EFFECT OF MULCHING AND NITROGENUS FERTILIZER ON THE GROWTH AND YIELD OF TOMATO

BY

MOHAMMAD MAHADE HASAN

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Approved by:

Prof. A.K.M. Mahtabuddin
Dept. of Horticulture and Postharvest Technology
SAU,Dhaka
Supervisor

Prof. M. A. Mannan Miah
Dept. of Horticulture and Postharvest Technology
SAU,Dhaka
Co-Supervisor

Prof. Md. Ruhul Amin
Chairman
Examination Committee

109 (02)
04/10/09

Dedicated to

My

Beloved Parents

Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207

PABX: +88029144270-9
Fax: +88029112649
Web site: www.sau.edu.bd

Ref:

Date: ....

109 (02)
04/10/09

CERTIFICATE

This is to certify that the thesis entitled, ***"EFFECT OF MULCHING AND NITROGEN FERTILIZER ON THE GROWTH AND YIELD OF TOMATO"*** *submitted to the Department of Horticulture and Postharvest Technology, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE in HORTICULTURE*** *, embodies the result of a piece of bona fide research work carried out by* ***MOHAMMAD MAHADE HASAN*** *Registration No. 00946 under my supervision and my guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

Dated :June,2008

Place: Dhaka, Bangladesh

(Prof. A.K.M. Mahtabuddin)
Dept.Of Horticulture and Postharvest Technology
SAU,Dhaka
Supervisor

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ABSTRACT

A field experiment was carried out to study the effect of mulching and nitrogenous fertilizer on the growth and yield of tomato at the Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka during October 2007 to March 2008. The experiment consisted of three different types of mulches (Mo=No mulch, M_1=Black polythene and M_2=White polythene) and four levels of nitrogen (viz. No=0, N_1=230, N_2=240 and N_3=250 kg N/ha) with their combinations were used as treatments in the study. The experiment was conducted in a Randomized Complete Block Design (RCBD) with three replications. In case of nitrogen, N_2 resulted the highest yield per hectare (59.73 t/ha) and control produced the lowest (28.13 t/ha). Different mulching had also significant influence on yield of tomato. The yield per hectare was the highest (59.83 t/ha) against black polythene mulch (M_1) while the control (no mulching) produced the lowest yield (35.75 t/ha). In respect of combined effect, application of N_2M_1 produced the highest yield per hectare (82.25 kg/ha) and the lowest yield (24.10 t/ha) was obtained from the control treatment. Considering the above findings, application of 240 kg N/ha with black polythene mulch seems to be recommendable for tomato cultivation.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

AEZ	=	Agro-Ecological Zone
BARI	=	Bangladesh Agricultural Research Institute
BBS	=	Bangladesh Bureau of Statistics
FAO	=	Food and Agriculture Organization
ppm	=	Parts per million
N	=	Nitrogen
et al.	=	And others
TSP	=	Triple Super Phosphate
MoP	=	Muriate of Potash
RCBD	=	Randomized complete block design
DAS	=	Days after sowing
ha^{-1}	=	Per hectare
g	=	gram (s)
kg	=	Kilogram
SAU	=	Sher-e-Bangla Agricultural University
SRDI	=	Soil Research and Development Institute
HI	=	Harvest Index
No.	=	Number
WUE	=	Water use efficiency
wt	=	Weight
LSD	=	Least Significant Difference
^0C	=	Degree Celsius
NS	=	Not significant
mm	=	millimeter
Max	=	Maximum
Min	=	Minimum
%	=	Percentage
cv.	=	Cultivar
NPK	=	Nitrogen, Phosphorus and Potassium
CV%	=	Percentage of coefficient of variance
Hr	=	Hour

CHAPTER I

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) a member of the family Solanaceae is one of the most popular and important vegetables grown in Bangladesh during Rabi season. It is originated in tropical America (Salukhe *et al.* 1987), most likely in the region of the Andes Mountain in Peru, Ecuador and Bolivia (McCollum, 1992). However, in spite of its broad adapted production is concentrated in a few area and rather dry area (Cuortero and Fernandez, 1999) it is cultivated in almost all home gardens and also in the field due to its adaptability to wide range of soil and climatic conditions (Ahmed, 1976). The soil and climatic condition in winter season in Bangladesh are congenial for tomato cultivation. Among the winter vegetables grown in Bangladesh, tomato ranks second in respect of production to potato and third in respect of area (BBS, 2004). It ranks next to potato and sweet potato in the world vegetable production (FAO, 1997).

The popularity of tomato and its products continues to rise. It is a nutritious and delicious vegetable used in salad in the raw stage and is made into soups, juice, ketchup, pickles, sauces conserved puree, paste powder and other products. It is extensively used in the canning industry. Nutritive value of the fruit is an important aspect of quality in tomato. Its food value is very rich because of higher content of vitamin A, B and C including calcium and carotene (Bose and Some, 1990). Tomato adds variety of color and flavors to the foods. It is also rich in medicinal value.

In Bangladesh recent statistics shows that tomato was grown in 12955.47 hectares of land and the total production was approximately 94000 metric tons in 2003-2004(BBS, 2004). Thus the average yield is quite low as compared to that of other tomato producing countries such as India (15.14 t/ha), China (30.39 t/ha) Egypt (34 t/ha) and USA (65.22 t/ha) respectively (FAO, 2002). The low yield of tomato in Bangladesh however is not an indication of the low yielding potentiality of this crop. This shy yield is mainly due to the use of low yielding variety and dearth of improved cultural practices including insufficient supply of required nutrient elements, water and poor disease management (Ali *et al.* 1994). Out of these, proper fertilizer management practices may improve this situation greatly. Ali and Gupta (1978) reported that NPK fertilizer significantly improved the yield of tomato. Laicheva and Demkin (1980) and Ahmed and Saha (1976) reported similar result.

In Bangladesh, there is a great possibility of increasing tomato yield per unit area with the proper use of fertilizer. The profit from the use of commercial fertilizers has been so often demonstrated by experiment that there is no doubt about the necessity for using the right doses of fertilizers and the economic results from them. Research results also indicate the positive response to the application of fertilizer in increasing yield of different species of tomato. Tomato requires large quantity of readily available fertilizer nutrients (Gupta and Sukla, 1977). In determinate types of tomato, vegetative and reproductive stage overlap and the plants need nutrients up to fruit ripening. To get one ton fresh fruit, plants need to absorb on an average 2.5-3 kg N, 0.2-0.3 kg P and 3-3.5 kg K (Hedge, 1997). In presence of other production constrains nutrient uptake and yields are very closely related. Nitrogen is essential to build up protoplasm and protein, which induce cell division and initial meristematic activity when applied in optimum quantity (Singh and Kumar, 1969). Nitrogen has the largest effect on yield and quality of tomato (Xin *et al.*1997). It also promotes vegetire growth, flower and fruit set of tomato (Bose and Som. 1990). It significantly increases the growth and yield of tomato (Banarjee *et al.*1997).

Normally, in Bangladesh tomato is grown during the months from September to April when rainfall is scare and about 250 mm of soil moisture is exhausted by evapotranspiration. Water is the single factor that directly affects the tomato yield, because it contains 94% water. For successful crop about 285 mm water is required especially at flowering, fruit setting and enlargement stage (Anonymous, 2004). But irrigation facilities are not sufficient in all regions of the country. Sometimes pumps cannot lift water in dry season due to lower water table. Moreover, many of the farmers cannot afford the expenses of irrigation. Under the situation mulching could be a good technique for conserving soil moisturre. Artificial mulches with straw, rice husk, water hyacinth, crop residues or plastic mulches are generally practiced in the production of horticultural crops (Wilhoit *et al.*, 1990). Different types of mulch play an important role in conserving soil moisture (Suh and Kim, 1991).

Mulching is a desirable management practice which is reported to regulate the soil temperature, improve the soil moisture, suppress the weed growth, saves labour cost (Patil and Basod, 1972), and improves the soil physical conditions by enhancing the biological activity of soil fauna and thus soil fertility (Lal, 1989). Mulching has been reported to increase yield by creating favorable temperature and moisture regimes, in the different parts of the world (Ma and Han, 1995). Soil temperature is an important factor affecting germination, growth and other developmental processes for crops (Larson et al., 1960). Mulching has that unique character of reducing the maximum soil temperature and increasing the minimum temperature (Singh et al., 1987).

Considering the above facts, the above study has been undertaken to fulfil the following objectives:

1) To find out suitable mulch for higher growth and yield per unit area of land.
2) To find out the optimum dose of nitrogenous fertilizer for proper growth and higher yield of tomato per unit area of land.

CHAPTER II

REVIEW OF LITERATURE

Tomato is one of the most important vegetable crops grown under field and greenhouse condition, which received much attention to the researchers throughout the world. Numerous investigators in various parts of the world have investigated the response of tomato to different types of mulches and different levels of nitrogen. In Bangladesh little work(s) have been done in this respect. However, the available findings in this connection over the world have been reviewed in this chapter under the following headings.

2.1 Effect of mulching on the growth and yield of tomato

Mulches have various effects on the plant growth and yield. Many researchers noted that plants were greatly influenced by mulching.

Rajbir-Singh *et al.* (2005) stated the effect of transplanting time and mulching on growth and yield of tomato. A field experiment was conducted in Abohar, Punjab, India during the winter of 1998-2000 to study the effects of transplanting time (10 and 30 December, 20 January) and mulching (black and clear polyethylene sugarcane trash and rice straw) on the growth and yield of tomato cv. Rupali. Early planting (10 December) resulted in the highest vegetative growth, yield attributes, early and total fruit yield, whereas the lowest for the parameter measured were lowest with 20January transplanting. Among the different mulching materials black polyethylene retained higher soil moisture and temperature compare to other mulching materials and the control. Fruit yield was also highest with black polyethylene mulches. The highest net returns (Rs. 52,700/ha) were recorded with transplanting on 10 December and mulching with black polyethylene treatment combination, which was significantly superior to all other treatment combinations.

Incalcaterra *et al.* (2004) stated the effects of transparent polyethylene mulching and different planting densities on tomato grown for processing in Sicily. Tomato cultivation is steadily increasing in the Sicilian countryside (Italy) where careful management of clay soils allows successful yields. The crop is established in the first week of May and rainfall is adequate to obtain a sufficient production without irrigation. In these areas, a recent development in tomato production for processing is the use of transparent polyethylene (PE) mulching. The aim of this study was to verify the effects of transparent polyethylene mulching vs. bare soil and of three different plant densities (0.74, 1.1 or 2.2 plants/m^2) on a tomato crop in the Sicilian countryside. Applying (PE) mulch and planting at a density of 2.2 plants/m^2 resulted in the highest yield (58.5 tones/ha). The lowest production (15tonnes/ha) was obtained on bare soil and planting at a density of 0.74 plants/m^2.

Field experiments were conducted by Singh *et al.* (2000) to study the response of tomato yield to three irrigation moisture regimes (corresponding to 100, 80 and 60% of crop water requirement) applied to drip irrigation system (in combination with 25 micron black plastic mulch) and one control (100% CWR) for surface method of irrigation. The plant height and leaf area were maximum for the treatment irrigated with drip system combined with plastic mulch and minimum for the control. The maximum marketable fruit yield was found to be 95 t/ha from this treatment (i.e. irrigated with drip system and combined with mulch at 80% moisture regimes) compared well with the range of yields (55 t/ha to 82 t/ha) achieved in the other treatments and the control. The same treatment achieved the highest water use efficiency (3.36t/ha-cm). The paper shows that an irrigation level of 0% through the drip system along with plastic mulch is the optimal solution, if water-saving vegetable growth, yield and economic return are taken into account.

An experiment was conducted by Sandha *et al.* (2000) on tomato cv. Punjab Kesari treated with 3 types of mulches (black or clear polyethylene and rice straw) and 2 mulching techniques (full plot and half-meter wide strip) alone or in combination with 2 herbicides (0.75 kg Stomp [pendimethalin]/ha and 0.12 kg Goal [oxyfluorfen]/ha) was compared with 2 controls (weeded and unwedded). The tallest plants were recorded under the clear polyethylene mulch full (TPMF) + Goal (69.23 cm) and TPMF + Stomp (69.01 cm) treatments at both the full growth and harvesting stages. Under the various treatments, no significant differences were observed for the crop stand. The highest total and marketable yields of tomato were recorded under the treatment TPMF + Stomp (628.16 and 566.59 q/ha, respectively); those of the black polyethylene mulch full (BPMF) + Stomp, TPMF + Goal and BPMF + Goal treatments were on a par (622.27 and 555.60, 614.84 and 552.09, and 611.79 and 537.89 q/ha, total and marketable yields, respectively). The highest numbers of fruits per plant were obtained under the TMPF + Stomp, BPMF + Stomp, and TPMF + Goal treatments. The heaviest fruits were recorded under TPMF + Stomp, BPMF + Stomp and BPMF + Goal treatments. The highest early tomato yields was recorded under TPMF + Stomp followed by TPMF + Goal treatment. Late yields, however, was higher under rice straw treatments.

A field experiment was conducted by Ramalan *et al.* (2000) during the dry season at the Irrigation Research Farm, Institute for Agricultural Research, Samaru, Nigeria to evaluate water management options on the performance of tomato. The trial involved three furrow irrigation methods (conventional furrow, conventional furrow with cutback, and alternate furrow), two mulch treatments (without mulch and straw mulch), and three irrigation schedules (5-day interval, irrigation at 30 and 60 kPa soil moisture suction). The 18 treatments were laid out in a split-plot design in three replications. The irrigation method was assigned to the main plot while the mulch and irrigation schedule were in the subplots. Days to 50% flowering and fruiting of tomato were unaffected by furrow irrigation methods. But, the applications of mulch and irrigation at the specified suction levels influenced the growth of tomato. The rice straw mulch on furrows significantly delayed the attainment of 50% fruiting by 6 days compared to the un-mulched plots. Fruit sizes at the ages of 17, 19 and 21 weeks after planting, marketable fruit yield, crop water use and water use efficiency were significantly affected by all the three factors. Fruit weight was affected only by soil water suction. The interaction of furrow irrigation method, mulch and soil water suction had a significant effect on water use efficiency (WUE) of the crop. Use of alternate furrow method was statistically at par, in terms of WUE with the conventional furrow method if it was mulched and irrigated at 5-days interval.

Ojeniyi *et al.* (2000) conducted an experiment on the effect of tillage and mulching on the growth and yield of late season tomato. The growth, development and yield of tomato grown on mulched and unmulched hand-hoed, raised beds and ridged sandy loam soil during the late cropping seasons of 1994, 1995 and 1996 in Akure, Nigeria, were investigated. Hand hoeing reduced soil temperature and conserved more soil moisture than ridging or the raised bed while grass mulch improved soil temperature and soil moisture regime compared with bare ground. Root biomass and root/shoot ratio increased in the order ridging, raised bed and hand-hoeing while shoot biomass, leaf area/plant and percentage fruit set decreased in the order raised bed, ridging and hand-hoeing. Number of fruit and fruit yield/plant produced by raised beds were significantly higher than those produced by ridging and hand hoeing. Mulch ameliorated the hydrothermal regime of the soil, improved the vegetative and flowering performance and significantly increased the fruit yield of tomato over bare ground.

An experiment was performed by Hundal *et al.* (2000) effect of mulching and herbicidal treatments on nutrient uptake in tomato. A combination of 3 mulches (black, transparent polythene and rice straw) and 2 mulching techniques (full plot and half meter wide strip) were applied alone or in combination with 2 herbicides (Stomp [pendimethalin] at 0.75 kg/ha and Goal [oxyfluorfen] at 0.12 kg/ha) in tomato, during 1991-92 and 1992-93, in Ludhiana, Punjab, India. The highest leaf N and P contents were obtained under mulched plots, although leaf K content was unaffected by these treatments. Available soil N, NH4 and NO3-N, P and K status of the soil after tomato harvest increased significantly under mulched treatment. The highest yield of tomato fruits was recorded under transparent polyethylene mulch strip + Stomp treatment (566.59 q/ha), which was statistically at par with other polyethylene mulched treatments in combination with both herbicides.

Experiments were conducted by Mohapatra *et al.* (1999) over two rabi seasons (1992/93 and 1993/94) in a well-drained acidic (pH 5.2), sandy loam oxisol of Bhubaneswar, India. Tomatoes were planted on ridges or flat beds and fertilized with 120 kg N (100% at planting; 50% at planting + 50% at 20 days after planting; or 25%, 50%, 25%, applied at 10, 25 and 40 days after planting, respectively). Linear black, low-density polyethylene film mulch was applied at planting or 20 days after planting. Plastic mulched plots were better than unmulched plots with respect to plant growth, yield and conservation of soil moisture. The highest yield of 180 q/ha was obtained with planting on ridges with 50% N applied basal, and mulching at 20 days after planting (this saved 24 cm of irrigation water).

Malik *et al.* (1999) observed the effects of the date of direct sowing or transplanting (15 December, 30 December, 16 January and 15 February) and mulches (black and white polyethylene, and sugarcane trash) on tomato were studied in Haryana, India. Plots mulched with black polyethylene recorded significantly higher soil temperature and moisture percentage compared to other mulch materials and the control (no mulch). Direct sowing on 15 December and mulching with black polyethylene recorded highest yield attributes and lowest disease incidence. The lowest, however, was observed for transplanting on 15 February and in the control plots. The combination of sowing on 15 December and mulching with black polyethylene recorded the earliest fruit ripening/picking, which was one month earlier compared to the treatment of transplanting on 15 February and the control. The highest early and late marketable yields, and lowest unmarketable yield, were observed under sowing on 15 December and mulching with black polyethylene. This treatment was significantly superior to all other treatment combinations, except on the aspect of late marketable and unmarketable yield observed under sowing on 15 December and mulching with white polyethylene.

Agele *et al.* (1999) conducted an experiment on the effect of plant density and mulching on the performance of late season tomato. The growth and yield of late-season tomato was studied at Akure, Nigeria, during 1995-98. In each year, treatments were 0 (bare ground) or 12-kg/ha grass mulch applied to tomatoes at densities of 1.9, 2.8, 3.7 and 5.6 plants/msuperscript 2 in a factorial combination. Increase in plant density and mulching reduced soil temperature at 5 cm depth while only the latter enhanced soil moisture at 10 cm depth throughout tomato growth. The improved soil hydrothermal regime resulted in earlier onset of flowering, 50% flowering date and date of first harvest, and shorter fruit harvest duration in tomato grown on either bare ground or at increased plant density. Although increased plant density reduced shoot dry weight per plant at final harvest, both root length per plant and root dry weight per plant were enhanced. Fruit yield/ha increased as plant density increased, although yield of the individual plants and their components were significantly reduced. Because of compensation at higher plant population densities, it is economical to grow late-season tomato at 5.6 plants/msuperscript 2. Mulching enhanced growth and yield of tomato compared to bare ground and the result emphasizes the need for early and rapid growth of late-season tomato before the onset of terminal drought.

A Field experiment was conducted by Lyimo *et al.* (1998) at the Horticultural Unit at Sokoine University of Agriculture, Morogoro, Tanzania in 1996 to determine the effect of mulching and staking on the development of early and late leaf blight of tomato (cv. Moneymaker) caused by Alternaria solani and Phytophthora infestans, respectively. Mulching and staking significantly (P=0.05) reduced the incidence of early and late blights by 5 to 20% and increased fruit yield more than two fold compared with unmulched and unstaked controls. The apparent rate of infection of the two pathogens was also significantly lower (P=0.05) in mulched and staked tomato than in the controls. Mulching was more effective than staking in suppressing early and late blight diseases in tomato. The combination of mulching and staking significantly (P=0.05) reduced the incidence of the two diseases by 20% compared to when the two practices were used separately.

The experiment was conducted by Monks *et al.* (1997). Shredded newspaper (2.5, 7.6, 12.7, and 17.8 cm depth), chopped newspaper (2.5 and 7.6 cm), wheat straw (15.2 cm), black plastic, and plastic landscape fabric were evaluated during 1993 and 1994 in West Virginia for their effect on soil temperature, soil moisture, weed control, and yield in tomato. Shredded newspaper and wheat straw applied at 0, 2, 4, or 6 weeks after transplanting (WAT) and napropamide (2.1 kg a.i. ha-1) + metribuzin (0.28 kg a.i. ha-1) applied at transplanting were evaluated during 1992 and 1993 in North Carolina for their effect on tomato yield and control of barnyardgrass (Echinochloa crus-galli), common lambs quarters (Chenopodium album), goose grass (Eleusine indica) and large crabgrass (Digitaria album). Results from West Virginia indicated that shredded (7.6 cm) and chopped (7.6 cm) newspaper conserved moisture similar to higher application rates of the shredded material. Higher newspaper mulching rates reduced soil temperature compared to black plastic and bare ground. Chopped newspaper controlled weeds more consistently than other treatments. At least 7.6 cm of chopped newspaper mulch was required to give at least 90% control. Wheat straw was not as effective in controlling weeds as 7.6 cm or greater of newspaper mulch. Chopped newspaper provided higher tomato yields than shredded newspaper applied at the same rates. Mulches applied at 0, 2, or 4 WAT resulted in weed control similar to the chemical treatment. In North Carolina, mulches applied 2 or 4 WAT resulted in tomato yields similar to the chemical treatment. It was concluded that shredded and chopped newspaper have potential as a mulching material but may vary in effect in different environments and vegetable crops.

Field experiments were conducted by Lourduraj *et al.* (1996) on tomato cv. Co.3 to study the effect of different mulching materials (plastic mulch and organic mulch compared to unmulched control) and irrigation rates (IW: CPE ratios of 0.40, 0.60 and 0.80) on yield and economics. Results revealed that mulching of tomato with black LLDPE mulch film (25 micro m) resulted in the highest yield of 12 735 kg/ha, an increase of 28.4% compared to the unmulched control. Among the irrigation regimes, irrigating tomato at IW: CPE ratio of 0.80 produced the highest yield (12 556 kg/ha).

The effects of fertilization on tomatoes were studied by Hegwood *et al.* (1995) in Mississippi, USA, in the autumn of 1994. The effects of tillage, plastic mulch, and fertilization on yield and fruit quality were compared. The marketable number and weight of tomatoes were highest from mulched plots, which were either fertilized or fertilized with granular fertilizer. These values did not significantly differ from fertilized plots, which were unmulched. Mulched fertilized plots yielded higher marketable yield than either no-till treatments or bare soil granular plots. Total fruit number and weight were highest from the mulched plots.

The experiment was conducted by Castellane *et al.* (1995). Aphid, thrips and spider populations were evaluated on tomato in Sao Paulo, Brazil, with mulching with polyethylene films and spraying with pesticides, during 1991-92. Insecticide treatment reduced insect populations and virus infection for spring-summer planting dates. An effect for mulching was only observed for the 1st evaluation, with black mulching providing thrips control, and red mulching virus control. For the autumn-winter planting date, spraying reduced thrips and spider populations, while red and orange mulching decreased aphid incidence. Insecticide treatment increased total yield and decreased fruit damage in the spring-summer, whereas in the autumn-winter, total yield was not affected by treatment.

Shrivastava *et al.* (1994) conducted Experiments with cv. Rupali on a Vertical Ustrochrept soil, 63% clay and 15% (by weight) available moisture content, during 3 successive winter seasons. Three moisture regimes (drip irrigation at 0.4, 0.6 or 0.8 of pan evaporation (PE)) were combined with 3 mulch treatments (no mulch, black plastic or sugarcane trash). Three other treatments combined surface flood irrigation with no mulch, black plastic or sugarcane trash; the recommended irrigation schedule, i.e. watering to a depth of 8 cm at 100 mm cumulative pan evaporation, was followed. The highest crop yield, about 51 t/ha, and 44% saving in irrigation water were obtained using the combination of drip irrigation at 0.4 PE and a mulch of sugarcane trash. This treatment also gave the maximum yield of 163 kg ha-1 mm-1 of water applied. Weed growth was also assessed, in g/msuperscript 2, in each treatment. The treatment combining drip irrigation at 0.4 PE with black plastic mulch reduced weed infestation by 95%, increased yield by 53% and resulted in a 44% saving in irrigation water compared with surface flooding without mulch.

Quezada-Martin *et al.* (1992) conducted an experiment to see the response of mulching in the development and yield of tomato cultivation in the greenhouse, tunnel and open air. Three systems of production, greenhouse, tunnel and no shelter were used with or without soil mulch. The av. yields in the greenhouse and tunnel were 204.7% and 67.4% greater than the 4.2 kg/msuperscript 2 obtained with no shelter. The use of soil mulch allowed a reduction in the water table of 10, 15 or 5 cm compared to bare soil in greenhouse, tunnel or without shelter resp. The water use efficiency increased 12.2, 169.6 and 36.6% due to the soil mulch, greenhouse and tunnel effects resp.

Rutledge-AD (1992) conducted an experiment on the effect of fertilization and black plastic mulch. The large-fruited, vigorous tomato cultivar Mountain Pride was grown in 1990 and 1991 trials to evaluate the effects of a black plastic mulch, drip irrigation and different rates of NPK fertilizer on fruit yield and quality. The results, with details of treatments and climatic conditions, are shown in tables. In 1990, which was a colder season than 1991, tomato yields did not differ significantly between treatments. In 1991 a broadcast application of 1000 lb of a 10:10:10 NPK fertilizer before planting, in combination with mulching and drip irrigation produced yields equal to those with higher rates of fertilizer applied partly before planting and partly via the irrigation system. The sandy loam soil, which had been supplied with organic matter from crops of winter wheat, appeared to maintain sufficient nutrient availability throughout the growing season. Drip irrigation + mulching improved yields of grade 1 quality fruits compared with no irrigation + no mulching. There was no indication that fertilization improved yields beyond those obtained with a pre-planting application (all rates) combined with mulching and irrigation. In both seasons, fruits were generally excellent.

Asiegbu-JE (1991), In an experiment at Nsukka, transplanted 5-week-old tomato cv. Roma VFN seedlings into plots given 0, 80 or 160 kg N/ha as ammonium sulfate and mulched with dry cassava peel, dry giant star grass (Cynodon plectostachyus) straw, dry guinea grass (Panicum maximum) straw, or black plastic sheeting or not mulched. In a 2nd experiment, Solanum incanum cv. Marvel seedlings were transplanted into plots given 0, 80, 160 or 240 kg N/ha and mulched as for tomatoes, except that black plastic was not included and the cassava peel mulch was applied at a doubled rate (25 t/ha). The black plastic mulch was the best at controlling weeds in tomatoes, and the straw mulches were more effective in controlling weeds in S. incanum than cassava peel. The black plastic mulch also gave the highest yields of tomato. Straw mulches did not improve S. incanum yields compared with the unmulched control but cassava peel mulch reduced yields; it also encouraged Sclerotium rolfsii [Corticium rolfsii] (necrotic ring spot). In both crops, increasing N rates above 80 kg/ha had no beneficial effect on yield.

Bleyaert (1991) showed that in trials in 4 successive years various tomato cultivars, planted in late Apr.-early May in plastic greenhouses, were grown with or without soil mulch. The materials used comprised (1) perforated transparent polyethylene, 50 micro m thick, (2) black imperforated polyethylene, 30 micro m thick, and (3) black woven polypropylene fabric, weighing 110 g/msuperscript 2. Although the crop yield was not influenced significantly, both polyethylene and polypropylene mulches clearly improved fruit quality compared with that for unmulched plants. The incidence of skin contraction cracks was reduced and the thickness of the waxy cuticle increased, improving glossiness. There was no significant difference in effect between the mulch types.

2.2 Effect of nitrogenus fertilizer on growth and yield of tomato

The effect of tillage system and nitrogen application on fruit quality and total fruit yield of tomato (*Lycopersicon esculentum*) cultivars was investigated by Rhoads *et al.*(2002)The treatments were either conventional tillage or rye (*Secale cereale*) mulch with or without 50 kg N ha-1. In both tillage systems, the application of 50 kg N ha-1 reduced the concentric cracking of tomato fruit, except for UC82 in conventional tillage and Cherry Express II in rye mulch. When harvested at the same stage of maturity, chroma and hue along with acetic and citric acid concentrations of fruit were not affected by tillage system or N treatment. Fruit yields ranged from 34.0 to 60.6 Mg ha-1. Total yield of UC82 was not affected by cropping system. Depending on the year, total yields of Mountain Supreme, Pik Red and Cherry Express II were reduced in the rye mulch. Although rye mulch had a minimal effect on fruit quality, the delay in fruit maturity and resultant lower total yields will limit acceptance of the system. Later applications of fertilizer or combining rye with plastic mulches might overcome these limitations.

Prabhakar *et al.* conducted a field experiment with tomato during summer 2001, in Bangalore, Karnataka, India. The treatments involved 2 levels of NK fertilization (full and half) through 2 sources of fertilizers. Commercial (urea and muriate of potash) and special fertilizers (Multi K) and one level each of full NPK through fertilization in the form of poly feed and soil application of fertilizers through ammonium sulfate, single super phosphate and muriate of potash. All these treatments were repeated with the black polyethylene mulch. In the soil application treatments, the recommended dose of fertilizers (200: 100: 200 NPK/ha) was applied in 2 splits: half (100: 100: 100 NPK/ha) as basal and the remaining half at 30 days after transplanting. In the treatments, which received half of NK fertilization, 50% of NK and full dose of P was given as soil application at the time of transplanting. In all other treatments, except the soil application, the water soluble fertilizers were injected in 10 equal splits at 10 days interval starting from the date of transplanting. Soil application of fertilizers with furrow method of irrigation served as the control. The treatment with half NK fertilization and drip with black polyethylene mulch resulted in the highest yield of 121.3 tones/ha, mean fruit weight of 64.5 g, number of fruits per plant of 62.0, yield per plant of 4.0 kg, number of branches per plant of 7.7 and number of clusters per plant of 12.3. Black polyethylene mulch resulted in an increase in yield of 7.2 tones/ha. The highest total soluble solids of 5.3 were observed in treatments with soil application of recommended levels of fertilizers and black polyethylene mulch. The fruit dry matter content (41.2%) was highest with half NK fertilization through Multi K + black polyethylene mulch.

Vanquez *et al.* (2002) carried out field trials in 2000 (experiment 1) and 2001 (experiment 2) in Valdegon (La Rioja, Spain), in a Xerochrept calcixerollic soil, with tomato cv. Brigade, with the aim of evaluating nitrate leaching, optimizing water use and reducing nitrate leaching in tomato cultivated with drip irrigation and plastic mulch, and following the management techniques of the middle Ebro valley. In experiment 1, tomato was cultivated under 2 management techniques:

bare soil (S1) and plastic mulch (S2), and 2 drip irrigation rates (R1 and R2), both estimated from the crop evapotranspiration (ETc) calculated for each soil management technique. Hence, there were 2 treatments where the irrigation rate was adjusted to crop needs, S1R1 and S2R2, one treatment with water limitation, S2R1, and one treatment, which received excess of water. In experiment 2, tomato was cultivated under 4 irrigation strategies: high rate at planting followed by daily irrigation equal to the ETc during the cropping period (T1R1), high rate at planting followed by daily irrigation equal to 80% ETc (T1R2), reduced rate and high frequency at planting followed by high frequency during the cropping period (T2R3 if water applied was 100% ETc, and T2R2 if it was 80% ETc). To evaluate nitrate leached to 1 m depth, the drainage volume was multiplied by the nitrate concentration of the soil solution at that depth. Weekly measuring the water content of the soil profile and applying the water balance equation calculated drainage. The soil solution at 1 m depth was extracted by porous ceramic cups and was analyzed for nitrate. Drainage and nitrate leaching were evaluated for 2 different crop periods: planting and cropping. In experiment 1, cumulative drainage accounted for 24.9% of total water applied for S1R1, 32.3% for S1R2, 29.6% for S2R1 and 31.6% for S2R2. Nitrate leaching was 62.8% of the initial plus the applied as fertilizer for S1R1, 91.4 for S2R1, 59.0 for S2R1 and 43.5 for S2R2. The larger water and nitrate losses took place during the period of planting. Most of the water applied at planting in experiment 2, was lost by percolation, probably due to the high soil permeability. During the cropping period, cumulative drainage accounted for 16% of total water applied for T1R1, while it was not relevant for the other treatments. Nitrate leaching for all treatments was only significant during the planting period, except for T1R1 were 27% of the total nitrate leached took place during the cropping period. Increasing frequency of irrigation allowed water application to be reduced, maintaining yield and optimizing water and nitrogen use. The Kc values in mulched crop systems are discussed

Olasantan, (2000) observed the effect of nitrogen rate (0, 30, 60 and 90 kg/ha) with hedgerow pruning applied as mulch in G. sepium alley cropping system on weed control and growth and yields of okra cv. NHAe47.4 and tomato cv. Ife 1 was studied in an on-farm experiment in South-western Nigeria in 1993 and 2004. Increasing nitrogen fertilizer rate up to 90 kg/ha with total hedgerow pruning applied as mulch increased the growth of the vegetables, but this was not accompanied by a significant increase in fruit yields beyond 60 kg/ha. When averaged over the two years, however, application of 30 kg/ha gave more economical yield than application of 60 kg/ha. With total foliage from hedgerow pruning applied as mulch, weed dry weight decreased significantly by 70-75 and 60-66% under okra and tomato, respectively, with and without fertilizer. It is concluded that application of small amount (about 30 kg/ha) of nitrogen fertilizer with hedgerow pruning applied as mulch can suppress weed growth and increase fruit yield of okra and tomato under G. sepium alley cropping system.

The effects of N fertilizer (75, 100 and 125 kg/ha) and mulch (black, transparent or silver-black polyethylene and pea straw) on the tomato hybrid cv. Naveen-2000 were investigated by Hedau,-N-K; Thakur,-M-C; Mahesh-Kumar; Mandal,-J in Himachal Pradesh,(2001) India .Among the N rates, 125 kg N/ha produced the highest fruit yield (71.67 t/ha). The highest fruit yields of 76.42 and 75.31 t/ha were obtained with silver-black and black polyethylene mulches, respectively. Among the various interactions between N rate and mulch, the highest fruit yield (89.40 t/ha) was recorded for 125 kg N/ha combined with silver-black polyethylene. Titratable acidity and ascorbic acid content increased with the N level.

Masson *et al.* (1990) observed the effects of nitrogen fertilization on the growth of tomato and lettuce transplants in multi cellular trays with and without supplementary lighting. Seedlings of tomato cv. Spring set and lettuce cv. Ithaca were raised in multi cellular trays (Suttons plug trays) in a polyethylene-clad greenhouse. They were grown under natural or supplementary light (100 micromole m-2 s-1 PAR) and supplied with N at 100, 200, 300 or 400 mg/liter in a complete nutrient solution. Supplementary lighting increased tomato shoot DW, shoot % dry matter, leaf area, root DW and root: shoot ratio. With lettuce it increased shoot and root DW and leaf area. For both crops, N application increased shoot DW and leaf area, but reduced shoot % dry matter and root: shoot ratio. The greatest increases in tomato and lettuce shoot DW and leaf area with high N doses were generally found in combination with supplementary lighting. Optimum N dosage for tomato was 300 mg in natural light and 400 mg with supplementary lighting; under either condition the optimum for lettuce was 400 mg.

Kaniszewski *et al.* (1990) showed that in field trials between 1985 and 1987 with cultivars Najwczesniejszy and Luca, plants received N at rates ranging from 37.5 to 450 kg/ha applied in a single dose (up to 225 kg N/ha) or in 2 split doses (in the case of higher N rates). The fertilizer schedule, including a PK basal dose, is outlined. Trickle irrigation was applied at 2 liters/plant when the soil moisture tension reached 40 kPa. Irrigation had a marked beneficial effect on the total and commercial yields but not on the early yield. Luca responded less to irrigation than Najwczesniejszy. N had a beneficial effect on yield at rates up to 300 kg N/ha under irrigation and of up to 150 kg N/ha without irrigation. Luca was more demanding of N than Najwczesniejszy. Both cultivars had a similar total yield, but the early and commercial yields were markedly higher in Luca. Irrigation and N at 225 kg/ha applied before planting gave the best fruit quality. Fruits of Luca were larger, firmer and had higher vitamin C content than fruits of Najwczesniejszy which had a higher DM content and better coloration than Luca.

Experiments were conducted at Punjab Agricultural University, by Kooner *et al.* (1990) Ludhiana to study the interaction of rates and sources of N with cultivars on the yield and processing quality of tomatoes in winter and spring seasons. Ostankinski (OS), Punjab Chhuhara (PC) and Punjab Kesri (PK) were used for the spring planting, and OS, PC and Cold Set (CS) for the winter planting. Four rates of N (50, 100, 150 and 200 kg/ha) were applied as 2 sources, calcium ammonium nitrate (CAN) and urea, in a randomized, split plot design. PC produced significantly higher yields (222.7 kg/ha) than PK (208.9 kg/ha) in the spring planting while in the winter planting OS (163.9 kg/ha) and CS (113.9 kg/ha) were the best. Yields increased linearly with increasing N rate up to 150 kg/ha and CAN was the best source of N. TSS, juice percentage, ascorbic acid content and titratable acidity increased with increasing N up to 150 kg/h

A-37227 A. 111 04/10/09

CHAPTER III

MATERIALS AND METHODS

This chapter deals with the materials and methods used in the experiment. It includes a short description of location of the experimental plot, characteristics of soil, climate and materials used for the experiment. The details of the experiment are given below.

3.1 Location of the experimental plot

The field experiment was conducted at the Horticultural Farm, Sher-e-bangla Agricultural University Dhaka during October 2007 to March 2008.

3.2 Soil of the experimental field

Initial soil samples from 0-15 cm depth were collected from experimental field. The collected samples were analyzed at Soil Resources Development Institute (SRDI), Dhaka, Bangladesh. The physio-chemical properties of the soil are presented in Appendix I. The soil of the experimental plots belonged to the agro ecological zone of Madhupur Tract (AEZ-28) as shown in Appendix I.

3.3 Climate of the experimental site

The area is characterized by hot and humid climate. The average rainfall of the locality of the experimental area is 209.06 mm, the minimum and maximum temperature is 24.86°C and 31.49°C respectively. The average relative humidity was 85.8% during October 2007 to March 2008 (Appendix II).

3.4 Planting materials used

The tomato variety used in the experiment was BARI TOMATO-2. This is a high yielding determinate type variety and the seeds were collected frrom Horticultural Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI).

3.5 Raising of seedlings

The land selected for nursery bed was well drained and was of sandy loam type soil. The area was well prepared and converted into loose friable and dried mass to obtain fine tilth. All weeds and dead roots were removed and the soil was mixed with well rotten cow dung at the rate of 5 kg/bed. The size of each bed was 3m x 1m rose above the ground level maintaining a spacing of 50cm between the beds. The seedbeds were prepared for raising the seedling. Ten grams of seeds were sown in each seedbed on 28th October 2007. After sowing, the seeds were covered with light soil. Sevin was applied in each seedbed as precautionary measure against ants and worms. Complete germination of seeds took place with 6 days after seed sowing. Necessary shading was made by bamboo mat (chatai) to protect the seedlings from scorching sunshine or rain. Weeding, mulching and irrigation were done as when required. No chemical fertilizer was used in the seedbed.

3.6 Treatments and layout

The experiment considered of two factors; (A) different types of mulches and (B) four different levels of nitrogen. The levels of two factors were as follows:

Factor A: Different types of mulches	**Factor B:** Four different levels of nitrogen
Mulches	Nitrogen fertilizer
Mo: No mulch	No: No nitrogen
M1: Black polythene	N1: 180 kg/ha
M2: White polythene	N2: 220 kg/ha
	N3: 250 kg/ha

The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The whole field was divided into three blocks each containing 12plots. In total, there were 36 plots. The treatments were randomly assigned to each unit plot. The size of unit plot was 3m x 2m. The distance between the blocks was 0.75m and that between plots was 0.75m.

3.7 Land preparation

The land was first opened with a tractor on 16 November 2007. There after, it was gradually ploughed and cross-ploughed three times with power tiller. Laddering to break the clods and to level the soil followed each ploughing. During land preparation weeds and other stubbles of previous crop were collected and removed from the land. These operations were done to bring the land under a good tilth condition. Irrigation channels were prepared around the plots.

3.8 Manure and Fertilizer application

In addition to the fertilizer under treatment, 10 tones of cow dung manure, 450 kg of triple super phosphate (TSP) and 250 kg of MP per hectare applied in the experimental plot. Half of the cow dung, the entire quantity of TSP, ½ of MP was applied during final land preparation. The remaining cow dung was applied during pit preparation. The entire urea and the rest of MP were applied in three equal installments at 15, 30 and 50 days after transplanting in the field.

3.9 Transplanting of seedlings

Healthy and uniform sized 30 days old seedlings were taken separately from the seedbed and were transplanted in the experimental field on 28 November 2007 maintaining spacing of 60 cm and 50 cm between the rows and plants respectively. The seedbeds were watered before uprooting the seedlings so as to minimize damage to the roots and this operation was carried out during late hours in the evening. The seedlings were watered after transplanting. Seedlings were also grown around the experimental area for gap filling and for checking the border effect.

3.10 Application of mulches

Two types of mulches, viz. black polythene and white polythene were placed on the respective plots per layout of the experiment immediately after transplanting. The thickness of the polythene was 0.03 mm.

3.11 Intercultural operations

After transplanting the seedlings, various kinds of intercultural operations were accomplished for better growth and development of the plants.

3.11.1 Gap filling

When the seedlings were established, the soil around the base of the seedlings was pulverized. A few gap feeling were done by healthy plants from border whenever it was required.

3.11.2 Weeding

Weeding was done in the unmulched plots as and when necessary to keep the crop free from weeds. It also helped for better soil aeration soil moisture conservation.

3.11.3 Staking and pruning practices

When the plants were well established, each plant was staked to keep them erect. Within a few days of staking the plants were pruned uniformly having single stem per plant.

3.11.4 Plant protection

Insect pests: As preventive measure against the insect pests like Cut worm, Leaf hopper and others Malathion 57 EC at the rate of 2ml/litre was applied. The insecticide application was made fortnightly from a week after transplanting to a week before first harvesting.

Disease: During the foggy weather precautionary measures against disease infestation were taken. Especially, for late blight of tomato Diethane M-45 was sprayed fortnightly @ 2g/litre.

3.12 Harvesting

Fruits were harvested at 5 days interval during ripening stage. The maturity of the crop was determined on the basis of red coloring of the fruits.

3.13 Data collection

Data on the following parameters were recorded from the sample plants during the course of experiment. The plants were selected

3.13.1 Plant height (cm)

Five plants were randomly selected from each plot and plant height was measured in centimeter from the ground level up to the tip of the longest stem and mean value was calculated. After transplanting, plant height was recorded at 15 days interval on 15, 30, 40, 60, and 75th day to observe the growth rate of the plants.

3.13.2 Total number of leaves per plant

Total number of leaves from transplant to harvest was counted from 5 randomly selected plants along with leaf scars of shade leaves and their average was taken as the number of total leaves per plant.

3.13.3 Length of leaf (cm)

The length of leaf was measured with a scale from the neck of the leaf to the bottom of 10 selected leaves from each plant and their average was taken in cm.

3.13.4 Breadth of leaf (cm)

The Breadth of leaf was measured with a scale from 10 selected leaves from each plant and their average was taken in.

3.13.5 Number of primary branch

The number of primary branch was counted from the sample plants and the average number of primary branch was recorded at the time of final harvest.

3.13.6 Number of secondary branch

The number of secondary branch was counted from the sample plants and the average number of secondary branch was recorded at the time of final harvest.

3.13.7 Number of flower cluster per plant

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

3.13.8 Number of flower per plant

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

3.13.9Number of fruits per plant

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

3.13.10 Fruit length (cm)

The length of fruit was measured with a slide calipers from the neck of the fruits to the bottom of 10 selected marketable fruits from each plot and their average was taken in cm.

3.13.11 Fruit diameter (cm)

Diameter of fruit was measured at the middle portion of 10 selected marketable fruits from each plot with the help of a slide calipers and their average was taken as the diameter of fruit.

3.13.12 Weight of fruit per plant (kg)

It was measured by the following formula:

Weight of fruit per plant (kg) = Number of fresh ripe fruit per plant x weight of Individual fruit

3.13.13 Weight of fruits per plot (kg)

A pan scale balance was used to take the weight of fruits per plot. It was measured during the period from first to final harvest.

3.13.14 Fruit yield per hectare

Fruit yield of tomato per plot was converted into yield in metric ton per hectare

3.14 Analysis of data

The data in respect on yield and yield contributing characters were analyzed to find out the statistical significance to the experimental results. The means for all the treatments were calculated and analyses of variance for all the characters were performed by F test. The significance of the difference among the means was evaluated by DMRT for interpretation of the results.

CHAPTER 4

RESULTS AND DISCUSSIONS

The present experiment was conducted to determine the effect of different levels of nitrogen and mulching on growth and yield of tomato. Data on different levels of yield and yield contributing characters were recorded (from 15^{th} to 80^{th} days after transplanting) to find out the optimum levels of nitrogen and effective mulch material on tomato. The results have been presented, discussed and possible interpretations are given under the following headings:

4.1 Plant height

Plant height differed non-significantly due to the application of different level of nitrogen and mulching at 20, 30, 40, 50, 60 and 70 DAT (Appendix III). Plant height was significantly affected due to the application of different nitrogen treatment. The plant height increased gradually with the advancement of time and continued up to 80 days after transplanting (DAT) and the tallest plant (86.16 cm) was produced by N_2 (480 kg N/ha) and the shortest plant (73.64 cm) was produced by N_0 (0 kg N/ha) (Figure 1) at 80 DAT. The plant height was increased possibly due to the readily available nitrogen, which might have encouraged more vegetative growth and development. Salam (2001) and Chung *et al.* (1992) reported that plant height was increased with increasing nitrogen rate. Grela *et al.* (1988) found that plant height was increased with increasing nitrogen rates up to 160 kg N/ha and then decreased.

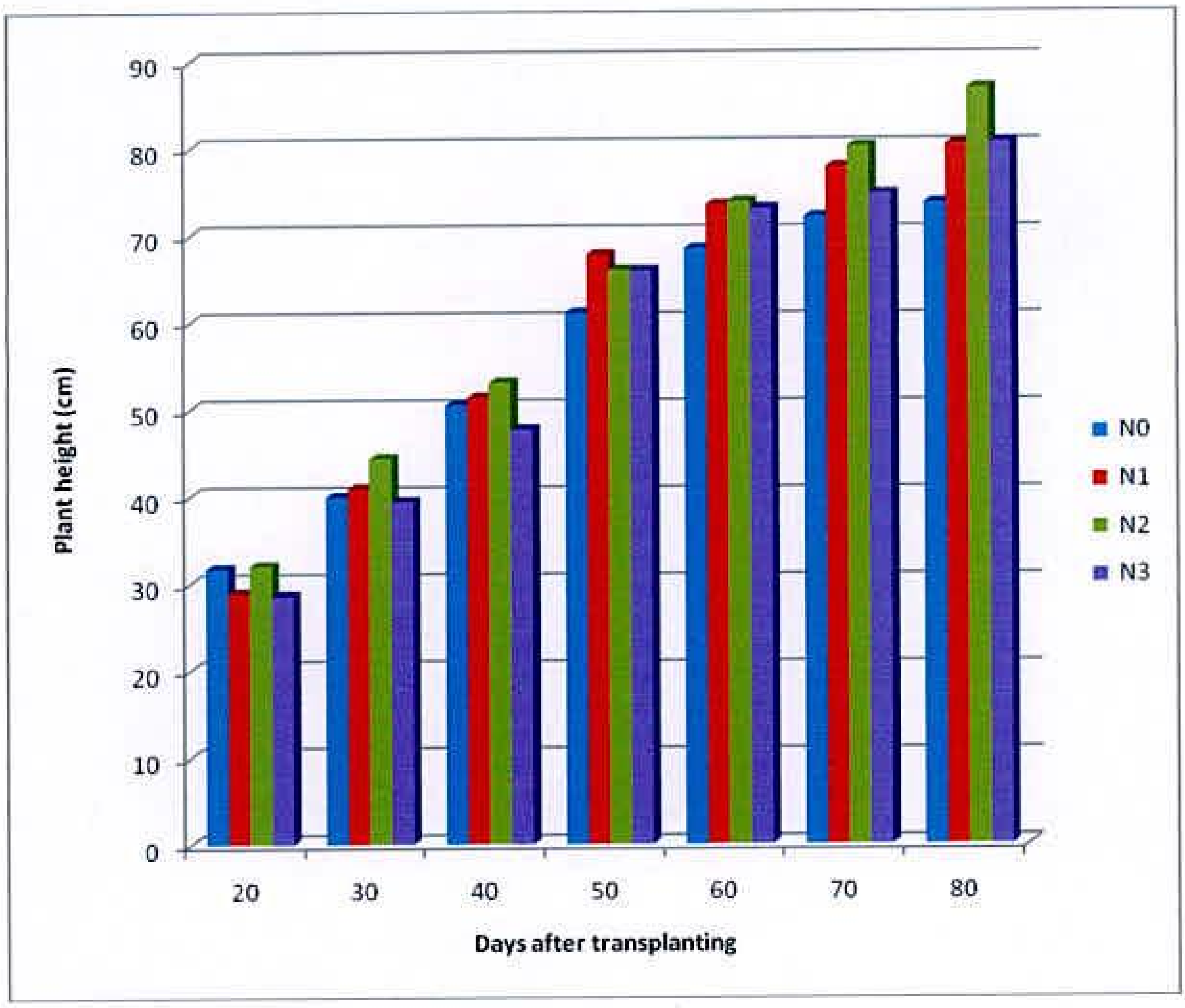

Figure 1 Main effect of nitrogen on the plant height of tomato.

N_0: 0 kg N/ha
N_1: 460 kg N/ha
N_2: 480 kg N/ha
N_3: 500 kg N/ha

Different mulching showed significant variations on the plant height at 20, 30, 40, 50, 60, 70 and 80 DAT (Appendix III). The plant height increased gradually with the advancement of time and continued up to 80 days after transplanting (DAT). The longest (83.467 cm) plant height was recorded from M_1 (black polythene) and the shortest (75.667 cm) was obtained from control i.e. no mulching (M_0) at 80 DAT (Fig 2). The mulch might be responsible for providing water to the plants at stages of growth by conserving sufficient soil moisture and also kept the soil warm, which resulted in increased height of plant. Gunadi and Suwanti (1988) reported that mulching helped to increase plant height. Similar opinion was also put forward by Buitellar (1989).

A significant variation was found due to combined effect of nitrogen and mulching in terms of plant height at different days after transplanting (Appendix III). The longest (89.87 cm) plant height was recorded at 80 DAT from the combined effect of N_2M_1 (480 kg N/ha + black polythene mulch), while N_0M_0 (0 kg N/ha + no mulching) gave the shortest (69.13 cm) plant height (Table 1).

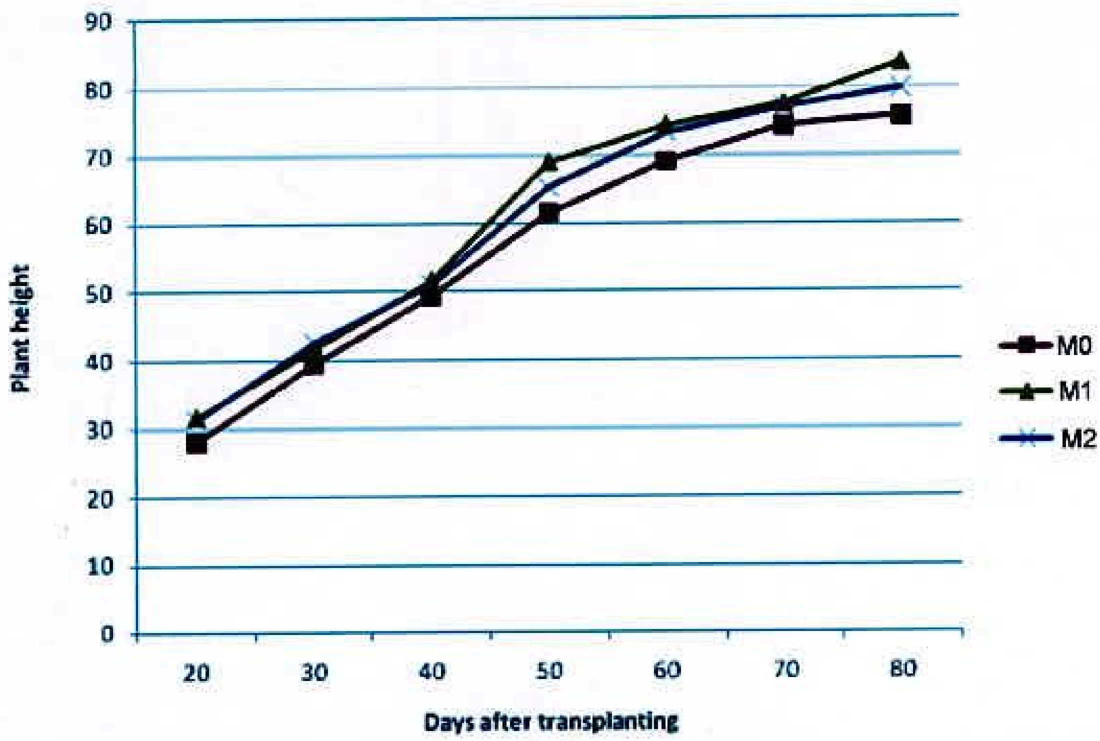

Figure 2 Main effect of different mulching on the plant height of tomato.

M_0: No mulch
M_1: Black polythene
M_2: white polythene

Table 1 Combined effects of nitrogen and mulching on the Plant height of tomato

Treatment	Plant height						
	20 DAT	30 DAT	40 DAT	50 DAT	60 DAT	70 DAT	80 DAT
$M_0 N_0$	30.05bcd	37.34e	48.20ab	56.13c	65.20a-d	69.00bcd	69.13e
$M_0 N_1$	25.96e	38.73cde	48.93ab	66.00abc	73.67abc	76.47abc	77.87b-e
$M_0 N_2$	28.91cde	43.93ab	52.07ab	60.20bc	67.27ab	77.67ab	78.93bcd
$M_0 N_3$	26.95de	37.20e	47.87b	63.60abc	69.87a-d	73.47bc	76.73b-e
$M_1 N_0$	31.83abc	40.93b-e	51.07ab	62.47bc	69.27bcd	72.53cd	75.47e
$M_1 N_1$	31.53abc	41.88a-d	52.87ab	69.87ab	73.27abc	79.13abc	83.07bc
M_1N_2	34.52a	45.57a	57.47a	74.87a	78.47a	83.33a	89.87a
$M_1 N_3$	28.97cde	38.20de	45.13b	68.33abc	76.40ab	74.73bcd	85.47ab
$M_2 N_0$	33.21ab	41.53a-e	52.13ab	64.53abc	70.87d	74.73d	76.33f
$M_2 N_1$	29.13cde	42.20a-d	52.20ab	67.33abc	73.53abc	77.87bc	80.13cde
M_2N_2	32.65abc	43.47ab	49.60ab	62.87abc	75.80cd	79.47abc	82.73cde
$M_2 N_3$	29.81b-e	42.73abc	50.07ab	65.93abc	72.93bcd	76.00bcd	79.67de
$LSD_{(0.05)}$	3.579	3.915	8.193	10.67	7.096	5.746	5.572
Level of significant	*	*	*	*	*	*	*
CV (%)	6.98	5.62	9.56	9.67	5.8	4.45	4.13

Mean a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

N_0: 0 kg N/ha M_0: No mulch

N_1: 460 kg N/ha M_1: Black polythene

N_2: 480 kg N/ha M_2: white polythene

N_3: 500 kg N/ha

4.2 Number of leaves per plant

In case of number of leaves per plant, significant difference was observed due to the application of different levels of nitrogen (Appendix IV). The maximum (14.93) number of leaves per plant was recorded from N_2, while N_0 gave the minimum (12.94) number of leaves per plant (Table 2). Sharma and Mann (1971) also reported that increasing levels of nitrogen application increased the number of leaves per plant (480 kg N/ha).

There were significant variations on the number of leaves/plant due to different mulching (Appendix IV). The maximum (15.25) number of leaves per plant was recorded from M_1 and the minimum (13.00) was obtained from M_0 (Table 3). This is in agreement with Calvert (1957). He found that high temperature and low light intensity accelerate the number of leaves per plant. From the results it was found that black polythene was more effective than other mulching materials under the trial. Lang (1984) found that polythene mulch increased the yield of potato.

Combined effect of nitrogen and mulching showed a significant variation in terms of number of leaves/plant (Appendix IV). The maximum (16.33) number of leaves per plant was recorded from the combined effect of M_1N_2, while M_2N_0 gave the minimum (11.53) number of leaves per plant (Table 4).

Table 2 Main effect of nitrogen on the growth and yield of tomato

Treatment	Number of leaves	Leaf length	Breadth of leaf	Number of primary branch	Number of secondary branch
N_0	12.94c	28.14b	20.32b	9.67c	7.46c
N_1	13.74b	28.70b	21.90b	10.47b	8.55b
N_2	14.93a	31.17a	24.87a	11.83a	10.43a
N_3	13.53b	29.89b	22.84b	11.71a	9.52b
CV (%)	7.74	6.77	9.27	16.40	15.73
$LSD_{(0.05)}$	1.8	3.18	4.20	1.65	3.1
Level of significant	*	*	*	*	*

*- significant

N_0: 0 kg N/ha

N_1: 460 kg N/ha

N_2: 480 kg N/ha

N_3: 500 kg N/ha

Table 3 Main effect of different mulching on the growth and yield of tomato

Treatment	Number of leaves	Leaf length	Breadth of leaf	Number of primary branch	Number of secondary branch
M_0	13.00b	28.51b	22.03b	10.88b	7.55b
M_1	15.25a	31.29a	23.20a	11.83a	10.73a
M_2	13.07b	28.63b	22.22b	10.05b	8.69b
CV (%)	7.74	6.77	9.27	16.40	15.73
$LSD_{(0.05)}$	1.75	3.00	1.01	1.20	2.30
Level of significant	*	*	*	*	*

*- significant

M_0: No mulch

M_1: Black polythene

M_2: white polythene

Table 4 Combined effects of nitrogen and mulching on the growth and yield of tomato

Treatment	Number of leaves	Leaf length	Breadth of leaf	Number of primary branch	Number of secondary branch
$M_0 N_0$	12.70def	25.80c	21.06bc	10.47ab	6.55e
$M_0 N_1$	12.93c-f	28.53bc	21.06bc	10.47ab	7.05de
$M_0 N_2$	14.27b-e	29.73ab	23.53abc	11.27ab	9.10b-e
$M_0 N_3$	12.37ef	28.86bc	22.47bc	11.33ab	7.50cde
$M_1 N_0$	14.60a-d	31.23ab	21.43bc	9.47b	8.70cde
$M_1 N_1$	14.87abc	29.66ab	21.91bc	11.07ab	10.12bc
M_1N_2	16.33a	33.00a	26.83a	13.40a	12.67a
$M_1 N_3$	15.20ab	31.26ab	23.63ab	13.37a	11.43ab
$M_2 N_0$	11.53f	27.40bc	19.48c	9.07b	7.14de
$M_2 N_1$	13.43b-f	27.92bc	22.74bc	9.87b	8.48cde
M_2N_2	14.20b-e	30.79ab	24.24ab	10.87ab	9.52bcd
$M_2 N_3$	13.03c-f	29.53abc	22.43bc	10.40ab	9.62bcd
CV (%)	7.74	6.77	9.27	16.40	15.73
$LSD_{(0.05)}$	1.806	3.378	3.530	3.031	2.394
Level of significant	*	*	*	*	*

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

N_0: 0 kg N/ha — M_0: No mulch

N_1: 460 kg N/ha — M_1: Black polythene

N_2: 480 kg N/ha — M_2: white polythene

N_3: 500 kg N/ha

4.3 Length of leaf

Length of leaf differed significantly due to the application of different level of nitrogen (Appendix IV). The maximum (31.17 cm) length of leaf was recorded from N_2, while gave the minimum N_0 (28.14 cm) length of leaf (Table 2). These results indicate that nitrogen increases the growth of tomato, which ensured the maximum length of leaf than control.

Significant variation was found on the length of leaf for different mulching (Appendix IV). The maximum (31.29 cm) length of leaf was recorded from M_1 and the minimum (28.51cm) was obtained from M_0 (Table 3). From the results it was found that black polythene was more effective than other mulching materials under the trial.

A significant variation was showed due to combined effect of nitrogen and mulching in terms of length of leaf (Appendix IV). The maximum (33.00 cm) length of leaf was recorded from the combined effect of N_2M_1, while N_0M_0 gave the minimum (25.80 cm) length of leaf (Table 4).

4.4 Breadth of leaf

Breadth of leaf showed significant variation due to the application of different level of nitrogen and mulching (Appendix IV). The maximum (24.87cm) breadth of leaf was recorded from N_2, while N_0 gave the minimum (20.32cm) breadth of leaf (Table 2). These results indicate that nitrogen increases the breadth of leaf than control.

Different mulching also had no significant variations on the breadth of leaf (Appendix IV). The maximum (23.20 cm) breadth of leaf was recorded from M_1 (black polythene) and the minimum (22.03 cm) was obtained from M_0 (Table 3). From the results it was found that black polythene was more effective than other mulching materials under the trial.

A significant variation was found due to combined effect of nitrogen and mulching in terms of breadth of leaf (Appendix IV). The maximum (26.83 cm) breadth of leaf was recorded from the combined effect of N_2M_1, while N_0M_2 (0kg N/ha + white polythene) gave the minimum (19.18 cm) breadth of leaf (Table 4).

4.5 Number of primary branch

Number of primary branch showed significant variation due to the application of different levels of nitrogen (Appendix IV). The maximum (11.83) number of primary branch was recorded from N_2 (480 kg N/ha), while the control (0 kg N/ha) gave the minimum (9.67) number of primary branch (Table 2). These results indicate that nitrogen increases the growth of tomato, which ensured the maximum number of primary branch than control.

Different mulching showed significant variation (Appendix IV). The maximum (11.83) number of primary branch was recorded from M_1 and the minimum (10.05) was obtained from M_2 (white polythene) (Table 3). From the results it was found that black polythene was more effective than other mulching materials under the trial.

A significant variation was found for the combined effect of nitrogen and mulching in terms of number of primary branch (Appendix IV). The maximum (13.40) number of primary branch was recorded from the combined effect of N_2M_1, which was statistically identical (13.37) with N_3M_1 (500 kg N/ha+ black polythene mulch), while N_0M_2 (0 kg N/ha + white polythene mulch) gave the minimum (9.07) number of primary branch (Table 4).

4.6 Number of secondary branch

Number of secondary branch differed significantly due to the application of different levels of nitrogen (Appendix IV). The maximum (10.43) number of secondary branch was recorded from N_2 (480 kg N/ha), while N_0 (0 kg N/ha) gave the minimum (7.46) number of secondary branch (Table 2). These results indicate that nitrogen increases the number of secondary branch than control.

Different mulching also showed significant variations on the number of secondary branch (Appendix IV). The maximum (10.73) number of secondary branch was recorded from M_1 (black polythene) and the minimum (7.55) was obtained from M_0 (no mulching) (Table 3). From the results it was found that black polythene was more effective than other mulching materials under the trial.

The combined effect of nitrogen and mulching showed a significant variation in terms of number of secondary branch (Appendix IV). The maximum (12.67) number of secondary branch was recorded from N_2M_1 (480 kg N/ha + black polythene mulch), while N_0M_0 (0 kg N/ha+ no mulching) gave the minimum (6.55) number of secondary branch (Table 4).

4.7 Number of cluster per plant

Significant variation was found due to the application of different level of nitrogen (Appendix V). The maximum (15.16) number of cluster/plant was recorded from N_2, while N_0 gave the minimum (10.72) number of cluster/plant (Table 5).

Different mulching did not show any significant variations on the number of cluster/plant (Appendix V). The maximum (17.02) number of cluster per plant was recorded from M_1 and the minimum (11.40) was obtained from M_0 (Table 6).

A significant variation was found due to combined effect of nitrogen and mulching in terms of number of cluster per plant (Appendix V). The maximum (19.05) number of cluster per plant was recorded from N_3M_1 (500 kg N/ha + black polythene mulch), which was statistically identical (18.45 and 18.26) with N_2M_1 (480 kg N/ha+ black polythene mulch) and N_1M_1 (460 kg N/ha +black polythene), while N_0M_0 gave the minimum (10.25) number of cluster per plant (Table 7).

Table 5 Main effects of different nitrogen on the yield and yield component of tomato

Treatment	Cluster per plant	Flowers/ plant	Fruits/ plant	Diameter of fruit (cm)	Length of fruit (cm)	Ripen fruits/plant (gm)	Yield/ plot (kg)
N_0	10.72c	43.58c	20.51	4.34b	5.09b	586.44b	16.89b
N_1	13.45b	45.02b	24.34	4.78ab	5.89a	697.67ab	27.54a
N_2	15.16a	54.11a	26.67	5.22a	6.16a	779.44a	35.72a
N_3	14.16b	52.24b	22.37	5.00ab	6.10a	678.00ab	30.73a
CV (%)	13.43	6.80	9.78	5.94	4.88	6.31	12.70
LSD $_{(0.05)}$	3.10	17.48	5.966	0.7486	0.7395	112.5	9.145
Level of significant	*	*	*	*	*	*	*

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability, NS- Non Significant.

N_0: 0 kg N/ha
N_1: 460 kg N/ha
N_2: 480 kg N/ha
N_3: 500 kg N/ha

Table 6 Main effects of different mulching on the yield and yield components of tomato.

Treatment	Cluster per plant	Flowers/ plant	Fruits/ plant	Diameter of fruit (cm)	Length of fruit (cm)	Ripen fruits/plant (gm)	Yield/ plot (kg)
M_0	11.40	45.32	19.02b	4.72	5.24b	635.17	20.62b
M_1	17.02	54.43	30.12a	4.96	6.33a	765.92	35.69a
M_2	11.70	46.47	21.28b	4.83	5.87ab	655.08	26.84ab
CV (%)	13.43	13.80	9.78	5.94	4.88	6.31	12.70
LSD $_{(0.05)}$	6.308	23.63	8.066	1.012	0.9998	152.0	12.36
Level of significant	NS	NS	*	NS	*	NS	*

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability, NS- Non Significant.

M_0: No mulch
M_1: Black polythene
M_2: white polythene

Table 7 Combined effects of nitrogen and mulching on the yield and yield components of tomato.

Treatment	Cluster per plant	Flowers/ plant	Fruits/ plant	Diameter of fruit (cm)	Length of fruit	Ripen fruits/plant (gm)	Yield per plot (kg)
$M_0 N_0$	10.25cd	43.27cd	12.87f	4.01e	4.93e	492.00f	14.49f
$M_0 N_1$	11.72bcd	42.47cd	18.93de	4.98a-d	5.33e	711.67cd	17.75f
$M_0 N_2$	12.78bc	59.33b	20.60cd	5.16ab	5.37e	742.00bc	24.61de
$M_0 N_3$	10.85bcd	36.20d	16.07ef	4.74bcd	5.32e	595.00e	25.64d
$M_1 N_0$	12.32bcd	45.13cd	26.13b	4.57cd	5.21e	626.00e	18.75ef
$M_1 N_1$	18.26a	48.80bcd	26.20b	4.77a-d	6.47abc	763.00bc	35.31bc
M_1N_2	18.45a	70.87a	35.53a	5.31a	6.97a	860.00a	48.85a
$M_1 N_3$	19.05a	52.93bc	32.60a	5.21ab	6.67ab	814.67ab	39.86b
$M_2 N_0$	8.99d	42.33cd	20.50cd	4.46de	5.13e	641.33de	17.42f
$M_2 N_1$	10.37cd	43.80cd	27.90b	4.60cd	5.87d	618.33e	29.57c
M_2N_2	14.25b	50.07bc	23.87bc	5.21ab	6.14cd	736.33bc	33.71d
$M_2 N_3$	13.18bc	49.67bc	24.47cd	5.06abc	6.32bcd	624.33e	26.68bc
CV (%)	13.43	13.80	9.78	5.94	4.88	6.31	12.70d
$LSD_{(0.05)}$	3.040	11.39	3.888	0.4878	0.4819	73.28	5.959
Level of significant	*	*	*	*	*	*	*

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

N_0: 0 kg N/ha
N_1: 460 kg N/ha
N_2: 480 kg N/ha
N_3: 500 kg N/ha

M_0: No mulch
M_1: Black polythene
M_2: white polythene

4.8 Number of flower per plant

Number of flowers/plant differed significantly due to the application of different level of nitrogen and mulching (Appendix V). The maximum (54.11) number of flowers/plant was recorded from N_2, while N_0 gave the minimum (43.58) number of flowers/plant (Table 5). The result is almost similar to the finding of Islam *et al.* (1997). They found that highest number of flowers per plant was produced from 480 kg N/ ha. Grela *et al.* (1988) put forwarded almost similar opinion.

Different mulching also showed no significant variations in case of number of flowers/plant (Appendix V). The maximum (54.43) number of flowers/plant was recorded from M_1 and the minimum (45.32) was obtained from M_0 (Table 6). The result is almost similar to the finding of Hasan (2002).

Combined effect of nitrogen and mulching showed a significant variation on the number of flower/plant (Appendix V). The maximum (70.87) number of flower/plant was recorded from N_2M_1, while N_3M_0 gave the minimum (36.20) number of flower/plant (Table 7).

4.9 Number of fruits per plant

Number of fruits per plant showed significant variation due to the application of different levels of nitrogen (Appendix V). The maximum (26.67) number of fruits/plant was recorded from N_2, while N_0 gave the minimum (20.51) number of fruits/plant (Table 5). These results clearly showed that the number of fruits/plant gradually increased with the increasing levels of nitrogen. The result is almost similar to the finding of Islam *et al.* (1997). They found that highest number of fruits per plant was produced from 500 kg N/ ha. Midan *et al.* (1985) reported that the number of fruits per plant increased as the nitrogen level was also increased.

Different mulching showed significant variations on the number of fruits/plant (Appendix V). The maximum (30.12) number of fruits/plant was recorded from M_1 and the minimum (19.02) was obtained from M_0 (Table 6). It was possible that the number of fruits/plant was compensated by the production of maximum number of flower clusters per plant. Gonzalez *et al.* (1993) state that plastic mulch enhances plant development, flowering and fruit numbers per plant of tomato compared with traditional of chemical weed control.

A significant variation was found for the combined effect of nitrogen and mulching in terms of number of fruits/per plant (Appendix V). The maximum (35.53) number of fruits/per plant was recorded from N_2M_1, while N_0M_0 gave the minimum (12.87) number of fruits/per plant (Table 7).

4.10 Length of fruit

Length of fruit had significant variation due to the application of different levels of nitrogen (Appendix V). The maximum (6.16 cm) length of fruit was recorded from N_2, while N_0 gave the minimum (5.09 cm) length of fruit (Table 5). Nasser (1986) had a similar report, which supports the present result. Islam *et al.* (1997) reported that the length of individual fruit was increased with the increased nitrogen levels.

Different mulching had significant variations on the length of fruit (Appendix V). The maximum (6.33cm) length of fruit was recorded from M_1; the minimum (5.24 cm) was obtained from M_0 (Table 6). From the results it can be said that black polythene was more effective than other mulching materials under the trial.

A significant variation was found due to combined effect of nitrogen and mulching in case of length of fruit (Appendix V). The maximum (6.97 cm) length of fruit was recorded from the combined effect of N_2M_1, while N_0M_0 gave the minimum (4.93cm) length of fruit (Table 7).

4.11Diameter of fruit

Fruit diameter differed significantly due to the application of different level of nitrogen (Appendix V). The highest (5.22 cm) diameter of fruit was recorded from N_2, while N_0 (0 kg N/ha) gave the minimum (4.34 cm) diameter of fruit (Table 5). Nasser (1986) also reported similar result. Islam *et al.* (1997) reported that the diameter of fruit was increased with the increased nitrogen levels.

Different mulching did not show any significant variations on the diameter of fruit (Appendix V). The maximum (4.96 cm) diameter of fruit was recorded from M_1 and the minimum (4.72 cm) was obtained from M_0 (Table 6).

Combined effect of nitrogen and mulching showed significant variation in terms of diameter of fruit (Appendix V). The maximum (5.31 cm) diameter was recorded from N_2M_1, while N_0M_0 gave the minimum (4.01 cm) diameter of fruit (Table 7).

4.12 Weight of fruits per plant

Weight of fruits per plant differed significantly due to the application of different levels of nitrogen (Appendix V). The maximum (779.44 g) weight of ripe fruits/plant was recorded from N_2, while N_0 gave the minimum (586.44 g) weight of fruit/plant (Table 5). These results indicate that nitrogen increases the growth of tomato, which ensured the maximum weight of fruits/plant than control.

Different mulching had no significant variations on the weight of ripe fruits/plant (Appendix V). The maximum (765.92 g) weight of ripe fruits/plant was recorded from M_1 and the minimum (635.17 g) was obtained from M_0 (Table 6). From the results it was found that black polythene was more effective than other mulching materials under the trial.

A significant variation was found for the combined effect of nitrogen and mulching in terms of weight of fruits/plant (Appendix V). The maximum (860.00 g) weight of fruits/plant was recorded from N_2M_1, while N_0M_0 gave the minimum (492.00 g) weight of ripe fruits/plant (Table 7).

4.13 Total yield of tomato

The total yield of tomato varied significantly due to the application of different levels of nitrogen (Appendix V). The highest yield of fruit (35.72 kg/plot and 59.73 t/ha) was obtained from N_2, which was statistically similar with N_1 and N_3, while (N_0) gave the lowest (16.89 kg/plot and 28.13 t/ha, respectively) yield (Fig 3 and Table 5). This result showed that the yield of tomato increased gradually with the increased doses of nitrogen fertilizer. Similarly Islam et al. (1997) reported that 500 kg/ha gave the highest fruit yield while the lowest was obtained from control. The result in conformity of the present study of profound influence of nitrogen levels to increase yield of tomato has been reported by many authors (Dose *et al.* 1981, Vris and George, 1985; Midan *et al.* 1985 and Kaniszewski *et al.* 1987).

Different mulching had significant variations on the yield of tomato (Appendix V). The maximum (35.69 kg/plot and 59.83 t/ha, respectively) yield of fruit was recorded from M_1 and the minimum (20.62 kg/plot and 35.75 t/ha) was obtained from M_0 (Fig. 4 and Table 6). The higher yield produced with mulch is due to conservation of moisture in the soil, increased microbial activities, hydraulic conductivity etc and decreased fertilizers leaching and weed population. On the contrary, less vegetative growth as well as low yield was obtained from no mulch treatment. Under polythene mulch, temperature of soil was high and there was almost no weed in contrast with other mulch, resulting higher yield of tomato. Monks *et al.* (1997); Kumar et al. (1995) and Biswas, (1993) mentioned that, the yield was higher when mulch was used and polythene mulch showed significantly higher yield of tomato.

Combined effect of nitrogen and mulching had a significant variation in terms of yield of fruit (Appendix V). The maximum (48.85 kg/plot and 82.25, respectively) yield of fruit was recorded from N_2M_1 (480 kg N/ha + black polythene mulch), while N_0M_0 (0 kg N/ha + no mulching) gave the minimum (14.49 kg/plot and 24.10 t/ha, respectively) yield of fruit (Table 7) (Fig. 5).

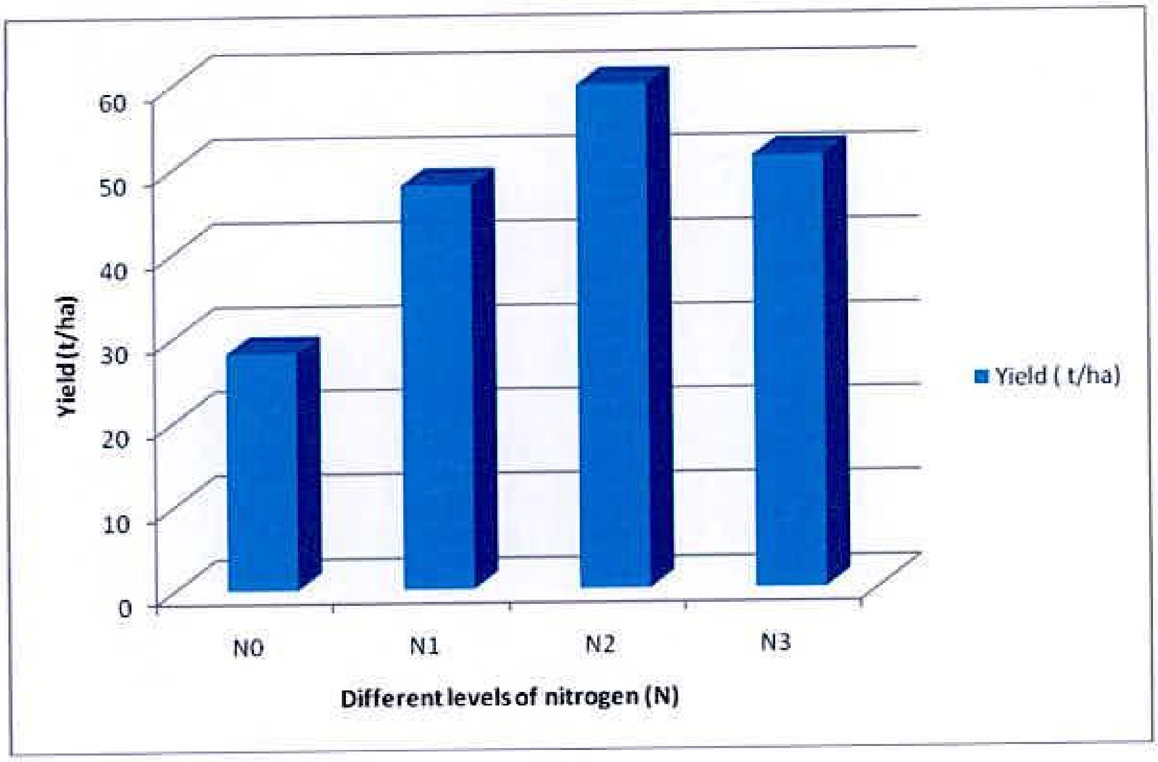

Figure 3 Main effects of different levels of nitrogen on the yield of tomato

N_0: 0 kg N/ha
N_1: 460 kg N/ha
N_2: 480 kg N/ha
N_3: 500 kg N/ha

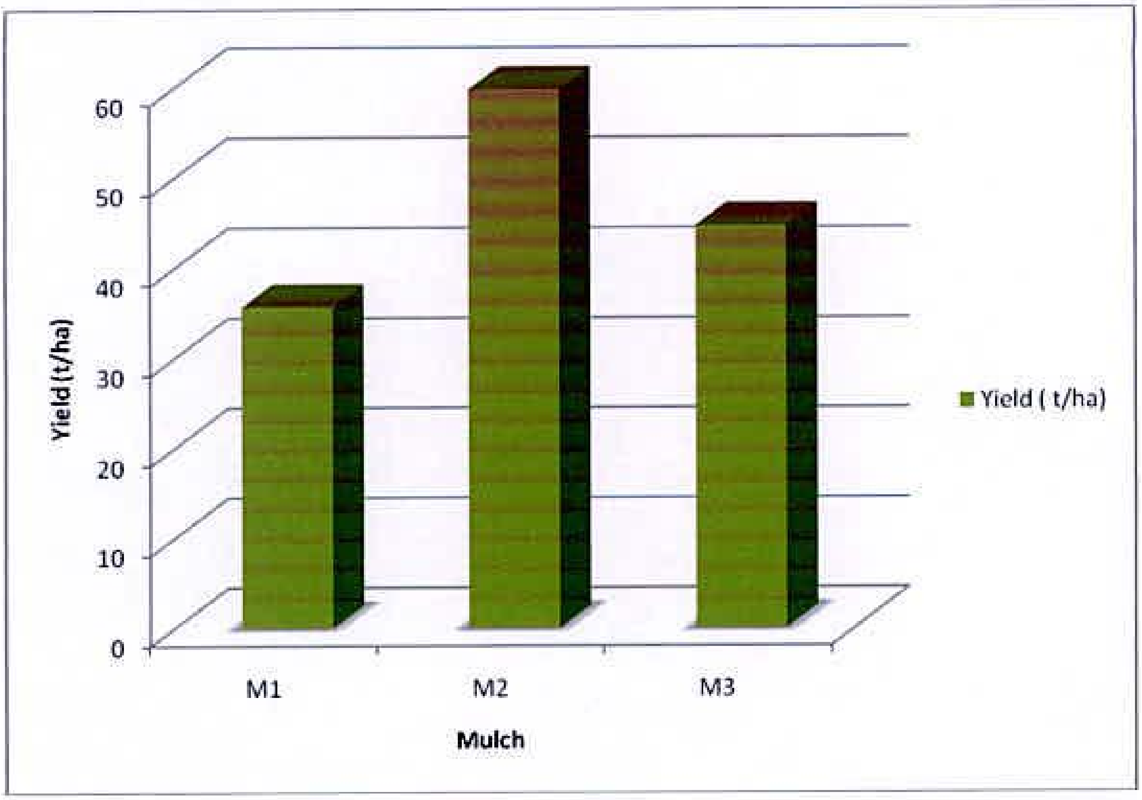

Figure 4 Main effects of different mulching on the yield of tomato

M_0: No mulch
M_1: Black polythene
M_2: white polythene

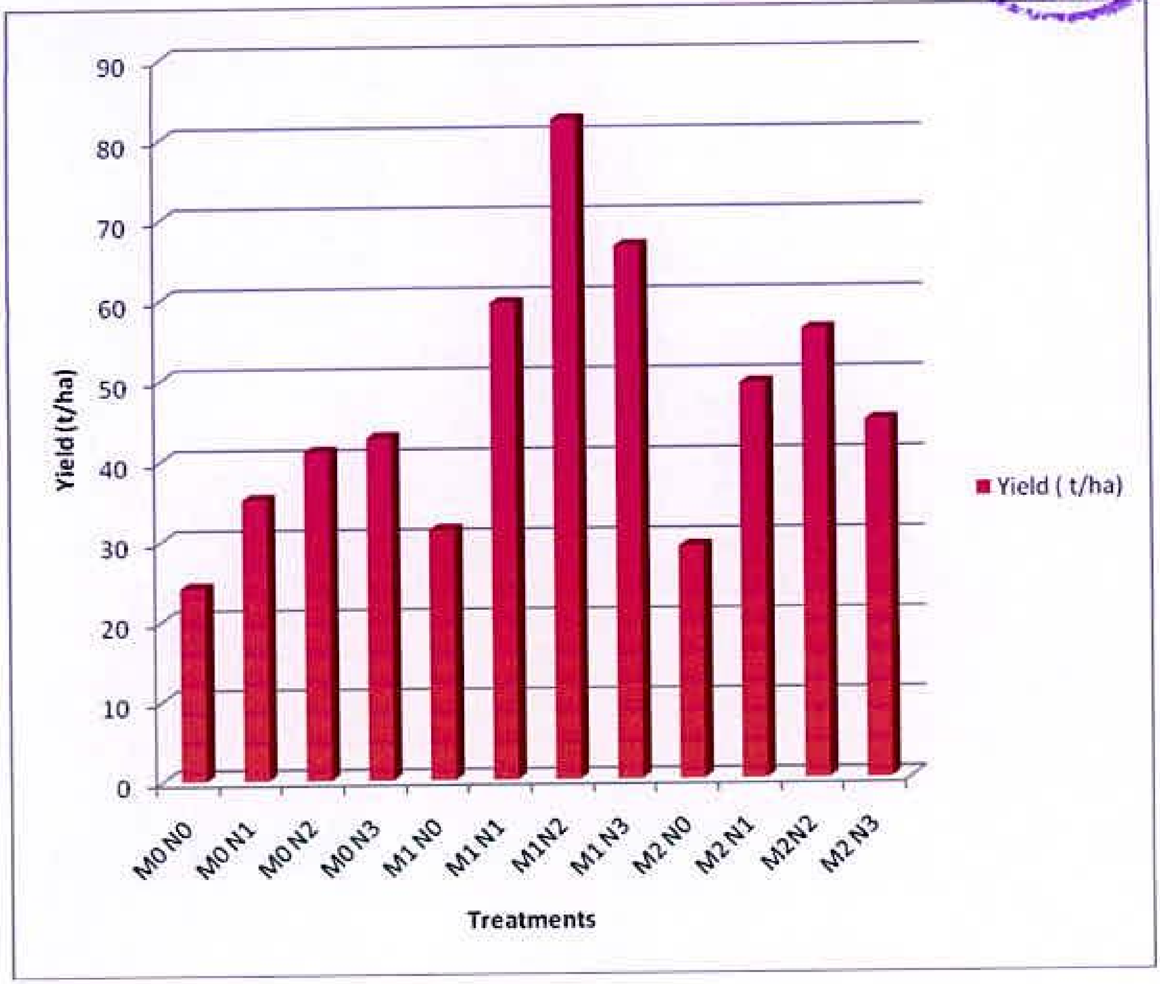

Figure 5 Combined effects of different levels of nitrogen and different mulching on the yield of tomato

N_0: 0 kg N/ha
N_1: 460 kg N/ha
N_2: 480 kg N/ha
N_3: 500 kg N/ha

M_0: No mulch
M_1: Black polythene
M_2: white polythene

CHAPTER 5

SUMMARY AND CONCLUSION

The present experiment was carried out at the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka-1207 to find out the effect of mulching and nitrogen fertilizer on the growth and yield of tomato during the pried from October 2007 to March 2008. The experiment consisted of three different types of mulches (No mulch, Black polythene and White polythene) and fou r levels of nitrogen (viz. 0, 460, 480 and 500 kg N/ha).

The two factors experiment was set up in Randomized Complete Block Design (RCBD) with three replications. In total, there were 12 treatment combinations in this study. A unit plot was 3-m×2 m and the treatments were distributed randomly in each block. The experimental plot was fertilized at the rate of 10 tons cow dung, 450 kg (TSP) and 500 kg of MP per hectare, along with Nitrogen as per treatment. Healthy and uniformed sized 30 days old seedlings were taken separately from the seedbed and were transplanted in the experimental field on 28 November 2007. Five plants were randomly selected for data collection from each plot. Data on growth and yield parameters were recorded and analyzed statistically. The differences were evaluated by Least Significant Difference (LSD) test.

Mulching has any significant influence on the plant height, leaf length, and leaf breadth and fruit diameter of tomato. The highest plant height (83.467 cm), leaf length (31.29 cm), leaf breadth (23.20 cm) and fruit diameter (4.96 cm) were obtained from the application of M_1 (black polythene). Mulching had a significant influence on the length of fruit. The maximum fruit length (6.33cm) and fruit diameter (4.96 cm) were obtained from M_1. Different mulching non-significantly influenced the number of leaves, primary branches, secondary branches, cluster and flowers. The maximum number of leaves (15.25), primary branch (11.83), secondary branch (10.73), cluster (17.02) and flowers (54.43) per plant were obtained from M_1. Different mulching showed significant influence on the number of fruits per plant also. The maximum number of fruits/plant (30.12) was obtained from M_1. Different levels of nitrogen non-significantly influenced the weight of fruit/plant. The maximum weight of fruit/plant (765.92 g) was obtained from M_1. The total yield of tomato differed significantly for different mulching. The maximum (35.69 kg/plot and 59.83 t/ha, respectively) yield of fruit was recorded from M_1 and the minimum (20.62 kg/plot and 35.75 t/ha) was obtained from no mulching (M_0).

Nitrogen had significant influence on the plant height, length of leaf and breadth of leaf. The highest plant height (86.1 6 cm), length of leaf (31.17 cm), breadth of leaf (24.87cm) were obtained from application of 480 kg N/ha (N_2). Nitrogen had significantly influenced the length of fruit and diameter of fruit. The maximum fruit length (6.16 cm) and diameter (5.22 cm) were obtained from the application of (N_2). Different levels of nitrogen did not significantly influence number of leaves, primary branches, secondary branches, cluster and flowers. The maximum number of leaves (14.93), primary branch (11.83), secondary branch (10.43), cluster (15.16) and flower (54.11) per plant were obtained from the application of (N_2). Different levels of nitrogen significantly influenced the number of fruits/plant. The maximum number of fruits/plant (26.67) was obtained from the application of (N_2). Different levels of nitrogen also significantly influenced weight of fruit/plant. The maximum weight of fruits/per plant (779.44 g) was obtained from the application of (N_2). The total yield of tomato showed significant difference due to the application of different levels of nitrogen. The highest yield of fruit (35.72 kg/plot and 59.73 t/ha, respectively) was obtained from N_2 and the control treatment (N_0) produced the lowest (16.89 kg/plot and 28.13 t/ha, respectively) in this respect.

Combined effect of nitrogen and mulching showed a significant variation in terms of plant height at different days after transplanting. The highest (89.87 cm) plant height was recorded at 80 DAT from N_2M_1 (480 kg N/ha + black polythene mulch). A significant variation was also found due to combined effect of nitrogen and mulching in terms of growth, yield and yield components of tomato. The maximum number of leaves (16.33), primary branch (13.40), secondary branch (12.67), cluster (19.05), flower (70.87), fruits (35.53) per plant and the highest leaf length (33.00 cm), leaf breadth (26.83 cm), fruit length (6.97 cm), fruit diameter (5.31 cm) fruit weight per plant (860.00 g) were recorded from N_2M_1. The maximum (48.85 kg/plot and 82.25, respectively) yield of fruit was also recorded from N_2M_1 (480 kg N/ha + black polythene mulch), while N_0M_0 (0 kg N/ha + no mulching) gave the minimum (14.49 kg/plot and 24.10 t/ha, respectively) yield of fruit.

Considering the situation of the present experiment, further studies in the following areas may be suggested:

1. Such study is needed in different agro-ecological zones (AEZ) of Bangladesh for regional adaptability and other performance.
2. Another level of Nitrogen fertilizer may be included for drawing conclusion.
3. Another mulching material may be used for further study.

REFERENCE

Agele, S. O., Iremiren, G. O. and Ojeniyi, S. O. 1999. Effects of plant density and mulching on the performance of late-season tomato (*Lycopersicon esculentum*) in southern Nigeria. *J. Agri. Sci.* **133**(4): 397- 402.

Ahmed, S. U. and Shaha, H. K. 1976. Effect of different levels of Nitrogen, phosphorus and potassium on the yield of four tomato varieties. *J. Punjub Veg. Grow.* **21**:16-19.

Ali, M., Alam, Z. and. Akondo, A. M. 1994. Grafting, a technique to control soil born diseases of tomato and eggplant. IPSA. JICA Project. Publication no.4. IPSA, Gazipur, Bangladesh.

Ali, S. M. and Gupta, B. K. 1978. Effect of N, P and K fertilizer on Tomato(*Lycopersicon esculentum*). *Indian J. Hort.* **8**(12): 942.

Amador, B. S. M. and. Vives, L. 1978. The soil temperature under different mulches and its action on tomato (*Lycopersicon esculentum*) production. Bulletion technico, Faculted de Agronomia. Universidad de costa Rica, **11**(5): 25.

Anonymous, B. S. M and Vives, L. 2004. Effect of irrigation and nitrogen on tomato Annual Research Report of Soil Science Division, BARI Joydebpur, Gazipur. pp. 14-17.

Asiegbu, J. E. 1991. Response of tomato and eggplant to mulching and nitrogen fertilization under tropical conditions. *J. Scientia-Horticulturae.* **46**: 1-2, 33-41; 13.

Baldev, S., Aujla, T. S., Sandhu, B. S., Kher, K. L. and Singh, B. 1988. Response of autumn potato(*Solanum tuberosum*) *J. Indian Agri. Sci.* **58**(7):521-524.

Banerjee, M. K., Balyan, D. S., Kallo, G., Singh, A. and Sain, P. S. 1997. Effect of Nitrogen fertilizer and planting pattern on fruit yield of Tomato CV. Hisar Lalmia. *J. Crop Res.* **14**(3): 441-446.

BBS. 2004. Statistical yearbook of agricultural statistics of Bangladesh, Statistics Division Ministry of Planning. Govt. of the Peoples Republic of Bangladesh, Dhaka. p. 89.

Bhatnagar, D. K. and. Pandita, M. L. 1981. A note on the effect of Nitrogen, phosphorus and spacing on growth and yield of tomato cultivar HS-102. *Haryana J. Hort. Sci.* **8**(1/2): 73-75.

Bhatnagar, D. K., Singh, G. P., Singh, J. P. and Singh, B. P. 1980. Studies on the storage behavior of different tomato cultivars. *Hariana agric. Univ. J. Res.* **10**: 5-9.

Biswas, P. K. 1993. Effects of different mulches on the production of tomato(*Lycopersicon esculentum* Mill.).M.S. Thesis Dept. of Crop Botany BAU Mymensingh. p. 41.

Bleyaert, J. Liptay, A. and Nicholls, S. 1991. Nitrogen supply during greenhouse transplant production affects subsequent tomato root growth in the field. *Journal of the American Society for Horticultural Science*. **118**(3): 339-342.

Bose, T. K. and Son, M. G. 1990.*J. Vegetable crops in India*. Published by B. Mitra and Naya Prokash, 206 Bidhan Saroni,Cakcutta, India. p. 249.

Boyajieva, N. and Rankov, V. 1989. Effect of polymer aided tomato mulching on the soil biological activity. *J. Pochvoznanie I Agrokhimiya.,* **24**(4):79-85.

Bragugnolo, N. and Mielnniczuk, J. 1990. Soil mulching by wheat straw and its relation to soil temperature and moisture. *J. Revista Brasilariade Cinencia do solo*. **14**(5):369-373.

Buitellar, K. 1989. [Substance Red refkective film? Just forget it] Substract Rode reflective Vigrate witmar. *J. Groentetenen Fruit*. **45**(17):41.

Calvert, A., 1957. Effect of the early environment on development of flowering in the tomato. I. Temperature. *J. Hort Sci*. **32**:9-17.

Caron, J., Parent, L. E. and. Gosselin, A. 1991. Effect of nitrogen and salinity levels in the nutrient solution on the DRIS diagnosis of greenhouse tomato. *J. Communications in Soil Science and Plant Analysis*. 1991. **22**(9-10): 879-892.

Castellane, P. D., Araujo, J. A., Bortoli, S. A. and Gabarra, P. A. 1995. Influence of mulching and pest control on the yield and arthropods in tomato cv. Rio Grande. *J. Cientifica Jaboticabal*. **23**(2): 343-354.

Chang, G. F., Rong, Dong, Y. L., Binand, D. H. and Jung, Q. H. 1995. Effect of polychrestic agricultural nourishing paper membrane (Pan PM) on the growth and flowering of tomato and cucumber. *J. Acta agriculturae Boreali-Sinca*. **10** (4):119-122.

Channabasavanna, A. S., Havanagi, G. V. and. Setty, R. A. 1989. Effect of mulching and spacing on growth and yield of tomato. Current Research University of Agricultural Sciences Bangalore. **18**: 10, 144-146; 4.

Chen, Y. and Katan, J. 1980. Effect of solar heating of soils by transparent polythene mulching on their chemical prkooperties. *J Soil Sci*. **130**(5):271-277.

Chenulu, V. V. and Thakur, D. P. 1968. Survey for storage and market disease of certain fruits and vegetables in Delhi and control of soft rot due to *Rhizopus* spp. I.P.S. Bull.no. **4**: 65-70.

Chung, S. J., Seo, B. S. and Lee, B. S. 1992. Effect of nitrogen, Potassium levels and their interaction on the growth and development of hydroponically grown tomato. *J. Kor.Sci.* **33** (3):244-251.

Creamer, N.G., Bennett, M. A., Stinner, B. R. and Cardina, J. 1996. A comparison of four processing tomato production systems differing in cover crop and chemical inputs. *Journal-of-the-American-Society-for-Horticultural-Science.* **121**: 3, 559-568; 56.

Cuortero, J. and Fernandez, R. 1999. Tomato and salinity. *J. Scintia Hort.* **78**(1-4): 83-84.

Davino, M., Mauromicale, G., Nucifora, S., Sortino, O., Raccuia, S. and Urso, F.1996. Effects of mulching with polyethylene sheets of different characteristics on infestation by Bemisia tabaci, TYLCV infection and yield of tomato grown in greenhouses. *Colture Protette*. **25**(6): 73-79.

Devaun, A. and Haverkort, A. J. 1987. The effect of shifting planting dates and mulching on late blight (*Phytopthora infestens*) and draught stress of potato crops grown under tropical high land conditions. *J. Hort. Agric.*, **23**(3) 325-333.

Dimri, D. C., Gulshan, Lal and Lal, G. 1988. Effect of nitrogen fertilization, spacing and method of planting on yield parameters and quality of tomato cultivar Pant Bahar. *J. Vegetable-Science*. **15**: 2, 105-112; 7.

Doss, B. D., Turner, J. L. and Evans, C. E. 1981. Influence of tillage, nitrogen and rye cover on growth and yield of tomato. *J. Amer.Soc. Hort. Sci.***106** (1) 95-97.

El-Beheidi, M. A., El-Sherbeiny, A. A. and. El-Sawah, M. H. 1990. Influence of different irrigation methods and nitrogen fertilizer on tomato plants in new reclaimed sandy soils. *Egyptian-Journal-of-Horticulture*.**17**(1): 25-36.

FAO. 1997. Land resource Appraisal of Bangladesh for Agricultural Development Report 3: Agro-e-ecological regions of Bangladesh. Food and Agricultural Organization. Rome, Italy, pp. 212-221.

FAO. 2002. FAO Publication Year Book. Basic Data Unit. Division, FAO. Rome, Italy. 51: 125-127.

Feng, J. and Barker, A. V. 1992. Ethylene evolution and ammonium accumulation by tomato plants with various nitrogen forms and regimes of acidity. *Part I. Journal-of-Plant-Nutrition*. **15**(11): 2457-2469.

Fortnum, B. A., Decoteau, D. R., Kasperbauer, M. J. and Bridges, W. 1995. Effect of colored mulches on root knot of tomato. Phytopath., **85**(3): 312-318.

Gonzalez, J. M., Gomez, Z. and Alarze. 1993. The mulching system in tomato cultivation in Venezuela: initial results; proc. *J. Amer. Soc. Trop. Hort.***37**: 31-38.

Grela, L. M., Delgado, N. M., Jimenez, R. R., Huerres, P. C. and Grela, L. H. 1988. Effect of different nitrogen rates and plant spacing on growth and development of commercial tomato. *J. Centro-Agricola*, **15** (4)55-62.

Gunadi, N. and Suwandi. 1988. Effects of mulching and plant spacing on growth and yield of tomato var. Berlian. Buletin-Penelitian-Hortikultura. **16**: 2, 61-66; 4.

Gupta, A. and Shukla, V. 1997. Response of tomato (*Lycopersicon esculentum* Mill.) to plant spacing, nitrogen, phosphorus and potassium fertilizer. *Indian J. Hort.* 33-34; 270-276.

Harris, R. E. 1965. Polythene covers and mulches for corn and bean production in northern regions. *J. Hort. Sci.* **87**:288-294.

Hedau, N. K., Thakur, M. C., Mahesh, Kumar, Mandal, J. and Kumar, M. 2001. Effect of nitrogen and mulching on tomato. *J. Annals-of-Agricultural-Research.* **22**: 3, 404-407; 4.

Hedge, D. M. 1997. Nutrient requirements of solanaceous vegetable crops. Food and Fertilizer Technology Center for the Asian and Pacific Region Extension Bulletin, Taipei, 441:9.

Hegwood, C. P., Hudson, P., Snyder, R. G. and Nagel, D. 1995. Comparisons of fertilization, mulching and tillage systems for field tomato production. International-Water-and-Irrigation Review. **15**(4): 8-10.

Hooda, R. S., Jitendra, Singh, Malik, Y. S. and. Batra, V. K 1999. Influence of direct seeding, transplanting time and mulching on tomato yield. *J. Vegetable-Science.* **26**(2): 140-142.

Hundal, I. S., Sandhu, K. S. Daljeet, Singh and Sandha, M. S. 2000. Effect of different types of mulching and herbicidal treatments on plant growth and yield in tomato (Lycopersicon esculentum L.). *Journal of Research, Punjab Agricultural University.* **37**(3/4): 184-189.

Hundal, I. S., Sandhu, K. S. Daljeet, Singh, Sandha, M.S. and Singh, D. 2000. Effect of different types of mulching and herbicidal treatments on nutrient uptake in tomato (Lycopersicon esculentum). *Haryana Journal of Horticultural Sciences.* **29**: 3-4, 242-244; 5.

Ifnekwe, O. P. and Tong, D. D.1987. Effect of mulch on dry-season yields of 10 potato varieties in the Jos Plateau of Nigeria.Ottawa Canada Int. Dev.Res Cent. 70-72 ISBN O-88936-498-2.

Incalcaterra, Barrell, P. J., Yongjin-Shang, Cooper, P. A. and Conner, A. J. 2004. Effects of transparent polyethylene mulching and different planting densities on tomato grown for processing in Sicily. *J. Annals of Applied Biology*. **140**(2): 197-205.

Islam, M. A., Farooque, A. M., Siddiqua, A. and Siddique. 1997. Effect of planting patterns and different levels on yield and quality of tomato. Bangladesh *J. Agric. Sci.*, **24**(1)9-15.

Kaniszewski, S. and Elkner, K. 1987. Effect of nitrogen fertilization and irrigation on yield and fruit quality of 2 staked tomato cultivars. Biuletyn-Warzywniczy. (36): 85-94.

Kooner, K. S.and Randhawa. K. S. 1990. Effect of varying levels and sources of nitrogen on yield and processing qualities of tomato varieties. *J. Acta Horticulturae*. (267): 93-99.

Kumar, V., Bishnoi, O. P., Rao, V. U. M. Singh, D.and singh, S.1995. Biomass production in summer moong under various mulching treatments. Indian J. *plant Physiol.* **38**(1):94-96.

Laicheva, L. I. and Demkin. 1980. Effect of fertilizer on the yield and quality of cabbage and tomato under irrigation. Hopt. Abstr. **50**(9): 593.

Lal, R. 1989. Conservation tillage for sustainable agriculture: Tropics versus temocrate environments. *J. Adv. Agron*. **42**:147-151.

Lang, J., McNeal, B. L. Boote, K. J., Jones, J. W.and Locascio, S. J. 1984. Nitrogen stress effects on growth and nitrogen accumulation by field-grown tomato. *J. Agronomy-Journal*. **92** (1): 159-167.

Larouche, R., Vezina, L. P. and Gosselin, A.1989. Nitrogen concentration and photosynthetic photon flux in greenhouse tomato production. II. Nitrate reductase and glutamine synthetase. *Journal of the American Society for Horticultural Science*. **114**: 3, 462-465; 16.

Larson, W. E., Burrows, W. C. and Wills, W. O. 1960. Soil temperature, soil moisture and corn growth, as influenced by mulches of crop residues. *J. Soil Sci. Soc. Amer. Proc.* **27**:350-353.

Lourduraj, A. C., Sreenarayanan,V. V., Rajendran, R., Ravi, V., Padmini, K. and. Pandiarajan, T. 1996. Effect of plastic mulching on tomato yield and economics. *J. South Indian Horticulture*. **44**(5/6): 139-142.

Lyimo, H. F. J., Tiluhongelwa, T. D. M., Maerere, A. P. and Njau, P. 1998. The effect of mulching and staking on the development of early and late blights of tomato. *Tanzania Journal of Agricultural Sciences*. **1**(2): 167-172.

Ma, Y. O. and. Han, Q. H. 1995. Effect of wheat straw mulching on the growth, development and yield of maize. *J. Acta. Agric. Borali-sincia.* **10**(1): 106-110.

Malik, Y. S., Batra, V. K., Hooda, R. S. and Jitendra-Singh; 1999. Influence of direct seeding, transplanting time and mulching on tomato yield. *J. Vegetable-Science.* **26**(2): 140-142

Manrijque, L. A. and Meyer, R. 1984. Effects of soil mulches on soil temperature, plant growth and potato yield in an aridic isothermoc environment in Peru. Turrialba. **34**(4):413-419.

Masson, J., Tremblay, N. and Gosselin, A. 1990. Effects of nitrogen fertilization on the growth of tomato and lettuce transplants in multicellular trays with and without supplementary lighting. *Canadian-Journal-of-Plant-Science.* **70**(4): 1199-1205.

Mccollum, I. and Atanasova, E. 1992. Uptake of nitrogen and changes in some biochemical components depending on the kind and amount of nitrogen source in tomato plants. *J. Pochvoznanie,-Agrokhimiya-i-Ekologiya.* **33** (6): 5-6.

Midan, A. A., Malash, N. M. and EL-Syed, M.M. 1985. Intensification and nitrogen fertilization in relation to tomato yield. *J. Ann.Agric.Sci.Fac. Agric.* Ainshams Univ., Cairo, Egypt **30** (2):1413-1431.

Mohapatra, B., Naik, P. and Lenka, D. 1999. Efficiency of plastic mulching in tomato. *J. Environment and Ecology.* **17**: 3, 775-776; 1.

Monks, C. D., Monks, D. W., Basden, T., Selders, A., Poland, S. and Rayburn, E. 1997. Soil temperature, soil moisture, weed control, and tomato (Lycopersicon esculentum) response to mulching. Weed-Technology. **11**(3): 561-566.

Mullins, C. A., Straw, R. A. and Rutledge, A. D. 1992. Tomato production with fertilization and black plastic mulch. *J. Tennessee-Farm-and-Home-Science.* No. 164, 23-28; 4.

Nassar, H. H. 1986. Effect of planting pattern, plant population and nitrogen laevels on yield and quality of tomato. *J. Acta Hort.*, **19** (5):435-442.

Oberly, A., Kushad, M. and Masiunas, J. 2002. Nitrogen and tillage effects on the fruit quality and yield of four tomato cultivars. *Journal of Vegetable Crop Production.* **8**(2): 65-79.

Ojeniyi, S. O., Agele, S. O. and Iremiren, G. O. 2000. Effects of tillage and mulching on the growth, development and yield of late-season tomato (Lycopersicon esculentum L.) in the humid south of Nigeria. *Journal of Agricultural Science.* **134**(1): 55-59.

Olasantan, F. O. 2000. Effect of nitrogen rate on okra and tomato in Gliricidia alley cropping system in South-western Nigeria. *J. Tropical Agricultural Research and Extension.* **3**(2): 110-114.

Patil, A. V. and. Basod, A. D 1972. Effect of different mulching treatments on soil properties, growth and yield of tomato (Var. Siouk). *Indian J. Hort.* **29**(2): 197-205.

Petrov, K. H. and Al-Amiri, M. 1976. Soil mulching early field tomato production. Gradinarstvo, **57**(6): 17-20.

Prabhakar, M., Vijaya, Savanur, Naik, C. L. and. Savanur V. 2001. Fertigation studies in hybrid tomato. Changing scenario in the production systems of horticultural crops. Proceedings of a National Seminar, Coimbatore, Tamil Nadu, India, 28-30 August 2001. *J. South Indian Horticulture*. 2001, 49: Special, 98-100; 3.

Prihar, S. S. 1986. Fertilizer and water use efficiency in relation to mulching. Indian *J. Agron.* **32**(4):452-454.

Quijada, J. S. 1990. Nitrogen nutrition of young tomato plants. Effects of various nitrogen concentrations on growth and development. *J. Acta-Horticulturae.* **5**(277): 167-177.

Rajbir-Singh and Basod, A. D. 2005. Effect of transplanting time and mulching on growth and yield of tomato. *J. Acta-Horticulturae-Sinica.* **29**(4): 333-336.

Ramalan, A. A., Nwokeocha, C. U. 2000. Effects of furrow irrigation methods, mulching and soil water suction on the growth, yield and water use efficiency of tomato in the Nigerian Savanna. *J. Agricultural Water Management*. **45**(3): 317-330.

Rhoads, F. T and Hafidh. 2002. The effect of tillage system and nitrogen application on fruit quality and total fruit yield of tomato (Lycopersicon esculentum). *J. Dirasat-Agricultural-Sciences*. **27**(1): 131-136

Rutledge, A. D., Adjanohoun, A., Hernandez, J. A and Berenguer, T. 1992. Rutledge-AD (1992). Effect of fertilization and black plastic mulch. Cultivos-Tropicales. **17**(2): 23-24.

Salam, A. 2001. Effect of different doses and time of application of Urea and Murate of Potash on the growth and yield of mukhi kachu. *J. Bangladesh Hort.* **18** (1 and 2):17-23.

Salukhe, D. K., Desai, B. B. and Bhat, N. R. 1987. Vegetable and flower seed production. *J. 1st Edn.,Agricole pub acad.*, New Dellhi India. p.135.

Sandha, M. S., Hundal, I. S., Sandhu, K. S, Daljeet Singh and Singh, D. Effect of different types of mulching and herbicidal treatments on nutrient uptake in tomato (Lycopersicon esculentum). *Haryana-Journal-of-Horticultural-Sciences.* **29**: 3-4, 242-244.

Sharma, J. P. and Mann, H. F. 1971. Studies on the effect of variety and level of nitrogen on plant growth and development and yield of tomato hybrids (Lycopersicon esculentum Mill.). *J. Annals of Agricultural Research.* **20**(4): 502-503.

Shrivastava, P. K., M. M. Parikh, N. G. Sawni and Rahman, S. 1994. Effect of drip irrigation and mulching on tomato yield. *J. Agril water management.* **25**(2): 179-184.

Shukla, V. and Nair, L. B. 1993. Agro Techniques for Solanaceous vegetables. *J. Advanced Hort.* **5**(1): 371.

Singh, H. S., Neeraj, Jain, Chauhan, P. K. and Shukla, K. N. 2000. Response of tomato under drip irrigation and plastic mulching. 6th-International-Micro-irrigation-Congress-Micro-2000,-Cape-Town,-South-Africa,-22-27-October-2000. 2000; 1-6.

Singh, K. and Kumar. 1969. Effect of Nitrogen and Phosphorus fertilization on the growth and yield of tomato. *J. Res. Ludhiana.* **6**: 764-768.

Singh, P. N., Joshi, B. P. and Singh, G. 1987. Effect of mulch on moisture conservation, irrigation requirement and yield of potato. Indian *J. Agron.* **32**(4):451-452.

Streck, N. A., Schneider, F. M., Buriol, G. A. and Heldwein, A. B. 1995. Effect of polythylens mulches on soil temperature and tomato yield in a plastic green house. *J. Scientia Agricola.* **52**(3) 587-593.

Subbiah, K.1990. Nitrogen and Azospirillum interaction on fruit yield and nitrogen use efficiency in tomato. *J. South Indian-Horticulture.* **38**(6): 342-344.

Suh, J. K. and Kim, Y. S. 1991. Studies of improvement of mulching, cultivar and method in Onion. Res. Rep. Rural Dev. Adm. Hort. **33**(3): 31-36.

Taja, H. and Vander-Zaag, P. 1991.Organic residue management in the hot tropics: influence on the growth and yield of solanum potato and maize. *J. Trop.Agric.,* **68**(2):111-118.

Varis, S. and George, R. A. T. 1985. The influence of mineral nutrient on fruit yield and quality in tomato. *J. Hort. Sci.* **60** (3):373-376.

Vazquez, N., Pardo, A., Suso, M. L. and Quemada, M. 2006. Drainage and nitrate leaching under processing tomato growth with drip irrigation and plastic mulching. *J. Agriculture, Ecosystems and Environment.* **112**(4): 313-323.

Vazquez, N., Quemada, M., Pardo, A. and. Suso, M.L 2002. Evaluation of nitrate leaching in relation to rate and frequency of irrigation in processing tomato. ITEA-. 2002; Extra(23): 107-118.

Wen, X. Z., Yagling, L. and Fengi, D. Z. 1997. Study on mechanism of perforated plastic film mulch increasing early and total yield of tomato. China vegetables, 2:9-11.

Widders, I. E. 1991. Absorption and translocation of foliar applied triazone-N as compared to other nitrogen sources in tomato. *Journal-of-Plant-Nutrition.* **14**(10): 1035-1045.

Wilhoit, J. H., Morse, R. D. and Vaughan, D. H. 1990. Strip tillage production of summer cabbage, using high residue levels. *J. Agric. Res.***5**(4): 38-342.

Xin, X. Y. L. J. Hui and Lili, H. 1997. The effect of N, P, and K mixed application on yields and quality of tomato in solar green house. *J. China Veg.* **4**:10-13.

APPENDIXES

Appendix I: Results of Physical and chemical properties of soil of the experimental plot

Physical properties (a)

Constituents	Percent
Sand,	32.45
Silt,	61.35
Clay,	6.10
Textural class	Sandy loam

Chemical analysis (b)

Soil properties	Amount
Soil pH	5.6
Organic carbon (%)	1.32
Total nitrogen (%)	0.075
Available P (ppm)	19.5
Exchangeable K (%)	0.2

Appendix II: Monthly Average Air Temperature, Total Rainfall, Relative Humidity and Sunshine Hours of the experimental site during the period from September 2007 to March 2008

Year	Month	Average Air temperature (^0C)			Total rainfall (mm)	Average RH (%)	Total Sun shine hours
		Maximum	Minimum	Mean			
2007	September	32.7	26.0	29.3	183	81	144
	October	30.5	24.3	27.4	417	80	142
	November	29.7	20.1	24.9	5	65	192.20
	December	26.9	15.8	21.35	0	68	217.03
2008							
	January	24.6	12.5	18.7	0	66	171.01
	February	27.1	15.8	21.05	09	66	168.60
	March	30.2	18.4	24.3	12	68	165.02

Source: Dhaka Metrological Centre (Climate Division)

Appendix III: Analysis of variance of the data on plant height of tomato as influenced of mulching and nitrogen fertilizer

Source of variance	Degrees of Freedom	Mean Square						
		Plant height						
		20 DAT	30 DAT	40 DAT	50 DAT	60 DAT	70 DAT	80 DAT
Replication	2	11.009	23.008	279.613	386.941	397.444	148.493	171.763
Factor A (Mulching)	2	49.431^{NS}	32.611^{NS}	18.013^{NS}	164.281^{NS}	96.214^{NS}	38.343^{NS}	182.61^{NS}
Factor B (Nitrogen)	3	29.758^{NS}	44.164^{NS}	45.003^{NS}	74.581^{NS}	57.661^{NS}	111.991^{NS}	165.296^{NS}
A × B	6	4.164*	7.842*	24.861*	34.893*	21.417*	7.352*	11.94*
Error	22	4.467	5.346	23.41	39.711	17.56	11.513	10.829

*Significant at 0.05% NS- non significant

Appendix IV: Analysis of variance of the data on number of leaves, leaf length, Breadth of leaf, Number of primary branch and Number of secondary branch of tomato as influenced of mulching and nitrogen fertilizer

Source of variance	Degrees of Freedom	Mean Square				
		number of leaves	leaf length	Breadth of leaf	Number of primary branch	Number of secondary branch
Replication	2	11.844	8.77	24.331	44.034	15.379
Factor A (Mulching)	2	19.214^{NS}	29.602^{NS}	4.733^{NS}	18.91^{NS}	31.118^{NS}
Factor B (Nitrogen)	3	6.27^{NS}	16.264^{NS}	32.459^{NS}	29.146^{NS}	14.627^{NS}
A × B	6	0.664*	3.014*	3.249*	11.313*	0.89*1
Error	22	1.138	3.979	4.346	70.519	1.999

*Significant at 0.05% NS- non significant

Appendix V: Analysis of variance of the data on number of cluster, number of flower, number of fruit, weight of ripe fruits per plant, Length of fruit, Diameter of fruit , yield per plot and Yield (t/ha)of tomato as influenced of mulching and nitrogen fertilizer

Source	Degrees of Freedom	Mean Square							
		number of cluster per plant	number of flower per plant	number of fruit per plant	weight of ripe fruits per plant	Length of fruit	Diameter of fruit	yield per plot (kg)	Yield (t/ha)
Replication	2	3.478	147.848	11.364	3382.861	0.22	0.385	61.592	195.873
Factor A (Mulching)	2	104.467^{NS}	295.808^{NS}	412.751*	59552.53*	3.598*	0.173*	688.072*	1778.475*
Factor B (Nitrogen)	3	18.947^{NS}	244.801^{NS}	62.867*	56525.37^{NS}	2.199*	1.268^{NS}	571.514*	1611.062*
A × B	6	17.9*	242.514*	69.537*	11375.23*	0.274*	0.131*	68.329*	178.759*
Error	22	4.974	45.261	5.272	1873.013	0.081	0.083	12.385	34.33

*Significant at 0.05% NS- non significant

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