indicated that, applying 10 ton manure/ha combined with nitrogen at a rate of 105 kg N/ha and phosphorus at a rate of 92 kg P_2O_5 led to maximum fruit yield of tomato in the study area whereas applying 10 ton manure/ha + 52 kg N/ha + 46 kg P_2O_5/ha resulted in the best seed yield of the crop.

Oyewole *et al.* (2013) conducted an experiment at the Kogi State University Research and Demonstration Farm, Anyigba in the Southern Guinea Savanna agro-ecological zone of Nigeria. The study evaluated the effect of different nutrient sources inorganic (MF), poultry manure (PM), oil palm residue (OPR), MF+PM, MF+OPR), and rates on the growth and yield of tomato and okra in the Guinea savanna agro-ecological zone Nigeria. The aim of the research was to apply three rates of N: O, 150 and 300 kg N/ha using inorganic, organic sources or their combination. Integrated nutrient applications performed better than individual application for all the nutrient sources, with the best performance obtained in MF + PM combinations. With integrated application of N at the rate of 150 kg PM/ha + 150 kg MF/ha being recommended for higher tomato and okra yield.

Durdane *et al.* (2011) studied to evaluate the effects of different organic fertilizers on yield and fruit qualities of indeterminate tomato. Influences of different organic and inorganic fertilizers on yields and fruit quality of tomato were studies under field conditions. The highest yields obtained from composted poultry manure, composted cattle manure, and control treatments were 128.12, 122.92 and 115.24 t/ha respectively.

Tonfack *et al.* (2009) carried out an experiment with five fertilizer treatments: (i) control with no fertilizer, (ii) minerals, with a (Ca:Mg:K) ratio of (76:18:6) and 75 mg P/kg of soil; (iii) poultry manure with a (Ca:Mg:K) ratio of (68:24:7) and 450 mg P/kg of soil; (iv) a combination of (ii) and (iii), and (v) mineral fertilization asapplied by local farmers, with a (Ca:Mg:K) ratio of (73:25:1) and 54 mg P/kg of soil. They found that all cation balanced treatments (organic, mineral or a combination of both) significantly improved plant growth, the number of trusses and fruits per plant, the marketable fruit yield and fruit P, K, Ca and Na contents of both tomato varieties considered.

Mistry *et al.* (2008) showed that maximum fruit yield (74.55 t/ha) was produced with maximum dose @ 25 t/ha of compost. Higher percent of 'leaf curl virus' incidence (24.57%) was found in Manik variety. However, higher 'bacterial wilt' (16.55%) was found in Ratan. Incidence of disease severity was reduced gradually with incremental doses of compost up to @ 25 t/ha. Similar trend was recorded due to effect of interaction in variety with doses. Where, the minimum 'bacterial wilt' 10.23% and 0.25% were recorded in variety Manik and Ratan respectively with maximum dose@25 t/ha of compost. Moreover, the maximum fruit yield (71.75 t/ha) was produced with dose @ 25 t/ha in variety Manik compared to Ratan (70.46 t/ha) with same dose of compost.

Ghorbani *et al.* (2006) obtained that the effects of various fertilizers and different compost extracts on crop health and tomato yield. Treatments included different fertilizers (cattle, sheep and chicken manures, green-waste and household composts and chemical fertilizers) and five aqueous extracts (from cattle manure, chicken manure, green-

waste and house-hold composts and water as control). The effect of fertilizer type on tomato yield was significant in both locations ($P < 0.05$). Organic fertilizer use did not obtain higher yields compared to using chemical fertilizer. Generally, chicken manure and green-waste compost led to the highest and lowest tomato yield among different organic fertilizers respectively. The effect of aqueous extracts was not significant on either crop health or tomato yield with these results were being very limited and inconsistent.

Solaiman *et al.* (2006) carried out a field experiment at the Bangabandhu Sheikh Mujibur Rahman Agricultural University farm to assess the effects of inorganic and organic fertilizers on vegetative, flowering and fruiting characteristics as well as yield attributes and yield of Ratan variety of tomato. The highest plant height and dry weight of shoot, the maximum number of clusters of flowers and fruits/plant as well as the greatest fruit size and fruit yield/plant, fruit yield/ha were obtained from the application of the recommended dose of nutrients viz. 200 kg N + 35 kg P + 80 kg K+ 15 kg S/ha, but similar results were obtained from the treatment 5 ton cowdung/ha along with half of the recommended dose of nutrients (100 kg N/ha + 17.5 kg P/ha + 40 kg K/ha + 7.5 kg S/ha). The effect of 10 ton cowdung per hectare, along with one third of the recommended dose of nutrients was also comparable to employing the recommended dose of nutrient. It was further observed, from an economic standpoint, that the combination of 5 ton cowdung/ha along with half of the recommended dose of nutrients appeared to be a viable treatment which would offer the maximum benefit concerning cost ration (4.38) for tomato production in the shallow red-brown terrace soil (AEZ-28) of Bangladesh.

CHAPTER-III

MATERIALS AND METHODS

CHAPTER-III
MATERIALS AND METHODS

This chapter presents with the different materials used and methodologies followed during the experimental period are presented in this chapter.

3.1 Description of the study area

3.1.1 Experimental Site

The field experiment was conducted during the period from October to March of 2013-2017 at Kalikapur, Baraigram Upazila, Natore.

3.1.2 Characteristics of Soil

The soil of the experimental area was sandy loam belonging to the high Ganges river floodplain under the agro ecological zone-12.The selected site was a well-drained medium high land having soil p^H 7.8. The analytical data of the soil sample from the experimental area was determined in the laboratory of Soil Resource Department Institute (SRDI), Rajshahi have been presented in Appendix-III.

3.1.3 Climate of the experimental site

The climate of the experimental area is sub-tropical in nature, which is characterized by high temperature, heavy rainfall, high humidity and relative long day during the months of April to September (Kharif Season) and low rainfall associated with moderately low temperature, low humidity and short day during the rest of the year (Rabi Season). Rabi is the more favorable for vegetable cultivation. The monthly average maximum and minimum air temperature, humidity, rainfall and sunshine during the growing period of the experimented crop were collected from

Bangladesh Meteorological Department, Rajshahi Centre, Rajshahi and shown in Appendix I to II. Rainfed area- low rainfall in this area comparatively and Govt. irrigation facilities are not here. Most of the time depend on the rain water. The experimental area besides of warm places of Lapur upazila. It is high land only for vegetable cultivation here.

3.2 Planting materials

In the study used four tomato varieties (BARI-2, BARI-8, BARI-14 & BARI-15), which were collected from the Horticulture Research Center (HRC) of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur.

3.3 Experimental methods and materials

All experiment were conducted for study was divided in field work and laboratory work. Methodological details of each experiment have been discussed under the section of methodology.

3.4 Cultural Practices

The details regarding the various cultural operations carried out during the course of investigation including the nursery operations are furnished below.

3.4.1 Raising of seedlings

Tomato seeds were sown in 50 cm apart rows in beds 3m × 1m. The beds were prepared well ahead of seed sowing. The bed soil was mixed with well- decomposed cowdung at the rate of 5-6 kg/bed. The soil prepared by spade and made into loose, friable and dried mass to obtain fine tilth. Seeds were placed at a depth of about 0.6 cm and covered with light soil. After sowing the seedbed was kept covered with bamboo mat and

polythene for 4-6 days to conservation soil moisture and to protect the bed from rain and scorching sunshine. Sevin 85 SP was applied around the bed immediately after sowing the seeds for controlling ant and other insects. The seedlings were watered whenever necessary by overhead irrigation using a watering can. In sunny days, seedlings were exposed to sunlight and open air. The top soil of the bed was loosened and the weeds were removed using a bamboo stick. No chemical fertilizer was used in the seed bed. Dithane M-45 was sprayed on the seed beds at the rate of 2g/l to protect the seedlings from damping-off and other diseases.

3.4.2 Land preparation

The land selected for the experiment was relatively high, well drained and had light soil. There was no Solanaceaeous crop in the land during the previous season. The experimental plot was thoroughly prepared by ploughing with a tractor driven plough followed by ploughing with a power tiller. The soil was pulverized by several harrowing. The clods were broken and weeds were removed from the field to obtain the desirable tilth. The weeds and stubbles were removed from the field. Finally the unit plots were prepared as 10 cm raised beds along with the addition of the basal doses of manures and fertilizers. The soil of each unit plot was treated with insecticide (Furadan 5G) when the plot was finally ploughed to protect young plants from the attack of mole cricket and cutworm. Plot was prepared as per requirements of experiments.

3.4.3 Manures and fertilization

Manuring and fertilization was done as per requirements of treatments.

3.4.4 Transplanting of seedlings

The healthy and uniform sized seedlings were transplanted in the main experimental plots at the age of 30 days. Transplanting was done in the afternoon and the seedlings were watered with a watering cane immediately after transplanting. Some extra seedlings were also transplanted around the border area of the experimental field for gap filling.

3.4.5 Intercultural Operations

After transplanting the seedlings, different intercultural operations were accomplished for better growth and development of the plants during the period of the experimentation.

3.4.5.1 Gap filling

Gap filling was done in place of dead or wilted seedlings in the field using healthy seedling of the same stock previously planted in the border area on the same date of transplanting. The soil around the base of each seedling was pulverized after the establishment of seedlings.

3.4.5.2 Weeding and mulching

Weeding and mulching were accomplished as and necessary to keep the crop free from weeds, for better soil aeration and to break the soil crust. It also helps in conservation of soil moisture.

3.4.5.3 Staking and pruning Practices

When the plants were well-established, staking was done with bamboo sticks to keep the plants erect. Within a few days of staking the plants were pruned and thereafter only 2 or 3 main branches were kept before them going to flowering stage only pruning related experiment.

3.4.5.4 Irrigation

Irrigations were given as per required throughout the growing period. Mulching was done by breaking the soil crust after irrigation properly.

3.4.6 Pest and Disease control

Insect pests: Sprayed of Malathion 57 EC @ 2 ml/l as preventive measure against the insect pests leaf hoppers and fruit bores. The insecticide applications were done 10 days interval starting from 15 days after transplanting seedlings.

Diseases: The precautionary measures against disease infections especially late blight and foot rot were taken sprayed of Dithane M-45 fungicide @ 2 g/l at the early vegetative stage. Redomil gold fungicide was also applied @ 2 g/l against late blight disease of tomato.

3.4.7 Harvesting

The fruits were harvested at breaker stage (just turn into yellowish color) and / or as per requirements of the experiment.

3.5 Collection of experimental Data

In each treatment, Five (5) plants were randomly selected and tagged for recording various biometric observations on the following parameters in each unit plot as detailed below.

3.5.1 Plant height: Plant height was measured from the soil surface to the tip of the tallest branch at 15 days interval after transplanting. The average plant height was expressed in centimeters.

3.5.2 Number of leaves per plant: Leaves was measured from the selected plant (5 tagged plants per treatment) at the 15 days interval after transplanting.

3.5.3 Number of branches per plant: It was estimated the number of stem at final harvesting time.

3.5.4 Total fruits per plant: The total number of fruit per plant harvested at different dates from the three selected plants was counted and taken as fruits per plant.

3.5.5 Fruit yield per hectare (t/ha): Tomato yield per hectare was calculated on the basis of yield per plot and expressed in ton. It was measured by the following formula:

$$\text{Fruit yield ton per hectare (t/ha)} = \frac{\text{Fruit yield per plot (kg)} \times 10{,}000}{\text{Area of plot (m2)} \times 1000}$$

3.5.6 Vitamin C Test: Vitamin C test in laboratory at the three stages are fresh, half maturity and maturity stage of tomato varieties.

The following data were also collected as: Number of flower's/ plant, Days to 1st flowering, Weight of fruit (average), Yield /Plot (Kg).

3.6 Details methodology of the experiment

The details of the experiments conducted during the period of four years' time as follows:

3.6.1 Experiment-1: Effect of Staking & Non staking on growth, yield and yield contributing characters of Tomato Varieties.

There were 2 factor in the experiments, as follows:

Factor-I: S_1= Staking, S_0=Non Staking

Factor-II: Four tomato varieties (V_1= BARI-2, V_2= BARI-8, V_3= BARI-14, V_4= BARI-15)

Treatment Combinations: 2 ×4=8

T_1=S_1V_1; T_2= S_1V_2; T_3= S_1V_3;T_4= S_1V_4; T_5= S_0V_1; T_2= S_0V_2 ; T_3= S_0V_3;T_4= S_0V_4

Design and layout of the experiment

The field experiment was laid out in Randomized Complete Block Design (RCBD) with 3 replications. The entire experiment was divided into 3 blocks each containing 8 plots. In total there were 24 unit plots. The selected treatments were randomly assigned to each unit plot. The unit plot size was 3 m x 1 m. The plots and blocks were separated by 80 cm. Planting distance was 60 cm x 40 cm. Sixteen seedlings were planted in each plot.

The staked with bamboo sticks at 20 days after transplanting to keep the plants erect.

Determination of Vitamin C content:

Vit. C test at the three stages are fresh, half maturity and maturity stage.

Principle

Ascorbic acid (Vitamin C) as the name implies possess the usual acidic properties (Donation of H+ion). The acidity of Vitamin C is not due to the carboxylic group tied up ion lactones form but is due to the ionization of enol group. The method of the estimation of Vitamin is based on the stoicheometric reduction of the dye 2, 6-dichlorophenyl indophenols to colorless compound by ascorbic acid. The titration is conducted in the presence of metaphosphoric acid in order to inhibit the oxidation of ascorbic acid catalyzed by certain metallic ion (such as cupric and silver ion present in distilled water) in aqueous system this vitamin is easily oxidized, the stability increases with the increase in p^H. Metaphosphoric acid stabilizes the solution by lowering the p^H. As result of titration. Vitamin C if oxidized to dehydro ascorbic acid.

Reagents

a) **Dye Solution:** 200 mg of 2, 6 dichlorophenol and 210 mg of sodium bicarbonate were dissolved in distilled water and made up to 100 ml. The solution was filtered.

b) **3% Metaphosphoric acid reagent:** 3gm of metaphosphoric acid was dissolved in 80 ml of acetic and made up to 100 ml with distilled water.

c) **Standard Vitamin C Solution (0.1gm/ml):** 10 mg of pure vitamin C was dissolved in 3% metaphosphoric acid and made up to 100ml with 3% Metaphosphoric acid.

Procedure

10 ml of standard vitamin C solution was taken in a conical flask and titrate it with the dye solution. About five grams of sample were cut into small pieces and homogenized well with 3% metaphosphoric acid (approximately 30ml) and filtered it through double layer of muslin cloth. The filtrate was centrifuged at 3000 r.p.m. for 10 minutes and clear supernatant was titrated against 2,6-dichlorophenol-endophenol solutions. The amount of vitamin C present in the extract was determined by comparing with the titration result of standard vitamin C solution.

Calculation

Vitamin C content of the sample was calculate by the following equation 10 ml Standard

Vitamin C Solution = 1 mg of vitamin C per 100 gm sample

$$= \frac{Y \times W}{X} \times 100$$

X = Volume of sample solution required to titrate the dye solution

Y =Volume of standard vitamin C Solution required to titrate the dye solution.

W =Weight of sample taken.

3.6.2 Experiment-2: Effect of Pest & disease management on growth, yield and yield contributing characters of Tomato Varieties.

There were 2 factor in the experiments, as follows:

Factor-I: C_1= Chemical use, NL_1= Neem leaf solution and Bordeaux mixture.

Factor-II: Four tomato varieties (V_1= BARI-2, V_2= BARI-8, V_3= BARI-14, V_4= BARI-15).

Treatment Combinations: 2 × 4= 8

T_1=C_1V_1; T_2= C_1V_2; T_3= C_1V_3;T_4= C_1V_4; T_5= NL_1V_1; T_2= NL_1V_2 ; T_3= NL_1V_3;T_4= NL_1V_4

Design and layout of the experiment

The field experiment was laid out in Randomized Complete Block Design (RCBD) with 3 replications. The entire experiment was divided into 3 blocks each containing 8 plots. In total there were 24 unit plots. The selected treatments were randomly assigned to each unit plot. The unit plot size was 3 m x 1 m. The plots and blocks were separated by 80 cm. Planting distance was 60 cm x 40 cm. Sixteen seedlings were planted in each plot. The staked with bamboo sticks at 20 days after transplanting to keep the plants erect.

Neem solution: Firstly take ½ kg Neem leaves to boil in 2 liters of fresh water in pot. After 30-40 minutes boiled properly for prepared a half of the solution then will collect extract solution. After 1 liter extract solution mixture with 8-10 litre fresh water and spraying in the experimental field. This solution spray in the field 7-10 day's interval.

Bordeaux mixture: Bordeaux mixture (also called Bordo Mix) is a mixture of copper (II) sulfate ($CuSO_4$) and slaked lime ($Ca(OH)_2$) used as a fungicide. Copper sulphate, lime and water in the ratio 1:1:100 are used for preparing one per cent Bordeaux mixture. 20 gm Copper sulphate mixed in 1 liter water in plastic/ earthen pot separately and 20 gm lime mixed in 1 liter water in plastic/ earthen pot separately in another pot. Copper sulphate solution into the lime water slowly with constant stirring using a wooden stick in another plastic/earthen pot 8-10 hours. After with the formation of the solution mixture with 8-10 litre fresh water then spraying in the experimental plot.

Insect pests: Sprayed of Malathion 57 EC @ 2 ml/l as preventive measure against the insect pest leaf hoppers and fruit borer. The insecticide applications were done 10 days interval starting from 15 days after transplanting seedlings.

Diseases: The precautionary measures against disease infections especially late blight and foot rot were taken sprayed of Dithane M-45 @ 2 g/l at the early vegetative stage. Redomil gold fungicide was also applied @ 2 g/l against late blight disease of tomato.

3.6.3 Experiment-3: Effect of Pruning & Non pruning on growth, yield and yield contributing characters of Tomato Varieties.

There were 2 factor in the experiments, as follows:

Factor-I: P_1= Pruning (Three stem keeping but all pruning), P_0=Non Pruning

Factor-II: Four tomato varieties (V_1= BARI-2, V_2= BARI-8, V_3= BARI-14, V_4= BARI-15).

Treatment Combinations: 2 ×4=8

T_1=P_1V_1; T_2= P_1V_2; T_3= P_1V_3;T_4= P_1V_4; T_5= P_0V_1; T_2= P_0V_2 ; T_3= P_0V_3;T_4= P_0V_4

Design and layout of the experiment

The field experiment was laid out in Randomized Complete Block Design (RCBD) with 3 replications. The entire experiment was divided into 3 blocks each containing 8 plots. In total there were 24 unit plots. The selected treatments were randomly assigned to each unit plot. The unit plot size was 3 m x 1 m. The plots and blocks were separated by 80 cm. Planting distance was 60 cm x 40 cm. Sixteen seedlings were planted in each plot. The staked with bamboo sticks at 20 days after transplanting to keep the plants erect.

Pruning was done by secateurs to remove the unwanted auxiliary buds and branches depending on the treatments. Here, two stem keeping but all pruning.

3.6.4 Experiment-4: Effect of Organic & In-organic fertilizer combination on growth, yield and yield contributing characters of tomato varieties.

There were 2 factor in the experiments, as follows:

Factor-I:

T_1 = Cowdung (15 ton/ha),

T_2 = ½ Cowdung + ½ Chemical Fertilizer (7.5ton/ha + Urea-250kg/ha, TSP 200kg/ha, MOP-100kg/ha),

T_3 = Poultry Litter (PL-10 ton/ha),

T_4 = ½ PL + ½ Chemical Fertilizer (5ton/ha + Urea-250kg/ha, TSP 200kg/ha, MOP-100kg/ha),

T_5 = ½ Cowdung + ½ PL (7.5 Ton/ha+5 Ton/ha).

Factor-II: Two tomato varieties (V_1= BARI-2, V_2= BARI-15)

Treatment Combinations: 2 ×5=10

T_1=T_1V_1; T_2= T_2V_1; T_3= T_3V_1; T_4= T_4V_1; T_5= T_5V_1; T_6= T_1V_2; T_7= T_2V_2; T_8= T_3V_2;T_9= T_4V_2; T_{10}= T_5V_2.

Design and layout of the experiment

The field experiment was laid out in Randomized Complete Block Design (RCBD) with 3 replications. The entire experiment was divided into 3 blocks each containing 10 plots. In total there were 30 unit plots. The selected treatments were randomly assigned to each unit plot. The unit plot size was 3 m x 1 m. The plots and blocks were separated by 80 cm. Planting distance was 60 cm x 40 cm. Sixteen seedlings were planted in each plot. The staked with bamboo sticks at 20 days after transplanting to keep the plants erect.

Statistical analysis

The data were statistically analyzed by using MSTAT-C a computer based program. The recorded data for different characters were subjected to variance analysis. Treatment means were compared by Duncan's Multiple Range Test (DMRT) and coefficient of variation (CV %) were also estimated for interpretation of results as suggested by Gomez and Gomez (1984).

CHAPTER-IV

RESULTS

CHAPTER-IV
RESULTS

Performance of BARI released four (4) tomato varieties was investigated and the finding of the present study has been discussed character wise under separate headings. The results of the study showed marked variation in different characters and the variations of different parameters are presented in the following tables and Graphs.

Experiment 4.1: Effect of Staking and Non Staking on tomato varieties on growth, yield and yield contributing characters of tomato varieties

Effects of Staking and Non-staking and their combination on growth and yield performance of tomato have been investigated and discussed accordingly in this chapter. The results and the analysis of variance of data on different plant growth characteristics and yield behavior obtained from the present study have been presented on tables (4.1.1 to 4.1.3) for clear interpretation and understanding. The results have been focused under the following headings:

4.1.1 Plant height

Plant height of tomato which is an important parameter affecting the growth, significantly varied due to different treatments (Table 4.1.1). That the variety of tomatoes used staking produced the tallest plant height (102.11 cm) and the minimum was plant height (97.59 cm) were found in non-staking treatment.

Significant variation was also found in among the treatments in plant height (Table 4.1.2). It was observed that the tallest plant height of

tomato (117.00 cm) was found in variety V_3 and the lowest plant height (85.72 cm) were found in V_2 tomato variety.

The combined effect of staking and non-staking in relation to the plant height was found to be statistically significant at 1% level of probability (Table 4.1.3). The tallest plant height was found (119.67 cm) in the treatment S_1V_3 (S_1= Staking; V_3= BARI-14). On the other hand, the lowest plant height (83.30 cm) was obtained in the treatment S_0V_2 (S_0= Non-staking; V_2= BARI-8). For better understanding the plant height of tomato varieties shown in figure 4.1.1.

4.1.2 Number of leaves per plant

Number of leaves per plant of tomato varieties significantly vary each other (Table- 4.4.1). The tomato cultivation used staking practice produced the maximum number of leaves per plant (65.17) while the minimum leaves number per plant (51.50) were obtained in non-staking treatment.

The difference of number of leaves per plant was significantly influenced on tomato varieties (Table 4.1.2). It was observed that the highest number of leaves per plant of tomato (62.50) was found in V_1 variety. On the other hand, minimum number of leaves per plant (53.50) were found in V_2 tomato variety.

The effect of staking and non-staking combination in relation to the number leaves per plant was non-significant variation (Table 4.1.3). The maximum number of leaves per plant was found in (69.00) the treatment S_1V_1 (S_1= Staking; V_1= BARI-2 and the lowest number of leaves per plant (46.67) was obtained in the treatment S_0V_2 (S_0= Non-staking; V_2= BARI-8).

4.1.3 Number of branches per plant

Number of branches per plant of tomato varieties statistically non-significant influenced among the treatments (Table- 4.1.1). The highest branches per plant was found in staking practice (5.33). On the other hand, the lowest was found in (5.08) as obtained in non-staking treatment.

Statistically significant variation was found among the treatments in number of branch per plant (Table 4.1.2). It was observed that the maximum number of branches per plant of tomato (6.83) was found in variety V_1 and the minimum number of branches per plant (4.33) were found in V_4 tomato variety.

The combined effect of staking and non-staking in respect of number of branches per plant was non-significant variation (Table 4.1.3). The highest number of branches per plant was observed (7.33) in the treatment S_1V_1 (S_1= Staking; V_1= BARI-2). On the other hand, the lowest number of branches per plant (4.33) was observed in the treatment S_0V_2 (S_0= Non-staking; V_2= BARI-8). Similar results were also found in S_1V_4 and S_0V_4.

4.1.4 Total fruit per plant

A significant variation was observed in respect of total fruit per plant (Table- 4.1.1). The highest total fruit per plant of tomato was found in staking treatment (24.33) and other non-staking treatment was observed in (21.83).

Significant variation was found among the treatments in total fruit per plant (Table 4.1.2). It was observed that the maximum total fruit per plant of tomato (27.33) was found in variety V_3 and the minimum total fruit per plant (17.50) were found in V_2 tomato variety.

The effect of staking and non-staking combination in respect to total fruit per plant was statistically significant at 5% level of probability (Table 4.1.3). The highest total fruit per plant was found in (29.33) the treatment S_1V_3 (S_1= Staking; V_3= BARI-14 and the lowest total fruit per plant (17.0) was obtained in the treatment S_0V_2 (S_0= Non-staking; V_2= BARI-8).

4.1.5 Yield (t/ha)

Analysis of variance showed that significant influence on the fruit yield per hectare (Table- 4.1.1).The highest yield was produced by the variety used Staking (54.85 t/ha) and the minimum yield was produced by the variety used non-staking (48.62 t/ha).

Statistically significant variation was found among the tomato varieties on yield (Table 4.1.2). It was observed that the maximum yield of tomato (59.85 t/ha) was found in variety V_1 and the minimum yield (46.48 t/ha) were found in V_2 tomato variety.

The combined of staking and non-staking in respect to the yield was non-significant (Table 4.1.3). The highest yield was found in (63.03 t/ha) the treatment S_1V_1 (S_1= Staking; V_1= BARI-2). On the other hand, the lowest yield (43.10 t/ha) was obtained in the treatment S_0V_2 (S_0= Non-staking; V_2= BARI-8).

4.1.6 Vitamin C Content at fresh Stage (mg/100gm)

Vitamin C content of fresh stage of tomato varieties significant each other (Table- 4.1.1).The maximum vitamin C was found by the variety used Staking (28.75) and the minimum vitamin C was found in the variety used non-staking (28.25).

A Significant variation was observed among the treatments in vitamin C content of tomato variety (Table 4.1.2). It was observed that the highest vitamin C content of tomato (29.50) was found in variety V_1 and the lowest (27.67) were found in V_2 tomato variety.

The combined effect of staking and non-staking on vitamin C content of tomato was found to be non-significant (Table 4.1.3). The maximum vitamin C was obtained (30.0) in the treatment S_1V_1 (S_1= Staking; V_1= BARI-2 and the lowest vitamin C (27.67) was obtained from the treatment S_0V_2 (S_0= Non-staking; V_2= BARI-8). More green portion present in this stage of fruits. So vitamin C content is high in this stage comparatively.

4.1.6 Vitamin C Content at half maturity Stage (mg/100gm)

Vitamin C content at half maturity stage of tomato varieties were found statistically significant at 1% level of probability (Table-4.1.1).The highest vitamin C was found in the variety used Staking (22.92) and the minimum vitamin C was found by the variety used non-staking (21.83).

Analysis of variance showed that among the treatments were found significant influenced on vitamin C content of tomato variety (Table 4.1.2). It was observed that the maximum Vitamin C content of tomato (23.33) was found in variety V_1 and the lowest yield (20.83) was found in V_2 tomato variety.

The effect of staking and non-staking combination in respect to the vitamin C content of tomato was non-significant variation (Table 4.1.3). The highest vitamin C was found (23.67) in the treatment S_1V_1 (S_1= Staking; V_1= BARI-2 and the lowest Vitamin C (19.67) was obtained in the treatment S_0V_2 (S_0= Non-staking; V_2= BARI-8).

4.1.6 Vitamin C Content at maturity Stage (mg/100gm)

Vitamin C content at maturity stage of tomato varieties were found significantly differ each other (Table-4.1.1).The maximum vitamin C was found in the variety used Staking (17.0). On the other hand, the minimum vitamin C was found in non-staking treatment (16.25).

A Significant variation was found among the treatments in vitamin C content of tomato varieties at maturity stage (Table 4.1.2). It was observed that the highest vitamin C content of tomato (17.50) was found in variety V_1 and the lowest yield (15.83) was found in V_2 tomato variety.

The combined effect of staking and non-staking on vitamin C content of tomato was statistically non-significant variation (Table 4.1.3). The maximum vitamin C was found (17.67) in the treatment S_1V_1 (S_1= Staking; V_1= BARI-2). On the other hand, the lowest vitamin C (15.0) was obtained in the treatment S_0V_2 (S_0= Non-staking; V_2= BARI-8).

Table-4.1.1: Effect of Staking and Non Staking on growth, yield and yield contributing characters of tomato varieties

Treatment	Plant Height	No. of leaves/ Plant	No. of branches/ plant	Total fruit/ Plant	Yield (t/ha)	Vit. C mg /100 gm Fresh	Vit. C mg/100 gm half maturity	Vit. C mg/100gm maturity
S_1	102.11a	65.17a	5.33	24.33a	54.85a	28.75a	22.92a	17.00a
S_0	97.59b	51.50b	5.08	21.83b	48.62b	28.25b	21.83b	16.25b
Level of significance	**	**	NS	**	**	**	**	*
CV %	0.28	1.59	12.13	2.93	1.54	2.58	4.51	5.23

Table-4.1.2: Effect of staking and non-staking on tomato Varieties

Variety	Plant Height	No. of leaves/ Plant	No. of branches/ plant	Total fruit/ Plant	Yield (t/ha)	Vit. C mg /100 gm Fresh	Vit. C mg/100 gm half maturity	Vit. C mg/100 maturity
V_1	89.95c	62.50a	6.83a	21.00b	59.85a	29.50a	23.33a	17.50a
V_2	85.72d	53.50c	4.50b	17.50c	46.48d	27.67b	20.83b	15.83b
V_3	117.00a	58.67b	5.17ab	27.33a	52.42b	28.50ab	22.83a	16.83ab
V_4	106.73b	58.67b	4.33b	26.50a	48.18c	28.33ab	22.50a	16.33b
Level of significance	**	**	**	**	**	**	**	*
CV %	0.28	1.59	12.13	2.93	1.54	2.58	4.51	5.23

Means followed by the same letter/letters do not statistically differ at 1% and 5% level tested by DMRT
* = Significant at 5% level of probability. ** = Significant at 1% level of probability. NS= Not Significant

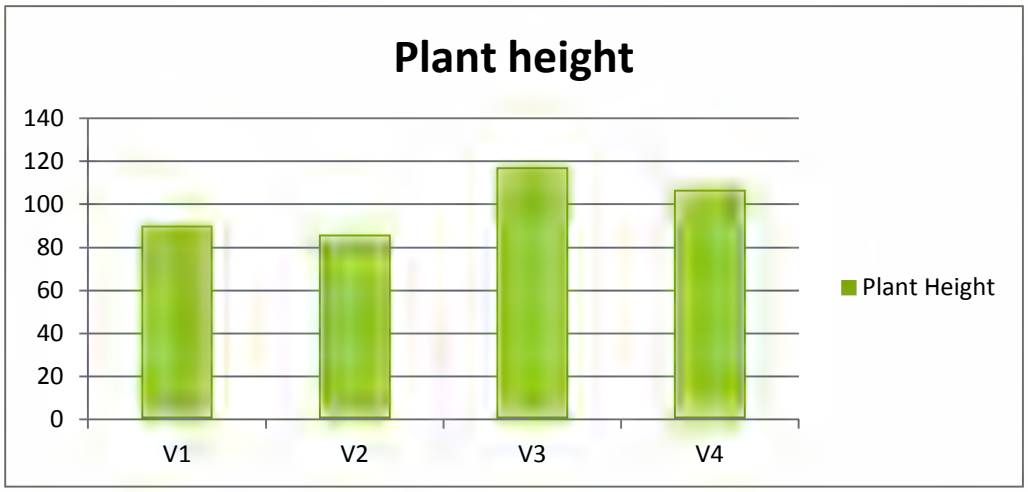
Whereas, S_1= Staking; So= Non Staking; V_1= BARI 2 (Ratan); V_2= BARI 8 (Shila); V_3=BARI 14; V_4= BARI 15

Table-4.1.3: Combined effect of Staking and Non Staking on growth, yield and yield contributing characters of tomato varieties

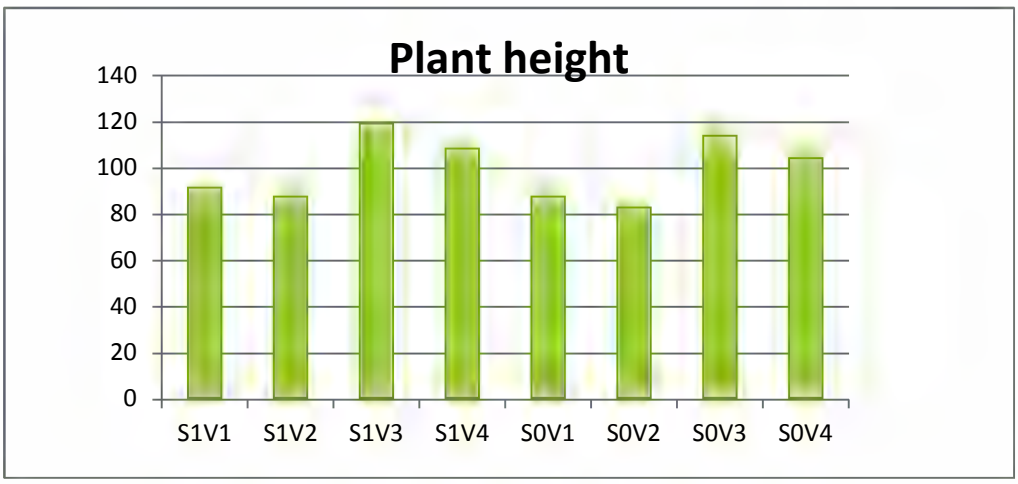
Combined	Plant Height	No. of leaves/ Plant	No. of branches/ plant	Total fruit/ Plant	Yield (t/ha)	Vit. C mg /100 gm Fresh	Vit. C mg/100 gm half maturity	Vit. C mg/100gm maturity
S_1V_1	91.90e	69.00	7.33	22.33d	63.03	30.00	23.67	17.67
S_1V_2	88.13f	60.33	4.67	18.00f	49.87	27.67	22.00	16.67
S_1V_3	119.67a	66.00	5.00	29.33a	55.43	28.67	23.00	17.00
S_1V_4	108.73c	65.33	4.33	27.67b	51.07	28.67	23.00	16.67
S_0V_1	88.00f	56.00	6.33	19.67e	56.67	29.00	23.00	17.33
S_0V_2	83.30g	46.67	4.33	17.00f	43.10	27.67	19.67	15.00
S_0V_3	114.33b	51.33	5.33	25.33c	49.40	28.33	22.67	16.67
S_0V_4	104.73d	52.00	4.33	25.33c	45.30	28.00	22.00	16.00
Level of significance	**	NS	NS	*	NS	NS	NS	NS
CV%	0.28	1.59	12.13	2.93	1.54	2.58	4.51	5.23

Means followed the same letter/letters do not statistically differ at 1% and 5% level tested by DMRT
* = Significant at 5% level of probability. ** = Significant at 1% level of probability. NS= Not Significant
Whereas, S_1= Staking; So= Non Staking; V_1= BARI 2 (Ratan); V_2= BARI 8 (Shila); V_3=BARI 14; V_4= BARI 15

(a) Effect of staking and non-staking on plant height

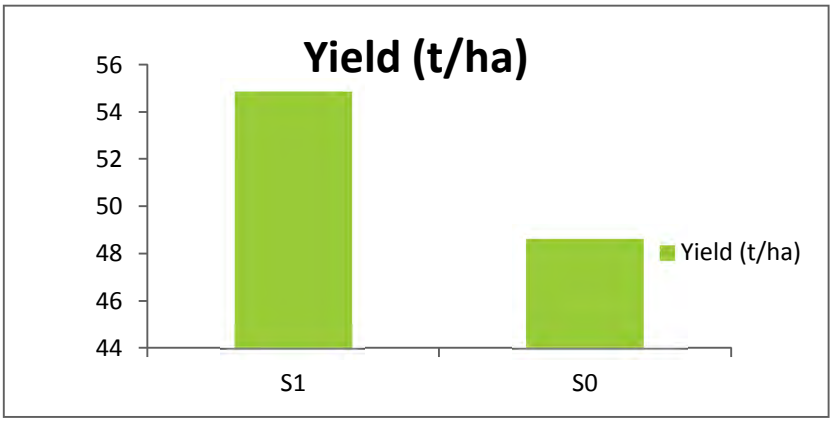


(b) Effect of tomato varieties on plant height

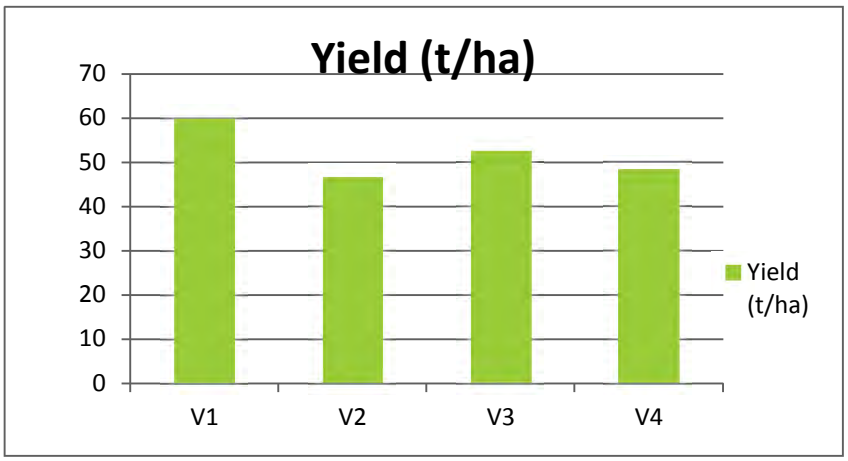


(c) Combined effect of staking and non-staking on plant height

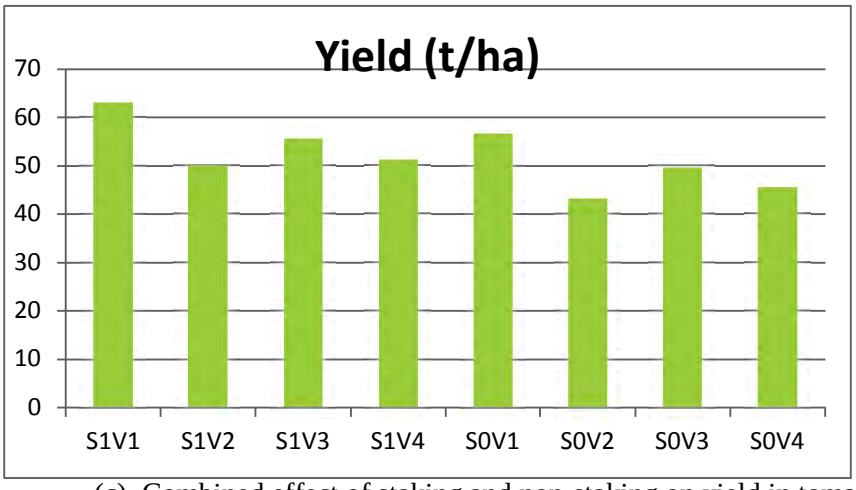
Fig. 4.1.1 Effect of staking and non-staking on plant height (Whereas, Staking (S_1); Non- staking (S_0); V_1= BARI 2 (Ratan); V_2= BARI 8 (Shila); V_3=BARI 14; V_4= BARI 15).



(a) Effect of staking and non-staking on yield



(b) Effect of tomato varieties on yield



(c) Combined effect of staking and non-staking on yield in tomato variety

Fig. 4.1.2 Effect of staking and non-staking on yield (Whereas, Staking (S_1); Non Staking (S_0); V_1= BARI 2 (Ratan); V_2= BARI 8 (Shila); V_3=BARI 14; V_4= BARI 15).

Staking

Non-Staking

Researcher work in experimental field

Overview of the experimental Field

Plate 4.1.1 Photographs showing experimental field

Plate 4.1.2: Photographs showing inspection day with research inspection team

Experiment 4.2: Effect of pest and disease management practices on growth, yield and yield contributing characters of tomato varieties

Effects of pest and disease management practices and their co-ordinate interactions on growth and yield performance of tomato have been investigated and discussed accordingly in this chapter. The results and the analysis of variance of data on different plant growth characteristics and yield behavior obtained from the present study have been presented on tables (4.2.1 to 4.2.3) for clear interpretation and understanding. The results have been focused under the following headings:

4.2.1 Plant height

The main effect of plant height of tomato was significantly varied due to different treatments (Table 4.2.1). The variety of tomatoes used chemical for pest and disease control and produced the tallest plant height (115.51 cm) and the lowest was (110.78 cm) obtained in neem leaf extract and Bordeaux mixture for pest and disease control.

A significant variation was also found among the treatments on plant height (Table 4.2.2). It was observed that the maximum plant height of tomato (141.50 cm) was found in variety V_3 and the minimum plant height (90.18 cm) were found in V_2 tomato variety.

The combined effect of chemical and neem leaf & Bordeaux mixture combination in respect to the plant height was statistically non-significant (Table 4.2.3). The highest plant height was found (144.13 cm) was obtained from the treatment C_1V_3 (C_1= Chemical used; V_3= BARI-14 and the lowest plant height (87.77 cm) was obtained from the treatment NL_1V_2 (NL_1= neem leaf & Bordeaux Mixture; V_2= BARI-8).

4.2.2 Number of leaves/plant

Number of leaves per plant of tomato varieties were observed significant variation (Table- 4.2.1). The variety used chemical produced the maximum number of leaves per plant (58.83) while the minimum leaves were obtained in (55.00) neem leaf and Bordeaux mixture for pest and disease control of tomato varieties.

A significant variation was also found among the treatments on number of leaves per plant (Table 4.2.2). It was observed that the highest number of leaves per plant of tomato (60.17) was found in variety V_1 and the lowest number of leaves per plant (53.17) was found in V_2 tomato variety.

The effect of chemical used and neem leaf extract & Bordeaux mixture combination in relation to the number of leaves per plant was statistically non-significant (Table 4.2.3). The maximum number of leaves per plant was found in (61.00) the treatment C_1V_3 (C_1= Chemical used; V_3= BARI-14 and the lowest number of leaves per plant (52.00) was obtained from the treatment NL_1V_2 (NL_1= neem leaf & Bordeaux Mixture; V_2= BARI-8).

4.2.3 Number of branches per plant

Non-significant variation was found in respect of treatments on number of branches per plant (Table- 4.4.1). The highest branches per plant were observed in used chemical (6.08) and the minimum number of branches per plant were obtained in (5.83) neem leaf extract and Bordeaux mixture for pest and disease control of tomato.

A significant variation was found among the treatments in number of branches per plant (Table 4.2.2). It was observed that the maximum

number of branches per plant of tomato (7.83) was found in variety V_1 and the lowest number branches per plant (4.83) were obtained in V_2 tomato variety.

The combined effect of chemical used and neem leaf extract & Bordeaux mixture in relation to the number of branches per plant was non-significant (Table 4.2.3). The highest number of branches per plant was found (8.00) in treatment C_1V_1 (C_1= Chemical used; V_1= BARI-2 and the lowest number of branches per plant (4.67) was obtained in the treatment NL_1V_2 (NL_1= neem leaf extract & Bordeaux Mixture; V_2= BARI-8).

4.2.4 Total fruit per plant

Total fruit per plant of tomato varieties were significant variation (Table-4.4.1). The highest total fruit per plant was found in used chemical (20.5).On the other hand, the lowest total fruit per plant was obtained in (18.08) neem leaf extract and Bordeaux mixture for pest and disease control of tomato varieties.

Statistically significant differ was also found among the treatments in total fruit per plant (Table 4.2.2). It was observed that the maximum total fruit per plant of tomato (23.66) was found in variety V_1 and the minimum total fruit per plant (14.33) was obtained in V_2 tomato variety.

The combined effect of chemical used and neem leaf extract & Bordeaux mixture combination in respect to the total fruit per plant was non-significant (Table 4.2.3). The highest total fruit per plant was found (26.33) in the treatment C_1V_3 (C_1= Chemical used; V_3= BARI-14). On the other hand, the lowest total fruit per plant (14.00) was obtained from the treatment NL_1V_2 (NL_1= neem leaf & Bordeaux Mixture; V_2= BARI-8).

4.2.5 Yield (t/ha)

The main effect of different treatments showed significant influence on fruit yield per hectare (Table- 4.2.1). The highest yield was obtained in used chemical (53.26 t/ha) while the minimum yield was observed from (50.88 t/ha) used neem leaf extract and Bordeaux mixture for pest and disease control of tomato.

Significant variation was also found among the treatments in yield (Table 4.2.2). It was observed that the maximum yield of tomato (58.57 t/ha) was found in variety V_1 and the minimum yield (47.85 t/ha) were found in V_2 tomato variety.

The effect of chemical and neem leaf extract & Bordeaux mixture combination in relation to the yield was non-significant variation (Table 4.2.3). The highest yield was found (60.87 t.ha) in the treatment C_1V_1 (C_1= Chemical used; V_1= BARI-2 and the lowest yield (46.63 t/ha) was obtained from the treatment NL_1V_2 (NL_1= neem leaf extract & Bordeaux Mixture; V_2= BARI-8). For clear perception fruit yield ton per hectare shown in figure 4.2.1.

Table-4.2.1: Effect of pest and disease management on Tomato varieties

Treatments	Plant height	No. of leaves/ Plant	No. of branches/ Plant	Total fruit/ Plant	Yield (t/ha)
Chemical use (C_1)	115.51a	58.83a	6.08	20.50a	53.26a
Neem leaf extract and Bordomixture solution (NL_1)	110.78b	55.00b	5.83	18.08b	50.88b
LS	**	**	NS	**	**
CV %	1.42	4.27	9.43	6.89	2.73

Means followed by the same letter/letters do not statistically differ at 1% level tested by DMRT

** = Significant at 1% level of probability; NS= Not Significant

Whereas, C_1= Chemical use; NL_1 = Neem leaf and Bordomixture solution

Table-4.2.2: Effect of pest and disease management on Tomato varieties

Variety	Plant height	No. of leaves/ Plant	No. of branches/ Plant	Total fruit/ Plant	Yield (t/ha)
V_1	95.47c	60.17a	7.83a	16.67b	58.57a
V_2	90.18d	53.17c	4.83b	14.33c	47.85c
V_3	141.50a	58.67ab	6.00b	23.66a	53.73b
V_4	125.43b	55.67bc	5.17b	22.50a	48.13c
LS	**	**	**	**	**
CV %	1.42	4.27	9.43	6.89	2.73

Means followed by the same letter/letters do not statistically differ at 1% level tested by DMRT

** = Significant at 1% level of probability; NS= Not Significant

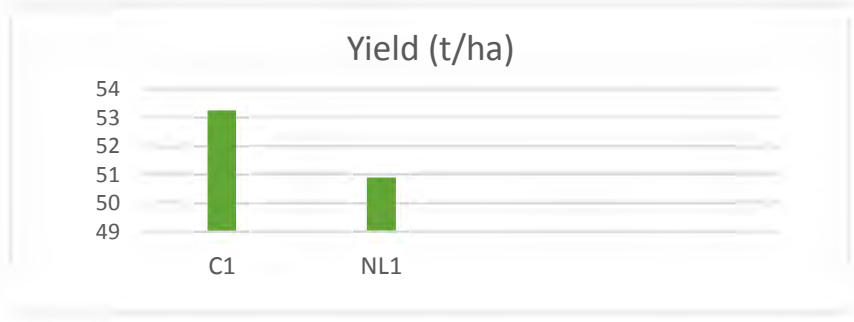
Whereas, V_1= BARI 2 (Ratan), V_2= BARI 8 (Shila), V_3=BARI 14, V_4= BARI 15

Table-4.2.3: Combined effect of pest and disease management on growth, yield and yield contributing characters of tomato varieties

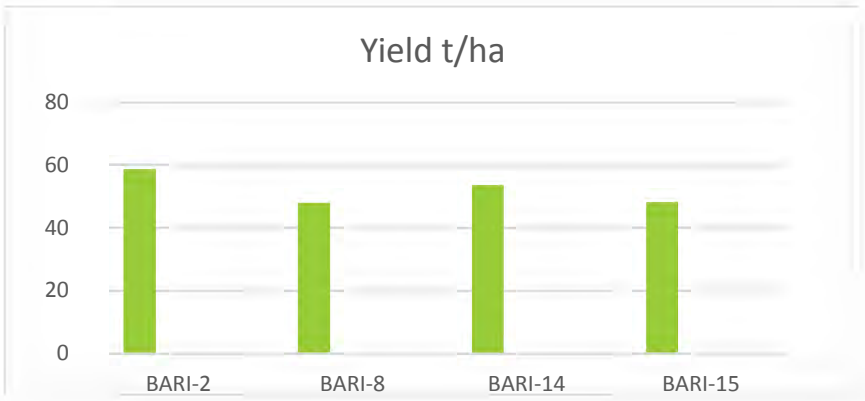
Combined	Plant height	No. of leaves/ Plant	No. of branches/ Plant	Total fruit/ Plant	Yield (t/ha)
$C_1 \times V_1$	97.10	60.67	8.00	17.33	60.87
$C_1 \times V_2$	92.60	54.33	5.00	14.67	49.07
$C_1 \times V_3$	144.13	61.00	6.00	26.33	54.33
$C_1 \times V_4$	128.20	59.33	5.33	23.67	48.77
$NL_1 \times V_1$	93.83	59.67	7.67	16.00	56.27
$NL_1 \times V_2$	87.77	52.00	4.67	14.00	46.63
$NL_1 \times V_3$	138.87	56.33	6.00	21.00	53.13
$NL_1 \times V_4$	122.66	52.00	5.00	21.33	47.50
LS	NS	NS	NS	NS	NS
CV%	1.42	4.27	9.43	6.89	2.73

NS= Not Significant.

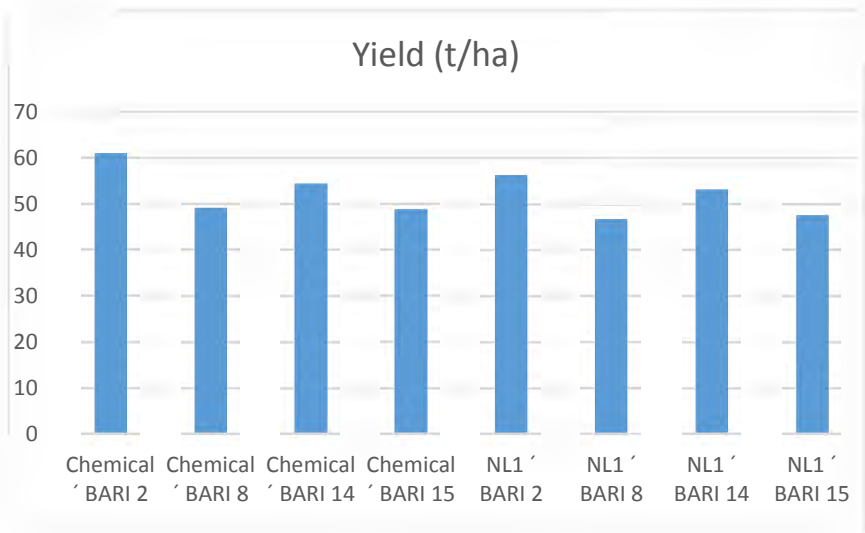
Whereas, C_1= Chemical use; NL_1 = Neem leaf extract and Bordeaux mixture; V_1= BARI 2 (Ratan); V_2= BARI 8 (Shila); V_3=BARI 14; V_4= BARI 15



(a) Effect of pest and disease management practices on yield



(b) Effect of tomato varieties on yield



(C) Combined effect pest and disease management practices on yield in tomato varieties

Fig. 4.2.1 Effect pest and disease management practices on yield of tomato varieties (Whereas, C_1= Chemical use; NL_1 = Neem leaf extract and Bordeaux mixture; V_1= BARI 2 (Ratan); V_2= BARI 8 (Shila); V_3=BARI 14; V_4= BARI 15).

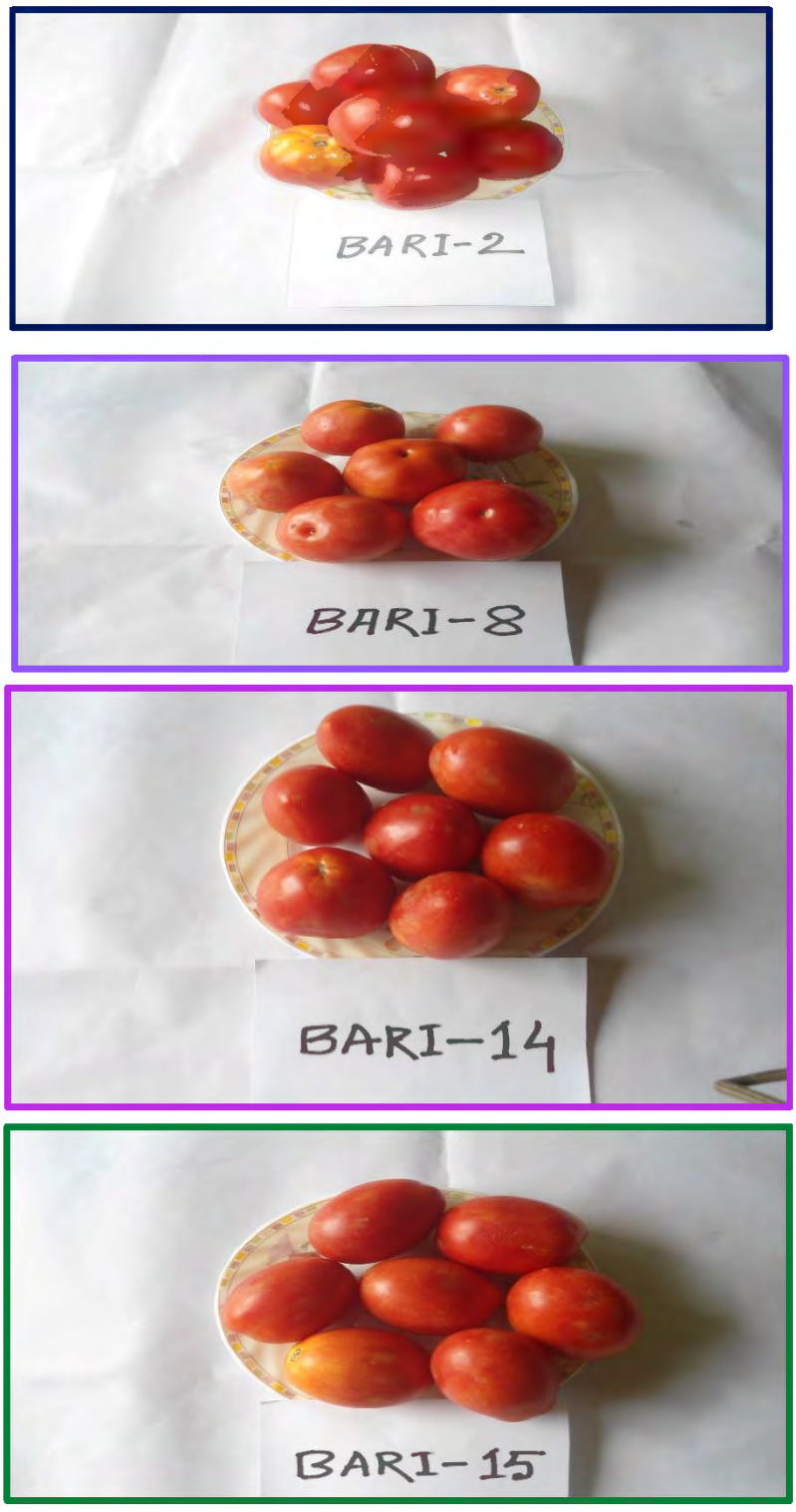


Plate 4.2.1: photographs showing of Tomato Varieties

Plate 4.2.2: Photographs showing segmented of tomato varieties

Experiment 4.3: Effect of Pruning and Non-pruning on growth, yield and yield contributing characters of tomato varieties

Effects of pruning and non-pruning and their co-ordinate interactions on growth and yield performance of tomato have been investigated and discussed accordingly in this chapter. The results and the analysis of variance of data on different plant growth characteristics and yield behavior obtained from the present study have been presented on tables (4.3.1 to 4.3.3) for clear interpretation and understanding. The results have been focused under the following headings:

4.3.1 Plant height

Plant height of tomato which is an important parameter affecting the growth. The main effect of pruning and non-pruning in relation to the plant height was significant (Table 4.3.1). The variety tomatoes used pruning produced the tallest plant height (102.11cm) and the lowest plant height was found in the non-pruning treatment (101.52 cm).

Significant variation was also found among the treatments in plant height of tomato varieties (Table 4.3.2). It was observed that the maximum plant height of tomato (119.00 cm) was found in variety V_3 and the lowest plant height (88.03 cm) was obtained in V_2 tomato variety.

The effect of pruning and non-pruning combination in relation to the plant height was non-significant (Table 4.3.3). The highest plant height was found (119.67 cm) as obtained from the treatment P_1V_3 (P_1= Pruning; V_3= BARI-14 and the lowest plant height (87.93 cm) was obtained from the treatment P_0V_2 (P_0= Non-pruning; V_2= BARI-8).

4.3.2 Number of leaves per plant

A significant variation on number of leaves per plant was observed due to the main effect of pruning and non-pruning (Table- 4.3.1). The variety of tomatoes used pruning produced the maximum number of leaves per plant (61.33) while the lowest number of leaves was obtained in non-pruning treatment (60.25).

A Significant variation was also found among the treatments in number of leaves per plant (Table 4.3.2). It was observed that the maximum number of leaves per plant of tomato (64.67) was found in variety V_1 and the lowest number of leaves per pant (55.67) was observed in V_2 tomato variety.

The effect of pruning and non-pruning combination in relation to the number of leaves per plant was non-significant (Table 4.3.3). The highest number of leaves per plant was found (65.00) in the treatment P_1V_1 (P_1= Pruning; V_1= BARI-2 and the lowest number of leaves per plant (55.00) was obtained from the treatment P_0V_2 (P_0= Non-pruning; V_2= BARI-8).

4.4.3 Number of branches per plant

The effect of pruning and non-pruning on number of branches per plant was significant (Table- 4.3.1). The highest number of branches per plant of tomato was found in non-pruning (5.17) and the minimum was (3.00) in pruning treatment.

Non-significant variation was also found among the treatments in number of branches per plant (Table 4.3.2). It was observed that the maximum number of branches per plant of tomato (4.5) was found in variety V_1 and

the lowest branches per plat of tomato varieties (3.67) was observed in V_4 tomato variety.

The combined effect of pruning and non-pruning in respect to the branches per plant was non-significant (Table 4.3.3). The highest number of branches per plant was found (6.00) from the treatment combination P_0V_1 (P_0= Non-Pruning; V_1= BARI-2 and the all others treatment combinations of pruning were similar performance (3.00).

4.3.4 Total fruit per plant

The effect of pruning and non-pruning on total fruit per plant was significant (Table- 4.3.1). The highest total fruit per plant was found in used pruning practice (23.0) and the lowest total fruit per plant was obtained in non-pruning practice (22.08).

Analysis of variance showed that the effect of pruning and non-pruning has significant influence on total fruit per plant of tomato varieties (Table 4.3.2). It was observed that the maximum total fruit per plant of tomato (27.17) was found in variety V_3 and the lowest total fruit per plant (16.33) was found in V_2 tomato variety.

The effect of pruning and non-pruning combination in relation to the total fruit per plant was statistically non-significant (Table 4.3.3). The highest total fruit per plant was found (26.33) in the treatment P_0V_3 (Po= non-pruning; V_3= BARI-14 and the lowest total fruit per plant (16.33) was obtained from the treatment P_0V_2 (P_0= Non-pruning; V_2= BARI-8), P_1V_2 also given lowest performance (16.33).

4.3.5 Yield (t/ha)

A significant variation was observed in respect of fruit yield per hectare due to the effect of pruning and non-pruning (Table- 4.3.1). The maximum yield was produced by the used of pruning practice (53.25 t/ha) and the minimum yield was produced by used non-pruning practice (52.55 t/ha).

Significant variation was also found among the treatments in yield per hectare (Table 4.3.2). It was observed that the highest yield of tomato (61.15 t/ha) was found in variety V_1 and the lowest yield per hectare (47.75 t/ha) was found in V_2 tomato variety.

The combined effect of pruning and non-pruning in relation to the yield of tomato was statistically significant at1% level of probability (Table 4.3.3). The highest yield ton per hectare was found (61.43 t/ha) in the treatment P_1V_1 (P_1= Pruning;V_1= BARI-2 and the lowest yield of tomato (47.33 t/ha) was obtained from the treatment P_0V_2 (P_0= Non-pruning; V_2= BARI-8). For better understanding yield ton per hectare shown in figure 4.3.1.

Table-4.3.1: Effect of Pruning and non- pruning on growth yield and yield contributing characters of tomato varieties

Treatment	Plant height	No. of leaves/ Plant	No. of branches/ Plant	Total fruit/ Plant	Yield (t/ha)
P_1	102.11a	61.33a	3.00b	23.00a	53.25a
P_0	101.52b	60.25b	5.17a	22.08b	52.55b
Level of significance	**	*	**	*	*
CV%	0.44	1.76	15.00	4.48	1.31

Means followed by the same letter/letters do not statistically differ at 1% and 5% level tested by DMRT

* = Significant at 5% level of probability. ** = Significant at 1% level of probability.
Whereas, P_1= Pruning; P_0 = Non-pruning

Table-4.3.2: Effect of pruning and non-pruning on Tomato Varieties

Variety	Plant height	No. of leaves/ Plant	No. of branches/ Plant	Total fruit/ Plant	Yield (t/ha)
V_1	91.78c	64.67a	4.50	21.33c	61.15a
V_2	88.03d	55.67c	4.00	16.33d	47.75d
V_3	119.00a	61.67b	4.17	27.17a	53.80b
V_4	108.45b	61.17b	3.67	25.33b	48.90c
Level of significance	**	**	NS	**	**
CV%	0.44	1.76	15.00	4.48	1.31

Means followed by the same letter/letters do not statistically differ at 1% level tested by DMRT
** = Significant at 1% level of probability.
NS= Not Significant

Whereas, V_1= BARI 2 (Ratan), V_2= BARI 8 (Shila), V_3=BARI 14, V_4= BARI 15

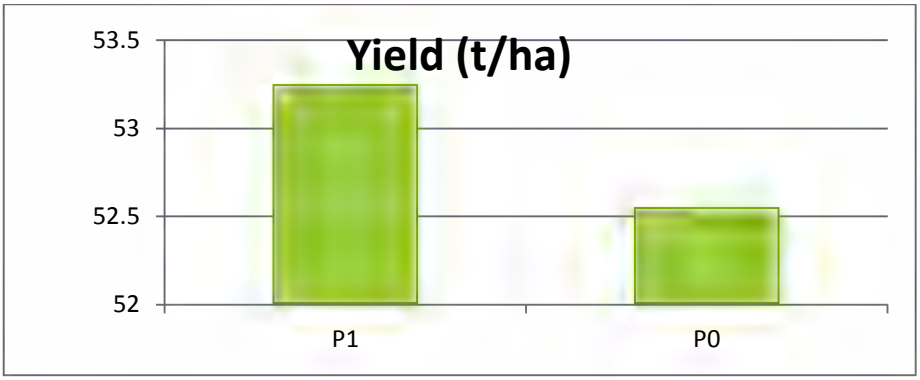
Table-4.3.3: Combined effect of Pruning and Non-pruning on growth, yield and yield contributing characters of Tomato varieties

Combined	Plant height	No. of leaves/ Plant	No. of branches/ plant	Total fruit/ Plant	Yield (t/ha)
P_1V_1	91.90	65.00	3.00	21.67	61.43a
P_1V_2	88.13	56.33	3.00	16.33	48.17d
P_1V_3	119.67	62.00	3.00	28.00	54.23b
P_1V_4	108.73	62.00	3.00	26.00	49.17cd
P_0V_1	91.67	64.33	6.00	21.00	60.87e
P_0V_2	87.93	55.00	5.00	16.33	47.33cd
P_0V_3	118.33	61.33	5.33	26.33	53.37b
P_0V_4	108.17	60.33	4.33	24.67	48.63c
Level of significance	NS	NS	NS	NS	**
CV%	0.44	1.76	15.00	4.48	1.31

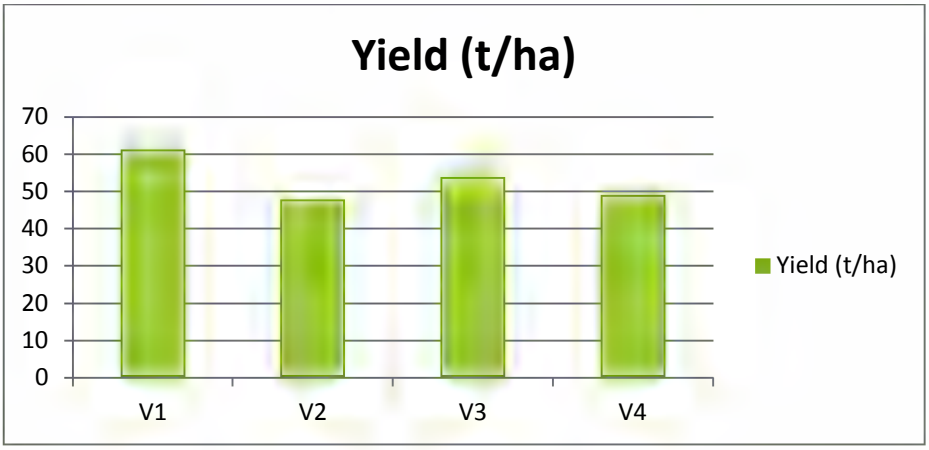
Means followed by the same letter/letters do not statistically differ at 1% level tested by DMRT

** = Significant at 1% level of probability. NS= Not Significant

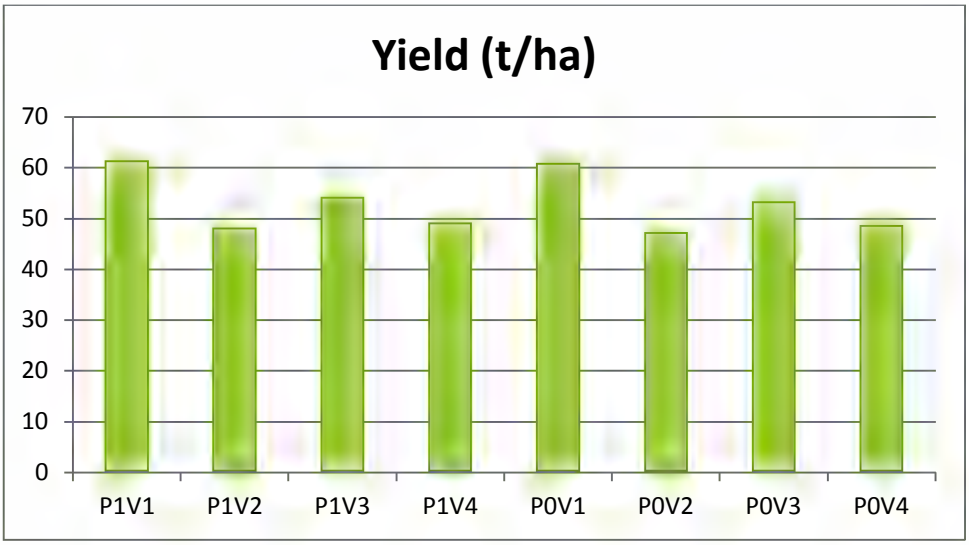
Whereas, P_1= Pruning; P_0 = Non-pruning; V_1= BARI 2 (Ratan); V_2= BARI 8 (Shila);V_3=BARI 14; V_4= BARI 15.



(a) Effect of pruning and non-pruning on yield



(b) Effect of tomato varieties on yield



(c) Combined effect of pruning and non-pruning on yield

Fig. 4.3.1 Effect of pruning and non-pruning on yield of tomato varieties Whereas, P_1= Pruning; P_0 = Non-pruning; V_1= BARI 2 (Ratan); V_2= BARI 8 (Shila);V_3=BARI 14; V_4= BARI 15.

Plate 4.3.1: Photographs showing root system of tomato varieties

Experiment 4.4: Effect of organic and inorganic fertilizer combination on growth, yield and yield contributing characters of tomato varieties

Effects of different doses of organic as well as inorganic fertilizer application and their combination on growth and yield performance of tomato have been investigated and discussed accordingly in this chapter. The results and the analysis of variance of data on different plant growth characteristics and yield behavior obtained from the present study have been presented on tables (4.4.1 to 4.4.3) and figure (4.4.1) for clear interpretation and understanding. The results have been focused under the following headings:

4.4.1 Plant height

Plant height of tomato which is an important parameter affecting the growth, significantly varied due to different treatments (Table 4.4.1). The variety BARI tomato-15 produced the tallest plant (105.35cm) and the dwarf was found in BARI -2 (86.55 cm).

Significant variation was also found among the treatments in plant height (Table 4.4.2). It was observed that the maximum plant height of tomato (101.07 cm) was found in T_2 treatment ½ Cowdung + ½ chemical Fertilizer (7.5ton/ha+Urea-250kg/ha, TSP-200kg/ha, MOP-100kg/ha) and the lowest plant height (92.4 cm) was observed in T_3 treatment poultry litre (10 t/ha).

The combined effect of organic and inorganic fertilizer in respect to the plant height was significant at 1% level of probability (Table 4.4.3). The highest plant height was found (109.33 cm) in the treatment V_2T_2 (V_2=BARI-15; T_2= ½ Cowdung + ½ chemical Fertilizer (7.5ton/ha + Urea-250kg/ha, TSP-200kg/ha, MOP-100kg/ha) and the lowest plant

height (80.03 cm) was obtained from the treatment T_3 (V_1=BARI-2; T_3= Poultry Litter -10 ton/ha).

4.4.2 Number of leaves per plant

Different levels of organic and inorganic fertilizers had significant variation on number of leaves per plant (Table- 4.4.1). The variety BARI-2 produced the maximum number of leaves per plant (60.53) while the minimum leaves were obtained in BARI-15 (54.87).

Analysis of variance showed that organic and inorganic fertilizers have significant influence on number of leaves per plant (Table 4.4.2). It was observed that the highest number of leaves per plant of tomato (68.50) was found in the T_2 treatment ½ Cowdung + ½ chemical fertilizer (7.5ton/ha + Urea-250kg/ha, TSP-200kg/ha,MOP-100kg/ha) and the minimum number of leaves per plant (45.83) were found in T_3 treatment Poultry Litter (10 t/ha).

The combined effect of organic and inorganic fertilizer combination in relation to the number of leaves per plant was differ non-significantly (Table 4.4.3). The maximum number of leaves per plant was found (72.67) in the treatment V_1T_2 (V_1=BARI-2; T_2= ½ Cowdung + ½ chemical Fertilizer (7.5ton/ha + Urea-250kg/ha, TSP-200kg/ha, MOP-100kg/ha) and the lowest number of leaves per plant (47.0) was obtained from the treatment V_1T_3 (V_1=BARI-2; T_3= Poultry Litter -10 ton/ha).

Table-4.4.1: Effect of organic and in-organic fertilizer combination on growth, yield and yield contributing characters of tomato Varieties

Treatments	Plant height	No. of leaves/Plant	No. of branches/ Plant	Total fruit/ Plant	Yield (t/ha)
V_1	86.55b	60.53a	5.73a	17.07b	48.41a
V_2	105.35a	54.87b	4.87b	21.20a	39.16b
Level of significance	**	**	**	**	**
CV%	0.37	3.36	8.47	4.65	1.24

Means followed by the same letter/letters do not statistically differ at 1% and 5% level tested by DMRT
** = Significant at 1% level of probability.
Whereas, V_1= BARI 2 (Ratan); V_2= BARI 15

4.4.3 Number of branches per plant

The effect of organic and inorganic fertilizers on number of branches per plant was significant (Table- 4.4.1). The highest number of branches per plant was found in BARI-2 (5.73) and the lowest branches per plant was observed (4.87) in BARI-15 tomato variety.

Significant variation was also found among the treatments in number of branches per plant (Table 4.4.2). It was observed that the maximum number of branches per plant of tomato (6.33) was found in T_2 treatment ½ Cowdung + ½ chemical fertilizer (7.5ton/ha + Urea-250kg/ha, TSP-200kg/ha, MOP-100kg/ha) and the minimum no of branch per plant (4.50) were found in T_2 treatment poultry litre (10 t/ha).

The combined effect of organic and inorganic fertilizer combination in relation to the number of branches per plant was non-significant (Table 4.4.3). The highest number of branches per plant was found (7.00) as obtained from the treatment V_1T_2 (V_1=BARI-2; T_2= ½ Cowdung + ½

chemical fertilizer (7.5ton/ha + Urea-250kg/ha, TSP-200kg/ha, MOP-100kg/ha) and the lowest number of branches per plant (4.33) was obtained from the treatment V_2T_3 (V_2=BARI-15; T_3= Poultry Litter-10 ton/ha) and V_2T_1 ($T_{1=}$ Cowdung 15 t/ha).

4.4.4 Total fruit per plant

The effect of organic and inorganic fertilizers on total fruit per plant was significant (Table- 4.4.1). The highest total fruit per plant was found in BARI-15 (21.2) and other variety BARI-2 was observed (17.07) fruit per plant.

A significant variation was also found among the treatments in total fruit per plant (Table 4.4.2). It was observed that the maximum total fruit per plant of tomato (25.17) was found in T_2 treatment ½ Cowdung + ½ chemical fertilizer (7.5ton/ha + Urea-250kg/ha, TSP-200kg/ha, MOP-100kg/ha) and the lowest perfomance total fruit per plant (12.33) were found in T_3 treatment Poultry Litter (10 t/ha).

The combined effect of organic and inorganic fertilizer combination in relation to the total fruit per plant was differ statistically non-significant (Table 4.4.3). The highest total fruit per plant was found (27.33) as obtained from the treatment V_2T_2 (V_2=BARI-15; T_2= ½ Cowdung + ½ chemical fertilizer (7.5ton/ha + Urea-250kg/ha, TSP-200kg/ha, MOP-100kg/ha) and the minimum total fruit per plant (11.00) was obtained from the treatment V_1T_3 (V_1=BARI-2; T_3= Poultry Litter -10 ton/ha).

4.4.5 Yield (t/ha)

A significant variation was observed in respect of fruit yield ton per hectare due to the effect of organic and inorganic fertilizer (Table-4.4.1).The maximum yield was produced by the variety BARI-2 (48.41 t/ha) and the minimum yield was produced by the variety in BARI-15 (39.16 t/ha).

A significant variation was also found among the treatments on yield ton per hectare (Table 4.4.2). It was observed that the maximum yield of tomato (57.47 t/ha) was found in the T_2 treatment ½ Cowdung + ½ chemical Fertilizer (7.5ton/ha + Urea-250kg/ha, TSP-200kg/ha, MOP-100kg/ha) and the minimum yield (28.53 t/ha) was observed in T_3 treatment Poultry Litter (10 t/ha).

The combined effect of organic and inorganic fertilizer combination in relation to the fruit yield ton per hectare was statistically significant (Table 4.4.3). The highest yield was found (63.57 t/ha) as obtained from the treatment V_1T_2 (V_1=BARI-2; T_2= ½ Cowdung + ½ chemical Fertilizer (7.5ton/ha + Urea-250kg/ha, TSP-200kg/ha, MOP-100kg/ha) and the lowest yield (25.56 t/ha) was obtained from the treatment V_2T_3 (V_2=BARI-15; T_3= Poultry Litter -10 ton/ha). For clear perception fruit yield ton per hectare shown in figure 4.4.1.

Table-4.4.2: Effect of organic and in-organic fertilizer combination on Tomato Varieties

Treatments	Plant height	No. of leaves/ Plant	No. of branches/ Plant	Total fruit/ Plant	Yield (t/ha)
T_1	92.40d	48.83c	4.67b	16.33c	37.80d
T_2	101.07a	68.50a	6.33a	25.17a	57.47a
T_3	90.70e	45.83c	4.50b	12.33d	28.53e
T_4	99.95b	66.00a	5.50ab	23.83a	54.82b
T_5	95.62c	59.33b	5.50ab	18.00b	40.30c
Level of significance	**	**	**	**	**
CV%	0.37	3.36	8.74	4.65	1.24

Means followed by the same letter/letters do not statistically differ at 1% level tested by DMRT

** = Significant at 1% level of probability.

Whereas, T_1=Cowdung (15ton/ha); T_2= ½ Cowdung + ½ chemical Fertilizer(7.5ton/ha+Urea-250kg/ha,TSP-200kg/ha,MOP-100kg/ha); T_3 = Poultry Litter (PL-10 ton/ha); T_4 = ½ PL + ½ Chemical Fertilizer (5ton/ha+ Urea-250kg/ha,TSP-200kg/ha,MOP-100kg/ha);T_5=½ Cowdung + ½ PL(7.5 Ton/ha+5 Ton/ha).

Table-4.4.3: Combined effect of organic and in-organic fertilizer combination on growth, yield and yield contributing characters of tomato varieties (Expt. 4)

Combined	Plant height	No. of leaves/ Plant	No. of branches/ Plant	Total fruit/ Plant	Yield (t/ha)
V_1T_1	82.00i	51.33	5.00	14.33	41.93f
V_1T_2	92.80f	72.67	7.00	23.00	63.57a
V_1T_3	80.03j	47.00	4.67	11.00	31.50i
V_1T_4	91.67g	69.67	6.00	21.33	60.37b
V_1T_5	86.23h	62.00	6.00	15.67	44.67e
V_2T_1	102.80d	46.33	4.33	18.33	33.66h
V_2T_2	109.33a	64.33	5.67	27.33	51.37c
V_2T_3	101.37e	44.67	4.33	13.66	25.56j
V_2T_4	108.23b	62.33	5.00	26.33	49.27d
V_2T_5	105.00c	56.66	5.00	20.33	35.99g
Level of significance	**	NS	NS	NS	*
CV%	0.37	3.36	8.74	4.65	1.24

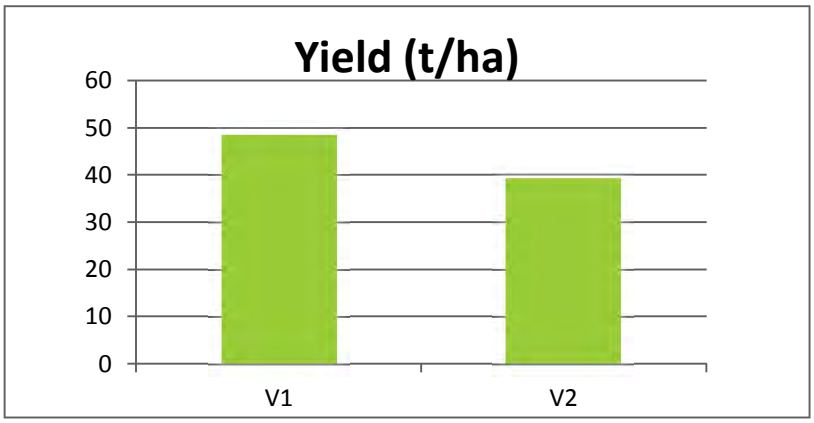
Means followed by the same letter/letters do not statistically differ at 1% and 5% level tested by DMRT

* = Significant at 5% level of probability

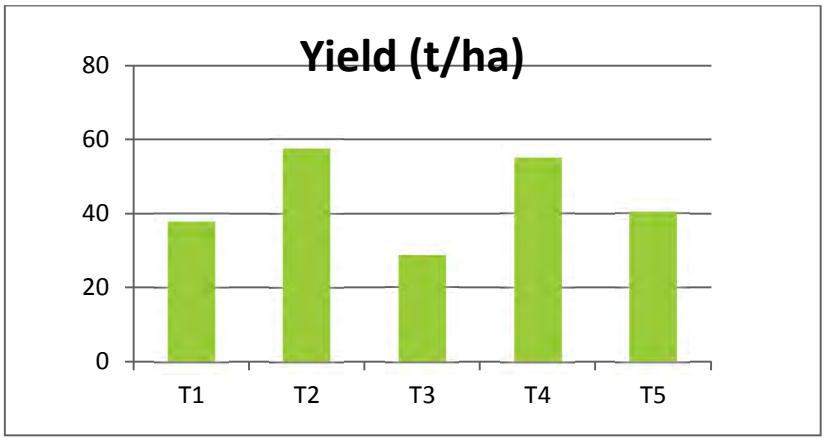
** = Significant at 1% level of probability; NS= Not Significant

Whereas, V_1 = BARI 2 (Ratan); V_2 = BARI 15

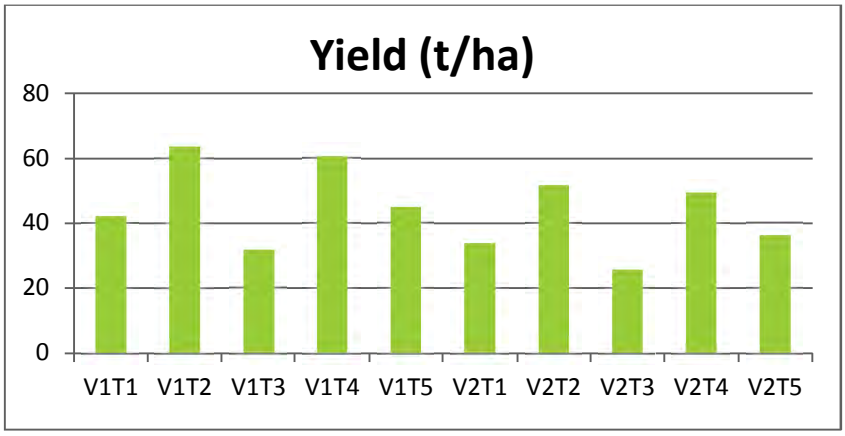
T_1 = Cowdung(15 ton/ha), T_2 = ½ Cowdung+ ½ chemical Fertilizer(7.5ton/ha+Urea-250kg/ha,TSP-200kg/ha,MOP-100kg/ha), T_3 = Poultry Litre (PL-10 ton/ha), T_4 = ½ PL + ½ Chemical Fertilizer (5ton/ha+ Urea-250kg/ha,TSP-200kg/ha,MOP-100kg/ha)), T_5 = ½ Cowdung + ½ PL (7.5 Ton/ha+5 Ton/ha).



(a) Effect of varieties on yield



(b) Effect of organic and inorganic fertilizer combination on yield



(C) Combined effect of organic and inorganic fertilizer combination on yield

Fig. 4.4.1 Effect of organic and inorganic fertilizer combination on yield of tomato varieties (Whereas, V_1 = BARI 2 (Ratan); V_2 = BARI 15; T_1 = Cowdung (15 ton/ha), T_2 = ½ Cowdung+ ½ chemical Fertilizer(7.5ton/ha+Urea-250kg/ha,TSP-200kg/ha,MOP-100kg/ha), T_3 = Poultry Litre (PL-10 ton/ha), T_4 = ½ PL + ½ Chemical Fertilizer (5ton/ha+ Urea-250kg/ha,TSP-200kg/ha,MOP-100kg/ha)), T_5= ½ Cowdung + ½ PL (7.5 Ton/ha+5 Ton/ha).

Plate 4.4.1: Photographs showing inspection day with research supervisor

CHAPTER-V

DISCUSSION

CHAPTER-V

DISCUSSION

This chapter comprises the discussion of the result obtained from the investigation. A series of experiments were conducted to determine the effect of staking and non-staking, pest and disease management practices, pruning and non-pruning, organic and inorganic fertilizer combination on growth, yield and yield contributing characters of tomato varieties in rainfed area and findings are discussed below:

Effect of staking and non-staking on growth and yield of tomato Varieties

In the present study staking and non-staking practices were used in the experimental plot.

Ogundare *et al*. (2015) found that plant height were significantly influenced by staking, tomato plants staked had higher plant height than no staked plants. This could be due to better photosynthetic activity created by good arrangements of the leaves.

Plant height showed significant variation in respect of staking and non-staking. The maximum plant height was observed from staking plants. On the other hand, the minimum plant height was observed from the treatment combination non-staking plants.

Leaf number is another important growth character of tomato plant. Staking and non-staking in respect of leaf number was found to be statistically significant. The maximum number of leaves was found from staking followed by non-staking. Ogundare *et al*. (2015) found that leaf number were significantly influenced by staking, tomato plants with

staked produce higher leaf than no staked plants. This could be due to better photosynthetic activity created by good arrangements of the leaves.

The combined effect of staking and non-staking in respect of yield of tomato varieties was produced highest yield staking with BARI-2 and minimum yield was produced non-staking wit BARI-8 tomato variety. .

The maximum number of Vitamin C content was found by the variety used Staking practices at fresh stage of tomato varieties than other half maturity and maturity stage.

Aneesh *et al*. (2007) and Shehla and Masud (2007) reported that titrable acidity gradually decreased during ripening and storage of tomatoes. These results were also supported by Bhattacharya (2004) who stated that acidity is an indicator of maturity, ripening results in decreased acidity in fruit. It has been observed during ripening in tomatoes that malic acid disappeares first then citric acid that results in reduction of tritable acidity, suggesting the catabolism of citrate, whereas, Mattoo *et al*., (1975) and Salunkhe and Desai (1984) reported that ripening results in increased sugar of tomato fruit.

Effect of Pest and disease management techniques on growth and yield of tomato Varieties

Plant height of tomato which is an important parameter affecting the growth, significantly varied due to different treatments. The variety of tomatoes used chemical produced the tallest plant height and the minimum was used neem leaf extract and Bordeaux mixture for pest and disease control of tomato varieties.

Number of leaves per plant of tomato varieties was observed significant variation. The variety used chemical produced the maximum number of

leaves while the minimum leaves were obtained from used neem leaf and Bordeaux mixture for pest and disease control of tomatoes. Number of branches and total fruit per plant were observed same results.

The combined effect of chemical and neem leaf & Bordeaux mixture in relation to the highest yield was found in the treatment chemical used with BARI-2 and the lowest yield was obtained from the treatment neem leaf & Bordeaux mixture with BARI-8 tomato varieties.

In the absence of an effective alternative method, the farmers are over-dependant on chemicals for the management of this pest. Reduction in the efficacy of a variety of insecticides, including synthetic pyrethroids, for the management of this pest has also been reported (Srinivasan and Krishna Moorthy, 1992).

During the past two decades, the effect of Dithane M-45 alone or other fungicides has been investigated by several workers in the control of early blight. In fact, in normal farming systems, a wide range of pesticides are being used to manage/suppress the progression of several target pathogens, pests and weeds, however, the application of such toxicant may exert deleterious impact on environment, animals and human health. Neem belonging to the family Meliaceae is a versatile and common tree has been exploited as a pesticide, commercially in the recent years and giving good result.

Several studies on direct effect of neem leaf and fruit extracts on target pests and pathogens have been reported (Amadioha, 2000). Aqueous leaf extract of *Azadirachta indica* induced resistance in barley against *Drechslera gramineae* through biochemical changes in the host plant (Paul and Sharma, 2002).

Effect of stem pruning and Non-pruning on growth and yield of tomato varieties

In the present study stem pruning and non-pruning were used. Tomato plants particularly of indeterminate and semi-determinate type grow continuously and produce large number of branches; In that case, pruning is necessary because the branch bend down to the ground due to heavy load of fruits. Tomato plant can be severely pruned without affecting the yield (Patil *et al*., 1973). Proper pruning practices may lead to the production of relatively large sized fruit with better quality, increased yield, early harvest, easy harvesting of fruits and conveniences in intercultural operations without damage to the fruits or plants.

Plant height showed significant variation in respect of stem pruning. The maximum plant height was observed from pruning. On the other hand, the minimum plant height was observed from the treatment combination of non-pruning. Plant height was increased with time and affected negatively with pruning. According to Frank (2000), once a creeping stem is allowed to grow undisturbed, it has the tendency to grow faster and longer than the plant trained to grow against its natural course.

Pruning had a significant effect on plant height. Two-stem keeping but all pruning produced the tallest plants compared to the three-stem keeping and unpruned plants. Taller plants recorded in two-stem keeping but all pruning could be due to reduced competition for photosynthate among the branches (Frank, 2000). In two-stem keeping but all pruning, photosynthate is diverted to two branches and in three stem keeping, it is diverted to three, while in unpruned, the photosynthate is diverted to many branches. Ara *et al*. (2007) found that in case of stem pruning, one stem keeping but all pruning

produced the tallest plant and shortest plant height was obtained in no pruning. This result is the same trend with the findings of Uddin *et al*. (1997).

Leaf number is another important growth character of tomato plant. Stem pruning in respect of leaf number was found to be statistically significant. The maximum number of leaves was found from pruning followed by non-pruning.

The effect stem pruning and non-pruning in respect of number of branches per plant was found to be statistically non-significant. The maximum number of branches per plant was obtained from the treatment combination non- pruning and with variety. On the other hand, the minimum number of branches per plant was of three stem keeping but all pruning and with variety .

Combined effect of stem pruning and non-pruning on the number of fruits per plant was found to be statistically non- significant. The highest number of fruits per plant was found in stem pruning. It is found that three stem keeping but all pruning plant gave the highest number of marketable fruits per plant than non-pruning and also stem pruning with BARI-2 tomato variety gave highest yield.

Ogundare *et al*. (2015) observed that staking significantly effect on number of fruits per plant. The result confirmed the work of Quinn (1973b) who reported that marketable yield of tomato under wet condition was significantly increased by staking of tomato plants.

Effect of organic and inorganic fertilizer combination on growth, yield and yield contributing characters of tomato Varieties

In the present study different levels of organic and inorganic fertilizers were used. This study revealed that organic and inorganic fertilizer

applications are very essential for enhancing soil nutrient status and increase crop yield. Despite the environmental and other yield constraints encountered by the crop during growth, the overall assessment showed that it is essential to consider the main commercial fraction like the marketable fruit yield in choosing the level of organic and inorganic fertilizers, and their combinations suitable for use in tomatoes production. The response of tomato to each fertilizer varied slightly but significant differences were obtained for the growth parameters, yield and yield components considered.

The plant height of tomato, which is an important parameter affecting the growth, significantly varied due to organic and inorganic fertilizer. It was observed that the maximum plant height of tomato was found in treatment T_2= ½ Cowdung + ½ chemical fertilizer (7.5ton/ha + Urea-250 kg/ha, TSP-200kg/ha, MOP-100kg/ha). On the other hand, the minimum plant height was found in 10 t/ha poultry litter. Gonzalez *et al*. (2001) reported that organic manure and inorganic fertilizer supplied most of the essential nutrients at growth stage resulting increase of growth variables including plant height. Rahman *et al*. (1996) reported that cowdung in combination with other fertilizers played an important role in respect to vegetable growth of tomato. Ewulo *et al*. (2015) also observed that 50% PM (180g) + 50% NPK (3.6g) had the highest plant height. Manure application at the rate of 10 t/ha produced significantly taller plants which were higher by 7.38% over the control. This might be due to the ability of manure to supply numerous plant nutrients and in creating suitable plant growing environment by improving moisture and nutrient status of the soil which enhance growth and general performance of the plants. Consistent with this suggestion, Hader (1986) reported that

organic fertilizers compensate for both the deficit and the excess of elements in the soil, which can take place with mineral fertilization.

The effect of organic and inorganic fertilizer in relation to the number of leaves per plant was significant. The highest number of leaves per plant was obtained from the treatment T_2 = ½ Cowdung + ½ chemical Fertilizer (7.5ton/ha + Urea-250 kg/ha, TSP-200kg/ha, MOP-100kg/ha) and the lowest number of leaves per plant were obtained from the treatment T_3 receiving Poultry litter 10 t/ha.

The effect of organic and inorganic fertilizer on number of fruits per plant was significant. The highest number of fruits per plant was found in the treatment T_2= ½ Cowdung + ½ chemical Fertilizer (7.5ton/ha + Urea-250 kg/ha, TSP-200kg/ha, MOP-100kg/ha).

Ojeniyi *et al*. (2007) also observed that NPK and animal manure increased plant height, number of branches, leaf area, number and weight of fruits significantly in tomato compared to control. Siato *et al.* (2014) showed that the main effects of N, P and manure highly significant affected total number of fruits per plant of tomato. The application of 10 t/ha manure increased the total number of fruits per plant by 33.99% over the control treatment.

Significant variation was found in respect of different levels of organic and inorganic fertilizer for fruit yield ton per hectare. The result gave that the highest yield of tomato fruits was obtained from the treatment T_2= ½ Cowdung + ½ chemical Fertilizer (7.5ton/ha + Urea-250 kg/ha, TSP-200kg/ha, MOP-100kg/ha) and the lowest yield of tomato fruits was obtained from T_3= poultry 10 t/ha. Solaiman *et al.* (2006) observed the highest fruit yield in treatment N200+ P35 + K80+ S15. All the treatments recorded higher fruit yield than the control. This finding is

supported by Rahman *et al.* (1996 and 1998) who reported that cowdung in combination with other fertilizers, play an important role with respect in tomato fruit yield.

Aditya (1993) reported that the highest tomato yield was obtained from response to the application of 375kg N/ha, 225kg P/ha and 225 kg K/ha along with cowdung at 10 t/ha. Nabi and Nandly (2001) also observed in a fertilizer trial on summer tomatoes (BARI tomato-4) that 250 kg N/ha, 150 kg P_20_5/ha and 150 kg K/ha along with 10 t/ha of cowdung produced the highest yield.

CHAPTER-VI

SUMMARY AND CONCLUSION

CHAPTER VI

SUMMARY AND CONCLUSION

The field and laboratory experiment were carried out to evaluate the "Study on growth, yield and yield contributing characters of tomato varieties in rainfed area" during rabi seasons of 2013 to 2017 at the experiment field of Kalikapur, Baraigram Upazila, Natore and laboratory of Crop Science and Technology, Rajshahi University, Bangladesh. Four different experiments were conducted and laid out in Randomized Complete Block Design with three replications. Four tomato varieties BARI-2, BARI-8, BARI-14, and BARI-15 were used as planting material. The experimental field soil was silt loams and silty clay loams, land was medium fertile belongs to the agro-ecological zone (AEZ-12).

Here cowdung, poultry litter, urea, TSP, MP and other fertilizer were applied in the plot as per treatment randomly. From each plot, three plants were randomly selected and marked for the collection of data. Data were analyzed statistically by using MSTAT-C program. The results of these experiments have been summarized below.

In the 1st experiment, Effect of staking and non-staking on growth, yield and yield contributing characters of tomato there were 8 treatment combinations involved in the experiment.

The result showed that the highest growth and yield component of tomato i.e., plant height (102.11), number of leaves per plant (65.17), total fruit per plant (24.33), yield (54.85 t/ha), Vitamin C at fresh stage (28.75 mg/100gm), Vitamin C at Half maturity stage (22.92 mg/100gm), Vitamin C at maturity stage (17.00 mg/100gm) were observed in

treatment staking practice. The lowest values of all parameter were found in the treatment non-staking practice.

The above result showed that the variety BARI-2 was found superior among the tomato varieties on different practice management while BARI-14 ranked second and other two varieties BARI-15 and BARI-8 showed intermediate in respect of growth and yield performance of tomato varieties.

In the 2nd experiment, Effect of pest and disease management practices (Chemical use and neem leaf extract, Bordeaux mixture) on growth, yield and yield contributing characters of tomato there were 8 treatment combinations involved in the experiment.

The result showed that the highest growth, yield component of tomato i.e., plant height (115.51), number of leaves per plant (58.83), total fruit per plant (20.50), yield (53.26 t/ha) was observed in treatment with chemical use for pest & disease control. The lowest values of all parameter were found in the treatment neem leaf extract and Bordeaux mixture used but all parameter are closely differ.

Here also indicate the variety BARI-2 was found superior among the tomato varieties on different practice management while BARI-14 ranked second and other two varieties BARI-15 and BARI-8 showed intermediate in respect of growth and yield performance.

In the 3rd experiment, Effect of pruning and non-pruning on growth, yield and yield contributing characters of tomato there were 8 treatment combinations involved in the experiment.

Stem pruning on growth, yield and yield components of tomato gave significant variation. The highest growth, yield components of tomato

i.e., plant height (102.11), number of leaves per plant (61.33), total fruit per plant (23.00), yield (53.25 t/ha) were observed in treatment with pruning except number of branches per plant. The lowest values of all parameter were found in the treatment non-pruning except number of branches per plant.

Here also indicate the variety BARI-2 was found superior among the tomato varieties on different practice management while BARI-14 ranked second and other two varieties BARI-15 and BARI-8 showed intermediate in respect of growth and yield performance.

In the 4rth experiment, Effect of organic and inorganic fertilizer combination on growth, yield and yield contributing characters of tomato there were 5 treatment involved in the experiment T_1= Cowdung (15 ton/ha), T_2 = ½ Cowdung + ½ Chemical Fertilizer (7.5ton/ha + Urea-250kg/ha, TSP 200kg/ha, MOP-100kg/ha), T_3 = Poultry Litter (PL-10 ton/ha), T_4 = ½ PL + ½ Chemical Fertilizer (5ton/ha + Urea-250kg/ha, TSP 200kg/ha, MOP-100kg/ha) and T_5 = ½ Cowdung + ½ PL (7.5 Ton/ha+5 Ton/ha).

Effect of organic and inorganic fertilizer combinations significantly influenced on growth and yield of tomato. The highest growth, yield component of tomato i.e., plant height (101.07 cm), number of leaves per plant (68.50), number of branches per plant (3.50), total fruit per plant (25.17), yield (57.47 t/ha) were observed in treatment T_2 = ½ cowdung + ½ chemical fertilizer (7.5ton/ha + Urea-250kg/ha, TSP 200kg/ha, MOP-100kg/ha). The lowest values of all parameter were found in the treatment T_3 = Poultry Litter (PL-10 ton/ha).

The results also showed that the variety BARI-2 was found superior performance to BARI-15 tomato varieties on different fertilizer combination on growth and yield of tomato.

For future improvement and sustainability of tomato production, management with chemical, Bordeaux mixture and neem leaf extract used for pest and disease control, organic and inorganic fertilizers combination, some intercultural management practices like staking, stem pruning etc. would be ensured. For quality tomato production of different tomato varieties from the results of the present study the following conclusions can be drawn.

Staking is a very effective intercultural management practice for quality tomato production. The treatment combination of the staking and BARI-2 tomato variety produced the highest yield (63.03 t/ha) and vitamin-C content maximum at fresh stage (30.00 mg/100 gm) which may be recommended for farmers practices.

Pest and disease management is very important for quality tomato production. The treatment combination of chemical with BARI-2 tomato variety produced the highest yield (60.87 t/ha) but neem leaf extract and Bordeaux mixture used with BARI-2 combination produced nearest yield (56.27 t/ha).

Pruning is also effective management practice for quality tomato production. The treatment combination of pruning with BARI-2 variety produced the maximum yield (61.43 t/ha) which may be suggested for farmers.

Organic and inorganic fertilizer in treatment $T_{2=}$ ½ Cowdung + ½ Chemical fertilizer (7.5ton/ha + Urea-250kg/ha, TSP 200kg/ha, MOP-

100kg/ha) was observed better performance than others treatment which may be recommended for farmers. It's improved the soil health and ecological condition also.

It has been mentioned in this chapter regarding the effect of organic and inorganic fertilizers and different management practices on growth, yield and yield contributing characters of tomato varieties in rainfed area. It may be said that the result of the studies may suggested for the growers to further tested different agro-ecological zone in Bangladesh.

CHAPTER-VII

REFERENCES

CHAPTER VII

REFERENCES

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APPENDICES

APPENDICES

Appendix-I

Record of monthly average, maximum and minimum air temperature, average humidity, total rainfall and average sunshine hour growing season from October 2013 to March 2014 and October 2014 to March 2015

Month	Year	Air Temperature (^{0}C)			Humidity (%)	Rainfall (mm)	Sunshine (hrs)
		Maximum	Minimum	Average			
2013-2014 Season							
October	2013	34.80	18.20	26.50	87.19	204.0	7.88
November	2013	32.00	12.00	22.00	75.90	0	7.72
December	2013	29.60	9.20	19.40	81.32	0	6.30
January	2014	27.50	7.00	17.25	82.68	0	5.57
February	2014	30.20	9.20	19.70	77.36	26.40	8.21
March	2014	39.60	13.40	26.50	66.48	8.80	8.44
2014-2015 Season							
October	2014	35.70	18.00	26.85	83.16	5.00	7.20
November	2014	33.80	11.30	22.55	78.13	0	7.12
December	2014	28.10	7.40	17.75	83.94	0	6.10
January	2015	28.70	6.70	17.70	83.58	13.80	5.37
February	2015	34.60	7.60	21.10	78.18	14.20	8.32
March	2015	37.20	11.60	24.40	66.39	0.40	8.54

Source: Bangladesh Meterological Department, Rajshahi Centre, Rajshahi

Appendix-II

Record of monthly average, maximum and minimum air temperature, average humidity, total rainfall and average sunshine hour growing season from October 2015 to March 2016 and October 2016 to March 2017

Month	Year	Air Temperature (^{0}C)			Humidity (%)	Rainfall (mm)	Sunshine (hrs)
		Maximum	Minimum	Average			
2015-2016 Season							
October	2015	31.10	19.20	26.50	83.16	204.0	7.88
November	2015	32.20	12.00	22.00	75.40	0	6.83
December	2015	28.60	8.20	19.40	82.32	0	5.56
January	2016	28.50	7.20	17.25	82.68	0	5.83
February	2016	31.70	9.70	19.70	77.36	26.40	8.33
March	2016	38.60	12.80	26.50	63.48	8.80	8.46
2016-2017 Season							
October	2016	35.70	17.00	25.45	84.14	5.00	7.80
November	2016	33.80	11.30	21.55	78.13	0	7.62
December	2016	28.10	7.40	17.55	83.94	0	6.20
January	2017	28.70	6.50	17.70	83.58	13.80	5.52
February	2017	34.60	7.60	21.10	76.12	14.20	8.10
March	2017	37.20	11.20	24.00	66.72	0.40	8.20

Source: Bangladesh Meterological Department, Rajshahi Centre, Rajshahi

Appendix-III

Fertility status of initial soil of the experimental plot

Chemical Properties of Soil	**Amount of Nutrients**
Soil P^H	8.1
Organic Matter	1.94
Total Nitrogen (%)	0.11
Available P (ppm)	9.8
Potassium (me/100g)	0.5
Sulfur (ppm)	12.1
Zinc (ppm)	1.37

Source: Soil Resource Development Institute, Shaympur, Rajshahi.