INFLUENCE OF NITROBENZENE ON GROWTH AND YIELD OF TOMATO, BRINJAL AND CHILI

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CERTIFICATE

This is to certify that the thesis entitled ***"INFLUENCE OF NITROBENZENE ON GROWTH AND YIELD OF TOMATO, BRINJAL AND CHILI"*** *submitted to the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE in HORTICULTURE****, embodies the result of a piece of bona fide research work carried out by* ***FHAMIDA BINTA RAHMAN URME,*** *Registration No.* ***17-08246*** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

Date: December, 2018
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"A single tear caused by the remembrance of ALLAH brings a comfort to the heart that nothing in the Dunya can match"

DEDICATED TO

My Beloved Parents & Husband

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ABSTRACT

A field experiment was conducted at the Horticulture Farm, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka-1207 during October 2018 to March 2019 with of nitrobenzene application in different position of plant to investigate the growth and yield contributing characteristics of tomato, brinjal and chili. The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications and four treatments (T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar+Soil application). Significant variations were found in both plant height and leaf number of tomato. The highest branch number (10.3), SPAD value (55.2%), flower/cluster (18), flower number (50.3), fruit/cluster (6.6), fruit length (61.1mm), fruit diameter (49.5mm), fruit number (29.3), fruit weight (84.3g), yield/plant (2.5 kg) and yield/ha (96.5t) were found from T_{F+R} treatment whereas the lowest values were observed from T_C treatment. In case of brinjal, the maximum plant height, number of leaves, branch number (12.6), fruit length (18.85 cm), fruit diameter (48.6mm), single fruit weight (80.8g), SPAD value (56.6), flower/plant (40.8), fruit/plant (24.1) and yield/plant (37.8kg) were found from T_{F+R} treatment while the lowest value from T_C treatment. The highest growth and yield parameters of chili in plant height, leaf number, SPAD value (69.2), branch/plant (19.3), flower/plant (104.3), fruit/plant (86.7), fruit length (16.8cm), fruit diameter (11.8mm), single fruit weight (9.2g), yield/plant (799.0kg) and yield/ha (29.5ton) was observed from T_{F+R} whereas the lowest values of these parameters were found T_C treatment. From this experiment it can be concluded that application of nitrobenzene in root and foliar combination treatment was suitable for higher growth and yield of tomato, brinjal and chili.

CONTENTS

List of Figure

List of Plate

List of Table

CHAPTER I

INTRODUCTION

Vegetables are certain parts of plants that are consumed by humans as food as part of a meal. Originally, the traditional term (still commonly used, especially in biology) included the flowers, fruits, stems, leaves, Soils, bark, seeds, and all other plant matter, although the alternative modern-day culinary usage of the term vegetable may exclude foods derived from plants that are fruits, nuts, and cereal grains, but include seeds such as pulses; the term vegetable is somewhat arbitrary, and can be largely defined through culinary and cultural tradition. Vegetables make a major portion of human health diet. Though the vegetable requirement is 250g/day/person, we are able to meet about 30% of the requirement only (Samantaray *et al*., 2009). Tomato (*Lycopersicon esculentum*), brinjal (*Solanum melongena*) and chili (*Capsicum annuum*) are one of the most consumed and popular vegetables in Bangladesh. People use these vegetables in their everyday meal as well as making different types of pickle.

Tomato is widely grown vegetables both in winter season as well as summer in Bangladesh. It is a good source of Vitamin A and C and it provides antioxidant elements such as lycopene which prevents cancer (Sahu *et al*., 2013). Tomato contains a number of nutritive elements almost double as compared to fruit apple and shows superiority with regard to food values (Barman, 2017). Tomato is composed mainly of water (approximately 90%), soluble and insoluble solids (5-7%) citric acid and other organic acids, vitamins and minerals (Pedro, 2007). Tomato is also effective in curing morning sickness, excessive gas formation in the intestine, gastro intestine diseases, indigestion etc (Friedman, M., 2013). Tomato is also helpful in preventing joint pain

problems and the respiratory disorder. It ranks next to potato and sweet potato in respect of vegetable production in the world (Hossain, M. E., 2010). In Bangladesh, tomato is cultivated all over the country due to its adaptability to wide range of soil and climate (Kibria, M. G., 2013).

Brinjal is a widely adaptive and highly productive vegetable crop of tropical and subtropical regions world, which suffers from various abiotic and biotic stresses (Kaur *et al*., 2004). The crop is cultivated on small family farms and considered to be important source of nutrition and cash income for many resource poor farmers (Bose *et al*., 1993). In Bangladesh, it is one of the most common, popular and principal vegetable crops grown throughout the country. It is a versatile crop adapted to different agro-climatic regions and can be grown throughout the year. It is a perennial but grown commercially as an annual crop. Due to wide number of varieties, consumer preference being dependent upon fruit color, size and shape (Gopalan *et al*., 2007). The fruits are known for being low in calories and having a mineral composition beneficial for human health. They are also rich source of Potassium, Magnesium, Calcium and Iron (Zenia *et al*., 2008).

Chilies are native of Peru and Mexico and Portuguese were the first to introduce chilies in India during 15th century. Its cultivation became popular in the 17th century. Chili is rich source of vitamins A, C, E and P. Hundred gram of edible portion of capsicum provides 24k cal of energy, 1.3g of protein 4.3g of carbohydrate and 0.3g of fat (Anon. 2001). Vegetable production in Bangladesh is characterized by low yields and seasonal availability, which lead to low per capita availability and widespread micronutrient deficiency. A large number of vegetables in Bangladesh have been introduced & vegetable cultivation has become highly commercialized but still have great barrier in successful vegetable

production. Such as, the increased fruit drop, decreased percentage of fruit set, flower shedding, delay in flowering are the major problems lead to low production of vegetable crops in case of tomato, brinjal and chili. Above problems can be reduced by the use of growth promoting hormone. Nitrobenzene is a combination of nitrogen and plant growth regulators, extracted from sea weeds that act as plant energizer, flowering stimulant and yield booster (Aziz *et al*., 2009). Nitrobenzene produces best results in combination with plant growth regulators, which have capacity to increase flowering in plant and also prevent flower shedding. It is specially recommended for vegetable crops and flowering plants. Nitrobenzene is a new generation plant energizer and yield booster of low cost PGRs compared to others (Kohombange *et al*., 2017). It also increases uniform and profuse flowering, increase in flowering rate and improvement in the yield of flowers up to 20-40%, stimulates growth of flower parts & promotes early fruit setting, Induces fruit setting and growth in plants, stimulates cell elongation & promotes increase in yield on account of increase in fruit number and size.

Objective:

i. To find out the influence of nitrobenzene on growth and yield of tomato, brinjal and chili.

CHAPTER II

REVIEW OF LITERATURE

An experiment was conducted by T. Saraswathi *et al*. (2013) to study the comparative efficacy of growth regulators and panchakavya on growth, yield and biochemical constitution of tomato. It is well known that panchakavya plays a vital role in organic cultivation. Hence, the present experiment was laid out to determine the effect of this biostimulant on yield and quality in tomato. Recommended dose of fertilizers recorded highest yield. Next best results were obtained by combined spray of panchakavya (3%) + salicylic acid (100ppm) + nitrobenzene (150ppm); panchakavya (3%) alone and panchakavya (3%) + salicylic acid (100ppm). Results also revealed comparable performance of panchakavya over salicylic acid and nitrobenzene indicating, that, panchakavya can be utilized as an organic component to increase yield in tomato.

One experiment was conducted at Bangladesh Rice Research Institute farm and another experiment was conducted at farmer's field, Samantopur, Gazipur by Aziz *et al*. (2009) during the T. aman season in order to determine the performance of nitrobenzene on the growth and yield of wetland rice. The following four treatment combinations were tested in both site: T_1= Control (No-fertilizer), T_2= nitrobenzene @ 3ml/lit. of water, T_3= Soil Test Based (STB) dose and T_4= T_3 + Nitrobenzene @ 3ml/lit. of water. BRRI dhan 31 was used as test crop. The blanket doses of fertilizers were applied on soil test based (STB). The experiments were laid out in Randomized Complete Block Design with 3 replications of each treatment. The sources of N, P, K and S were Urea, TSP, MP and gypsum. Urea was applied into three equal

splits,1/3rd basal, 1/3rd maximum tillering stage and the remaining 1/3rd at panicle initiation stage. The treatment T_4 where chemical fertilizer was applied on STB in combination with nitrobenzene produced the maximum yield but in terms of economic point of view the treatment T_3 (STB) was found superior toother treatments.

Kohombange *et al*. (2017) conduct an experiment to examine the effect of various concentration of nitrobenzene (flowering stimulant and yield booster) on bell pepper yield. The study was conducted at a farmer poly tunnel located in Pilimathalawa (WU1), Sri Lanka. The experiment was laid out in a Completely Randomize Design (CRD) with four treatments randomized in three replicates. The treatments were T_1 – Control (without Nitrobenzene), T_2 – Nitrobenzene 15%, T_3 – Nitrobenzene 20%, T_4 – Nitrobenzene 25%. Plants were established in drip-fertigated bags in the Poly tunnel and standard crop management practices were applied throughout the study. Nitrobenzene was sprayed to the seedlings 40, 55, 80 and 105 days after planting. Albert solution, 6:30:30 fertilizer mixture 20:20 fertilizer mixture and Ca $(NO_3)^2$ were used as recommended fertilizers. Measurements were taken on flowering, fruit setting, yield as well as the quality of the fruits. The data obtained were tabulated and analyzed subjected to the Analysis of Variance (ANOVA) procedure of Statistical Analysis System (SAS). Duncan's New Multiple Range Test (DNMRT) was performed to compare the differences among treatment means at p=0.05. The highest number of fruits and flowers/plant was observed in T_3 and T_4, i.e. 20% and 25% Nitrobenzene applied treatments. On the other hand the lowest number of flowers as well as fruits were recorded from T_2 (15% nitrobenzene) and T_1 (control of the experiment). Among different treatments tested, 25% nitrobenzene

applied plants showed superior results in contrast to other nitrobenzene levels with enhancing flowering, fruit setting, yield quality as well as postharvest performances under greenhouse condition.

Kannan *et al*. (2009) field experiments on effect of growth regulators on paprika cv. KtPl-19 was carried out by using randomized block design at coconut garden of Tamil Nadu Agricultural University, Coimbatore. The greatest plant height was observed at NAA 50ppm at vegetative, flowering and harvest stages during winter and summer seasons. The application of GA_3at 50ppm showed the highest number of primary branches per plant during winter and summer seasons. The highest number of leaves per plant was observed with NAA at 50ppm in vegetative stage in both the seasons, at flowering stage GA_3 at 50ppm in winter and NAA at 50ppm in summer and at harvest stage GA_3 at 50ppm in winter and summer. Early flowering and highest fruit yield were achieved by the treatment with NAA 50ppm during winter and summer seasons. Based on the results, it can be concluded that NAA 50ppm had positive effect on plant growth, early flowering and yield potential.

An experiment was accomplished by Ahmad *et al*. (2017) in the Horticulture Farm of Department of Horticulture, Sher-e-Bangla Agricultural University to evaluate the influence of different plant growth promoters on growth and yield of JP-27 summer cherry tomato line. Four different growth promoters including control viz. F0= Control (Water), F_1= Nitrobenzene (Nitrobenzene 20% w/w) @ 2.5ml/L, F_2= 4-CPA @ 2.5ml/L and F_3= GA3 @ 200ppm was used in this experiment arranged in a Randomized Completely Blocked Design (RCBD) with three

replications. Maximum plant height, no. of leaves, no. of branches, days to first flower, no. of flowers, no. of fruits, fruit length, single fruit weight, yield/plant and yield/ha (194.5cm, 28.7, 12.7, 18.0, 48.3, 34.7, 19.9cm, 20.4g, 458.7kg and 19.0t respectively) were found in F3 treatment and maximum fruit diameter (40.7mm) were found in F2 whereas the minimum (179.7cm, 13.1, 5.7, 27.3, 36.3, 22.3, 13.5mm, 33.0mm, 10.6g, 287.9g and 13.2t respectively) were observed in F0. Thus, application of plant growth promoters for improving overall performance of cherry tomato produced in summer can be recommended.

Singh *et al*. (2000) indicated that yield and yield attributes of chili (*Capsicum annuum* var. longurn) cv. ReH-l were greatly influenced by the foliar sprays of urea (0.5, land 1.5%) and naphthalene acetic acid (25, 50 and 75ppm). Increasing concentrations of urea and naphthalene acetic acid increased per cent fruit set, fruit weight, per cent dry yield and yield ha'l and decreased fruit drop percentage, whereas time taken to 50% flowering was decreased by the higher concentrations of naphthalene acetic acid. The maximum yield was obtained with the treatment of 1.5% urea and 75ppm naphthalene acetic acid,

Kumar *et al*. (2014) conducted conducted an experiment with the objective to determine the effects of gibberellic acid (GA3) on growth, fruit yield and quality of tomato. The experiment consisted of one tomato variety- Golden, and six treatments with five levels of gibberellic acid (GA_3- 10ppm, 20ppm, 30ppm, 40ppm and 50ppm), arranged in randomized block design with three replications. The highest plant height, number of leaves, number of fruits, fresh fruit weight were

observed and ascorbic acid, total soluble solids (TSS) were estimated for GA_3 50ppm.

An experiment was laid out by Kumar *et al*. (2018) in randomized block design with three replications at horticultural research farm of Udai Pratap Autonomous College, Varanasi, Uttar Pradesh during year 2015-16. Max/min, temperature/humidity was measured 29 0C/12.4 0C, 89%/63%. The objectives are to study the effect of varying levels of NAA, 2, 4-D and GA_3 on growth, quality and yield of tomato and to ascertain the best concentration of NAA, 2, 4-D and GA_3 for vegetative growth and fruit quality of tomato. The experiment consisted tomato variety viz. kashivishesh (H-86) and different levels of NAA (15, 30, 45ppm), 2, 4-D (5, 10, 15ppm) and GA_3 (20, 30, 40ppm) of different concentrations were used. From the result it was observed that concentration of GA_3 @ 40ppm concentration showed significant effects on growth, flowering, yield and quality of tomato.

Ujjwal *et al*. (2018) studied to find out the response of foliar application of GA3 and NAA on vegetative and flowering attributes of tomato cv. Pusa Rohini. The two bio-regulators i.e. GA_3 and NAA ware used in different concentration i.e. GA_3 (20, 30, 40 and 50 ppm) and NAA (15, 20, 25 and 30 ppm) and Control (distilled water spray). All variables parameters related to vegetative growth and flowering parameters were significantly influenced by different concentrations of the plant bio-regulators. Results revealed that between both the growth regulators, the foliar application of GA_3 (50 ppm) registered significantly higher vegetative growth viz., plant height (101.45cm) & internodes length (6.20

cm) and flowering parameters viz., minimum number of days to first flowering (24.60) & maximum number of flower per plant (50.13) as compared to other treatments.

The experiment was conducted by Akshay Kumar Gocher *et al*. (2017) at the Horticulture Research Farm-I of the Department of Applied Plant Science (Horticulture) at Baba Saheb Bhimrao Ambedker University (A Central University), Vidya Vihar Rae Bareli Road, Lucknow. The present experiment on foliar application of GA_3 and Homa ash on growth and yield of Cape gooseberry were studied. The maximum plant height (64.75cm), number of branches (12.25) and internodal distance (7.75) are observed intreatment T_4 (400ppm gibberellic acid) followed by treatment T_3 (300ppm gibberellic acid) increased significantly compared to the control. It were observed that the maximum yield of fresh fruits (387.12g) was recorded in treatment T_4 400ppm GA3 followed by T_3 400ppm (356.32g), whereas minimum (161.60g) yield was recorded in treatment T_0 (Control).

A field experiment was carried out by Ranjeet *el al*. (2014) to assess the growth, flowering, fruiting yield and quality traits of Tomato cv. KASHI VISHESH (H-86). The experiment was laid out in randomized block design with three replications for tomato crop consisted of 10 treatments namely, Control, GA_3 20ppm, GA_3 40ppm, GA_3 60ppm, NAA 10ppm, NAA 20ppm, NAA 30ppm, 2, 4-D 10ppm, 2, 4-D 15ppm and 2, 4-D 20ppm to find out the effect of the growth, flowering, fruiting, yield and quality of tomato and various horticulture characters namely; plant height (cm), number of branches, number flowers per plant, number of clusters

per plant, number of fruits per clusters, number of fruits per plant, average fruit length (cm), average fruit diameter (cm), average fruit weight (g), fruit yield per plant (kg), fruit yield per plot (kg), fruit yield per hectare (q), acidity (%) and total soluble solids TSS (0Brix). However, application of the plant bio regulators had a significant influence on plant growth, flowering, fruiting, yield and quality traits of tomato and GA_3 gave the highest yield than other plant growth regulators. So, GA_3 was superior among all treatments under investigation for response tomato production.

Desai *et al*. (2012) find out the effect of different plant growth regulators and micronutrient on fruit characters and yield of tomato cv. GUJARAT TOMATO-3 (GT-3) at Horticulture Farm, Junagadh Agricultural University, Junagadh, Gujarat, India during 10 December, 2010 to 10 April, 2011. Eleven different treatments consisted of four plant growth regulators and three micronutrients were used, viz., T_1= gibberellic acid @ 50ppm, T_2= gibberellic acid @ 75ppm, T_3= naphthalene acetic acid @ 50ppm, T_4= naphthalene acetic acid @ 75ppm, T_5= boron 50ppm, T_6 = boron 75ppm, T_7=zinc 0.5per cent, T8= zinc 1per cent, T_9=iron 100ppm, T_{10}= iron 150ppm and T_{11}= Control (No application of plant growth regulator and micronutrients) in the study. The fruit characters and yield parameters in plant significantly differed due to different plant growth regulators and micronutrient on tomato. The maximum fruit length (7.57cm), girth (6.47cm) and pulp-seed ratio (12.93)was found in T_2= gibberellic acid @ 75ppm, whereas fruit weight (57g), yield plant-1 (2.47kg) and yield hectare^{-1} (913.258q/ha) were found in treatment T_4= naphthalene acetic acid @ 75ppm and the minimum for all the parameters were found in control treatment.

Mehraj *et al*. (2014) assessed the response of foliar application of GA_3 with different concentrations to cherry tomato plants. The assessment expressed that the foliar application of 200ppm gibberellic acid solution provided maximum number of leaves (16.7), tallest plant (70.0cm), early flower bud initiation (13.0 days), early flowering (16.0 days) and early fruiting (20.3 days); utmost fruit diameter (25.9mm) and number of fruits (105.0 fruits) per plant; maximum single fruit weight (11.1g) and total fruit weight (1.2kg) per plant, whereas the control was lowest.

Kobryń*et al*. (2002) observed three types of tomato were cultivated on rock wool using the following levels of nitrogen in the nutrient solution:140, 210mg N in 1 dm3 for the entire vegetation period or 140mg until 3 cluster were set and then 210mg. At the pick of fruiting samples of fruits were collected from all the analyzed combinations for chemical, physical and sensory analyses. The obtain results show that the fruit of cherry tomato contained the largest amounts of dry matter, total sugars, acids, vit. C, free amino acids, beta-carotene and flavonoids. They also obtained the highest grades in the sensory evaluation of the typical taste and tomato flavour. The cluster type had the largest amounts of lycopene; its fruits were hardest and had the most intensive colour as compared to cherry and large-fruit tomato. Nitrogen fertilization modified the content of the determined components in various ways, depending on the tomato type.

Jamal Uddin *et al*. (2014) find out growth and yield performance of potted Gerbera against foliar application of different concentration of Gibberelic acid (GA_3). Three varieties viz. V_1 (red), V_2 (brick red), V_3

(pink) and four GA_3 concentrations viz. G_0: 0ppm, G_1: 100ppm, G_2: 150ppm, G_3: 200ppm were evaluated in the experiment. Maximum number of flower (22.1), flower bud diameter (3.6cm), peduncle length (29.3mm), peduncle diameter (1.9mm) and flower head diameter (8.6mm) were found from V_2 while G_2 provided maximum number of flower (24.0), longest peduncle (28.3), maximum peduncle diameter (1.7) but G_2 and G_3 both provided maximum flower bud diameter (3.1mm) and flower head diameter (8.1mm). V_2G_2 was found as the best treatment combination.

Meliha *et al*. (2006) studied to test the effects of high concentrations of two growth regulators 2,4- dichlorophenoxy acetic acid (2,4-D) and 4-chlorophenoxy acetic acid (4-CPA) on fruit development in the tomato plant, was carried out. This plant is grown on a large scale in Turkey, contributing to and supporting the national economy. Our tests confirm that application of concentrations in excess of the recommended dosage produces deformed and inferior fruit, increases fruit number and incidence of parthenocarpy. The use of growth regulators led to an increase in the levels of the internal plant hormone indol-3 acetic acid (IAA) and decrease in abscissic acid (ABA) during early stages of fruit development.

Prajapati Vandana *et al*. (2014) studied on Effect of Spray Treatment of Plant Growth Substances at Different Stages on Growth and Yield of Sweet Pepper (Capsicum Annum L.) CV. Indra under Green House. The results revealed that among different spray treatment of plant growth substances, the maximum height of plant at 30 days after transplanting

(30.15cm) was found significant with spray of GA_3 50ppm (P_3).The minimum day taken for edible maturity was also superior with GA_3 50ppm. Whereas the maximum number of branches (5.52) and minimum days taken for initiation of flower (48.50 day) with ethrel 100ppm (P_7) treatment. The maximum fruit set (70.78%) was recorded with spray of GA3 25ppm (P_2). Regarding yield parameter, spray treatment of GA_3 50ppm (P_3) was superior with respect to average weight of fruit (96.58gm), yield/plant (1.84kg)and yield/ha (244.65q/ha). Among two stages of spray, S_2 (Spray at 20 days after transplanting) was recorded the maximum girth thickness of stem at 30 days after transplanting (0.47cm). Whereas S_1 (Spray at 20 days after sowing) was recorded initiation of first flower (49.96 day). No any beneficial effect on yield parameters.

Choudhury *et al*. (2013) studied the effect of different plant growth regulators on tomato during summer season 2011. Different plant growth regulators (PGR) viz. PGR = Control, PGR = 4-CPA (4-chloro phenoxy 0 1 acetic acid) @ 20ppm, PGR = GA (Gibberellic Acid) @ 20ppm and PGR = 4-CPA + GA_3 @ 20 ppm of each 2:3:3 were used in the study. The growth and yield contributing characters were significantly differed due to different plant growth regulators. The maximum plant height at 60 DAT (86.0 cm), number of flowers cluster per plant (10.60), number of flowers per plant (39.69), number of fruits per plant (36.54), single fruit weight (74.01g) and yield (28.40 t/ha) were found in PGR and the minimum for all the parameters were found in control (PGR) 1:3:0 treatment.

Zeng *et al*. (2009) studied on the effect of composite method of plant growth regulators, nitrogen fertilizer and planting density on the yield and quality of hot pepper. By means of orthogonal rotational combination design, a five - factor including N, Pix, NAA, PCPA and D and five - level experiment on hot pepper was conducted, and the effects of these five factors on the yield and quality of hot pepper were studied. The results indicated that there were significant effects of these five factors on the yield of hot pepper, and nitrogen fertilizer and density showed most notable effects among these factors, the levels of nitrogen, Pix and NAA markedly affected the content of capsaisin, and nitrogen, NAA and PCPA had distinctly effects on the content of Vc in fruit of hot pepper, and nitrogen, PIX, PCPA and NAA markedly affected the content of nitrate. In addition, there were complicated and distinct relationships between these factors, such as active and negative mutual actions.

Alam *et al.* (2002) reported that the spray application of NAA at variable concentration significantly increased the fruit yield of tomato, when compared to control. The nutrient contents were also increased in majority of cases. The tomato plants were sprayed with aqueous solution of 0, 5, 10, 15, 20 and 25mg NAA/L at flowering time. A 0.01 % Tween-80 as wetting agent was also used along with the NAA solution. The spray application of naphthalene acetic acid (NAA) had significant effects on increasing number of tomato/plants, weight of tomato per fruit and fruit yield/plant compared with control. The yield increase was due to retention of flower in the plants due to the application of different concentrations of NAA treatments.

Nisar *et al.* (2001) has been conducted an experiment that, both time and different concentrations of gibberellic acid (GA_3) had affected significantly the growth parameters of tomato plants. Maximum days to flowering (42.67), fruit per plant (77.69), plant height (77.78cm), fruit weight (71.15g), number of branches (12.33) per plant and total yield (26840kg/ ha) were recorded in the plants sprayed with 60mg/lit of gibberellic acid 10 days before transplantation, while minimum values were noted in controlled treatment. Maximum fruit drop per plant was found to control treatment and minimum for the plants treated with gibberellic acid at 6Umg/lit. It is suggested that tomato should be supplied with gibberellic acid at 60mg/lit. 10 days before transplantation under the agro-climatic conditions of Peshawar.

Masroor *et al.* (2006) performed a pot experiment according to a factorial randomized design at Aligarh to study the effect of 4 levels of gibberellic acid spray (0, 10-8, 10-6 and 10-4 M GA_3) on the growth, leaf-NPK content, yield and quality parameters of 2 tomato cultivars *(Lycopersicon esculentum*), namely Hyb-SC-3 and Hyb-Himalata. Irrespective of its concentration, spray of gibberellic acid proved beneficial for most parameters, especially in the case of Hyb -SC-3.

In this study, 0, 15, 30, 60 and 90ppm doses 4-CPA were applied by one or twice on opened flowers of F-144 (Fantastic) tomato variety grown under greenhouse (Ozgtiven, 2000). At the end of experiment, the yield per plant, fruit shape, and quality were investigated. In addition to these, amounts of 4-CPA residue into ripened fruits were analyzed by using densitometric TLC method. According to the results, the highest yield per

plant and good quality fruits was obtained 60-ppm doses of 4-CPA applied twice. 4-CPA analyses determined by densitometric method after TLC has shown that 4-CPA in the ripened fruits were not detectable at ng level.

Hidekazu *et al.*(2005) studied the effects of plant growth regulators on fruit set of tomato *(Lycopersicon esculentum Mill.*) under high temperature were examined in a controlled environment and a field under rain shelter. Tomato plants exposed to high temperature (34/20°C) had reduced fruit set. Treatments of plant growth regulators reduced the fruit set inhibition by high temperature to some extent, especially treatment with mixtures of 4- chlorophenoxyacetic acid (4-CPA) and gibberellins (GAs). In the field experiment, tomatoes treated with a mixture of 4-CPA and GAs showed increased fruit set and the numbers of normal fruits (excluding abnormal types such as puffy fruit) were more than the plants treated with 4-CPA alone during summer.

Nothmann (2002) found that Growth regulator treatments (2, 4-D, 2.5 ppm) were given to winter tomato cultivars with different growth and flowering characteristics. The plants were grown in the cool season when flower drop is frequent and fruit development is slow and sometimes stops very early. All cultivars tested reacted favorably to 2, 4-D applications, each in its own distinct way. Fruit set and development were much improved, especially in cultivars whose development was more affected by the unfavorable growing conditions of the cool season. Differential responses in fruit set and in fruit growth were recorded, but fruit growth was improved very much even when the effect on fruit set

was restricted. Only on 2, 4-D treated plants did all or most of the fruits reach adequate size.

Salma *et al*. (2016) execute an experiment on Effect of Foliar Application of Oligo-chitosan on Growth, Yield and Quality of Tomato and Eggplant. Three levels of oligo-chitosan concentration viz. 0 (control), 60 and 100ppm. O-chitosan was sprayed five times after sowing in this experiment. From this experiment it was revealed that plant height and number of flowers plant^{-1} increased with increasing concentration of chitosan till 100ppm. Treatments with 60 and 100ppm O-chitosan were effective in increasing total yield plot G1 of tomato (41.67 and 38.30kg, respectively) than control (22.79kg). In tomato, the acidity and protein content has been significantly ($p<0.05$) decreased from plant treated with 60ppm chitosan whereas 100ppm chitosan treatment significantly ($p<0.05$) increased protein content in eggplant. There were no significant differences between 60ppm chitosan treatment and control on ash and p^{H} value of tomato and eggplants. Chitosan treatment (60 and 100ppm) significantly ($p<0.05$) decreased total soluble solids (TSS) content in tomato but showed reverse phenomenon in eggplant. Higher dose of chitosan reduced vitamin C content in both tomato and eggplant although 60ppm increases vitamin C compared to control in tomato. The powerful antioxidant (phenolic content) component has been found to be increased ($p<0.05$) significantly with chitosan treatment in eggplant but decreased only with lower dose in tomato.

Mahindre *et al*. (2018) conducted an experiment on –Effect of different concentration of plant growth regulators on growth and quality of green

chili‖ at Chili and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *kharif* season of 2016-2017. The experiment consists of ten treatment comprising plant growth regulators and their mode of application and was laid out in randomized block design having three replications. There were three plant growth regulators were use with different combinations and were applied by foliar application at 30 DAT, 60 DAT, 90 DAT to assess the effect on growth and quality of green chili. The investigation revealed that, the vegetative growth observations in terms of plant height of plant was produced in the treated with NAA at 50ppm and number of branches per plant were produced significantly the maximum due to application of CCC at 500ppm. The plant spread was found significantly the maximum when the treated with an NAA at 50ppm. As regards to the yield parameters which were recorded viz. fruits per plant of green chili were produced significantly the maximum due to an application of NAA at 50ppm concentration. As far as the fruit quality concern in terms of fruit length was observed significantly the maximum obtained an application of GA_3 at 50ppm, significantly the maximum fruit breadth was obtained with an application of CCC at 500ppm concentration and the other quality parameter like in respect to the chlorophyll content i.e. chlorophyll A, chlorophyll B and total chlorophyll were observed maximum when the treated with CCC at 500ppm concentration.

CHAPTER III

MATERIALS AND METHODS

An experiment was conducted at Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh during the period from October, 2018 to March, 2019 to observe the influence of nitrobenzene on growth and yield of different vegetables. This chapter contains a brief description of location of the experimental site, climatic condition and soil, materials used for the experiment, treatment and design of the experiment, production methodology, intercultural operations, data collection procedure and statistical analysis etc. which are presented as follows:

Experimental site

The experiment was conducted at Horticulture Farm of Faculty of Agriculture, Sher-e-Bangla Agricultural University during the period from October, 2018 to March, 2019 to find out the influence of nitrobenzene on growth and yield of different vegetable crops. The location of the experimental site is 23°74′N latitude and 90°35′E longitude and at an elevation of 8.2m from sea level.

Climatic condition

Experimental site was located in the subtropical monsoon climatic zone, set parted by heavy rainfall during the months from April to September (Kharif season) and scant of rainfall during the rest of the year (Rabi season). Also under the sub-tropical climatic, which is characterized by high temperature, high humidity, heavy precipitation with occasional gusty winds and relatively long in Kharif season (April-September) and plenty of sunshine with moderately low temperature, low humidity and short day period during Rabi season (October- March).

Characteristics of soil

The experimental soil belongs to the Modhupur Tract under AEZ No. 28 (UNDP- FAO, 1988). The selected experimental plot was medium high land and the soil series was Tejgaon (FAO, 1988). The characteristics of soil under experimental plot were analyzed in the SRDI, Soil Testing Laboratory, Khamarbari, Dhaka. The soil of the experimental field initially had a p^H of 6.5.

Experimental materials

Plantings materials

Brinjal (BARI brinjal 7), tomato (BARI tomato 14) and chili (Local) varieties were used for the present research work. The purity and germination percentage were leveled as above 80%. The genetically pure and physically healthy seeds were collected from Advanced Seed Research and Biotech Center (ASRBC), ACI Limited, Dhaka.

Treatments of the experiment

The experiment was conducted to evaluate of nitrobenzene on growth and yield of three different vegetables (tomato, brinjal and chili). The experiment consisted of single factor as follows:

Four nitrobenzene application levels

T_C= Control

T_F= Foliar application

T_R= Soil application

T_{F+R}= Foliar+Soil application

Design and layout of the experiment

The single factorial experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The treatments and replications of this experiment was 4 and 3 respectively so that 12 plots were arranged in each experiment. The whole experimental plots were divided into nine blocks for tomato, brinjal & chili. 25 days old seedlings for Tomato and Brinjal, 40 days old seedlings for Chili were transplanted in the bed.

Production methodology

Land preparation

The experimental plot was first measured and cultivated by a tractor in April, 2018. It was prepared by ploughing, cross ploughing followed by laddering. Weeding was done to remove unexpected plants from experimental plots. The soil was treated with soil insecticide Furfuran 5G to protect the young plants from the attack of soil insect such as cut worm, mole cricket etc.

Raising of seedling

Seedlings were raised in seedbeds of 3m × 1m size prepared on high land under the polythene tunnel at Horticulture farm. The seeds were sown in the seedbed on 26 October, 2018. After seed sowing furfuran 5G was dusted on the seedbed as a precaution against ants and cutworms.

Seedling transplanting and after care

Small pits were prepared earlier by removing the soil in individual plot and seedlings were placed followed by compaction of soil. Healthy, disease free and uniform sized seedlings were transplanted in the experimental plots on 26 November, 2018 maintaining spacing of 60cm x

40cm. The transplanted seedlings were shaded for three days with banana leaf sheath cuttings. The plants were irrigated every evening until they were fully established.

Intercultural operations

After transplanting of seedlings, various intercultural operations such as irrigation, weeding and top dressing etc. were accomplished for better growth and development of the brinjal and tomato seedlings.

Stalking

When the plants were well established, stalking was given to each plant by bamboo sticks to keep them erect.

Irrigation

Irrigation was given as when as necessary by observing the soil moisture condition. Irrigation was given throughout the growing period. The first irrigation was given 40 days after planting followed by irrigation 20 days after the first irrigation. Each plant was irrigated by a watering cane.

Weeding

Weeding was done as when as necessary. It was done at every 15 days interval after planting followed up to peak flowering stage. As the land was covered by plant canopy by that time weeding was discontinued. Spading was done from time to time specially to break the soil crusts and keep the land weed free after each irrigation.

Harvesting

Harvesting continued for about one month because fruits of different lines matured progressively at different dates and over long time. Fruits were

picked on the basis of horticultural maturity, size, color and age being determined for the purpose of consumption as the fruit grew rapidly and soon get beyond the marketable stage, frequent picking was done throughout the harvesting period.

Data collection:

The plants in each entry were selected randomly and were tagged. These tagged plants were used for recording observations for the following characters.

Plant height (cm)

The plant height was measured from ground level to tip of the plant expressed in centimeters at different days after transplanting and mean was computed.

Number of leaves per plant

The number of leaves per plant was counted from the selected plants and their average was taken as the number of green leaves per plant. It was recorded during different days after transplanting.

Leaf length (cm)

Leaf length was measured by centimeter scale. Mature leaf (from 4th node) were measured once at 60 days after transplanting and expressed in cm. Five mature leaves from each plant were measured and then average it after that mean was calculated.

Leaf width (mm)

Leaf width was measured by centimeter scale. Mature leaf (from 4th node) were measured once at 60 days after transplanting and expressed in

centimeters. Five mature leaves from each plant were measured and then average it after that mean was calculated.

SPAD value

Leaf chlorophyll content was measured by using SPAD-502 plus (plate 2c). The chlorophyll was measured at 4 different portion of the leaf and then averaged for analysis. Chlorophyll content expressed in percentage.

Total number of branches per plant

The total number of branches arising from the main stem above the ground was recorded during experimental period.

Number of flowers per plant

Total number of flowers was counted from the tagged plants of each treatment and variety and mean was computed.

Number of fruits per plant

Total number of fruits from different pickings during the cropping season was added and the appraisals were made for fruits per plant.

Fruit length (cm)

Length of five mature fruits at marketable stage was measured individually in centimeters from the base of calyx to tip of fruit using centimeter scale, when held vertically and the average was computed.

Fruit diameter (mm)

Five mature fruits at marketable stage were used to measure the diameter of fruit in millimeter (mm) using Digital Caliper-515 (DC-515) at the

widest point of the fruit. Average of five fruits diameter was expressed in millimeter (mm).

Single fruit weight (g)

Fruit weight was measured by an Electronic Precision Balance in gram. Total fruit weight of each treatment was obtained by addition of weight of the total fruit number and average fruit weight was obtained from division of the total fruit weight by total number of fruit.

Yield per plant (kg)

Yield/plant was calculated from weight of total fruit divided by number of total plants.

Statistical analysis

The recorded data for different characteristics were analyzed statistically using MSTAT-C program to find out the significance of variation among the treatments. The analysis of variance (ANOVA) was performed by F-test, while the significance of difference among the treatment means were evaluated by the Duncan's Multiple Range Test (DMRT) at 5% and 1% levels of probability (Gomez and Gomez, 1984).

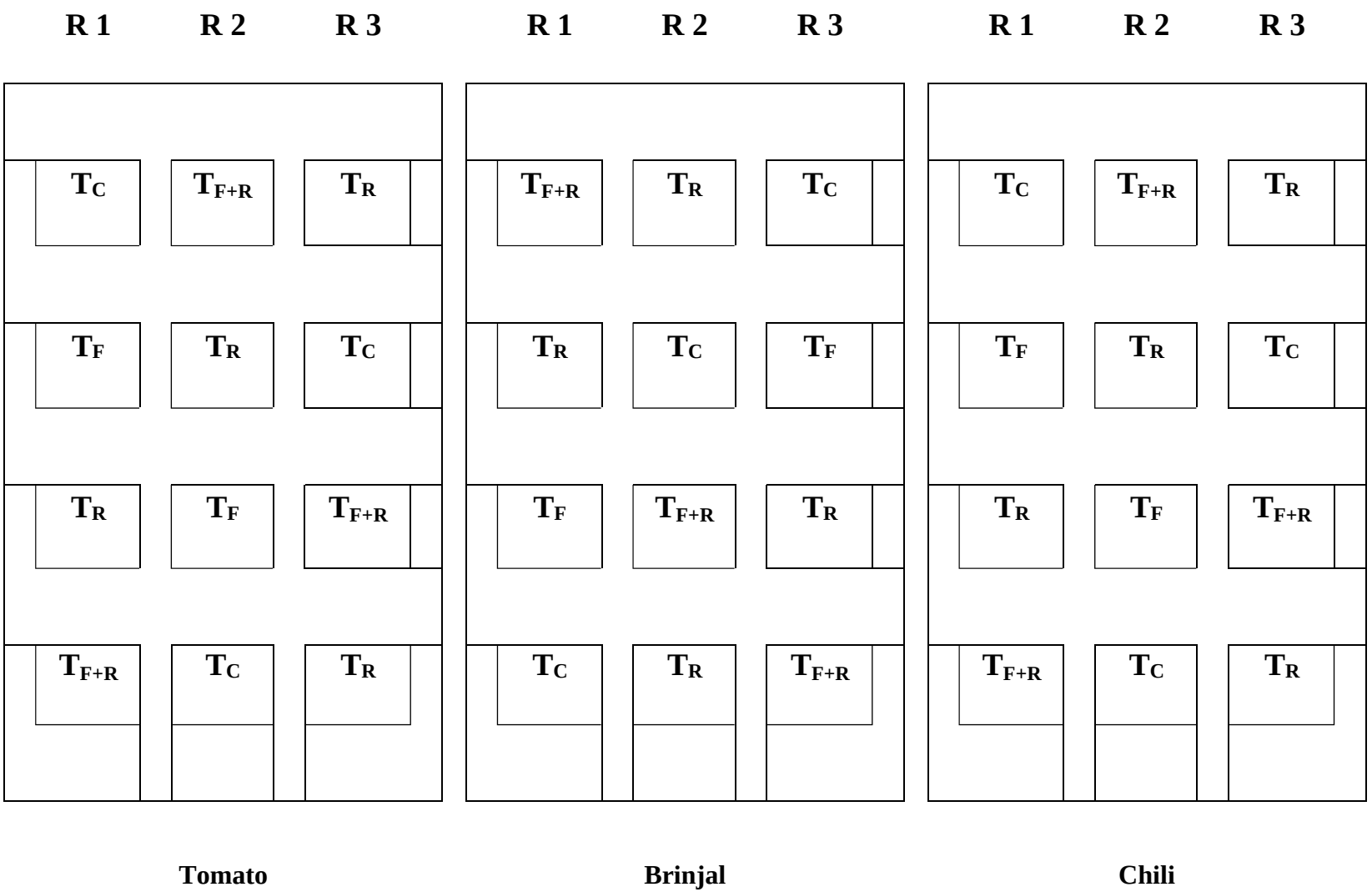


Fig 1. Sketch of the whole experimental plot

(a)

(b)

(c)

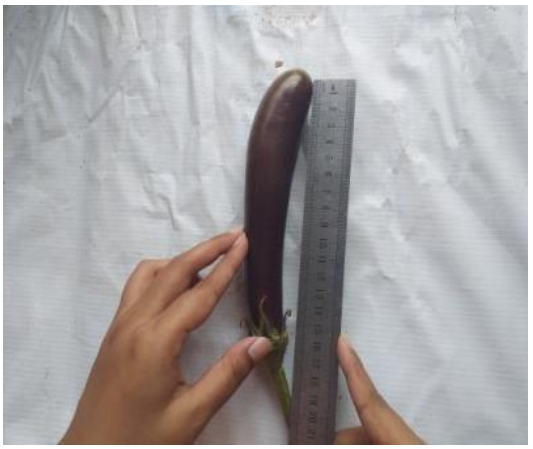
(d)

(e)

(f)

Plate1. Some pictorial view of this experiment (a-c) Seedlings of Chili, Brinjal and Tomato (d) data collection form experimental field (e) SPAD value determination (f+g) weight measurement.

(g)



(h)

(i)

(j)

(k)

(h) length determination (i) diameter measurement (j) weight of chili (k) pictorial view of experimental plot.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter comprises the presentation and discussion of the results obtained from the present study. The results have been presented, discussed and possible interpretations were given in the tabular and graphical forms. The results obtained from the experiment also have been presented under separate sub-headings as follows.

Exp. 1. Growth and yield attributes of tomato an influenced by application of nitrobenzene

Plant height (cm)

It is considered that plant height is one of the important parameters, which is directly correlated to yield of tomato. Application of nitrobenzene in different positions showed significant impact on plant height of tomato (Figure 2). The tallest plant was found in T_{F+R} treatment at 25, 35, 45, 55 and 65 DAT whereas the shortest plant was recorded from T_C treatment in different DAT.

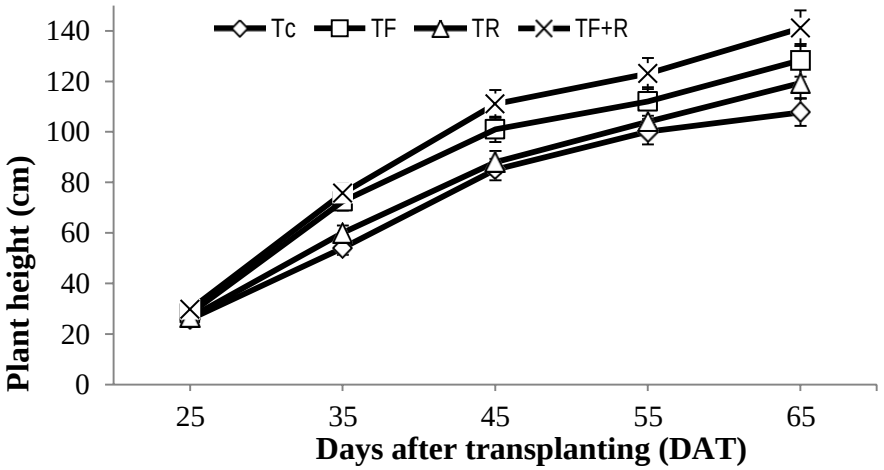


Fig 2. Plant height of tomato under different treatments.

T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar + Soil application.

Leaf number

Number of leaves in tomato was significantly influenced by nitrobenzene application under different treatments (Figure 3). The maximum number of leaves per plant was found from T_{F+R} treatment in 25, 35, 45, 55 and 65 days after transplanting whereas the lowest number of leaves observed in T_C treatment.

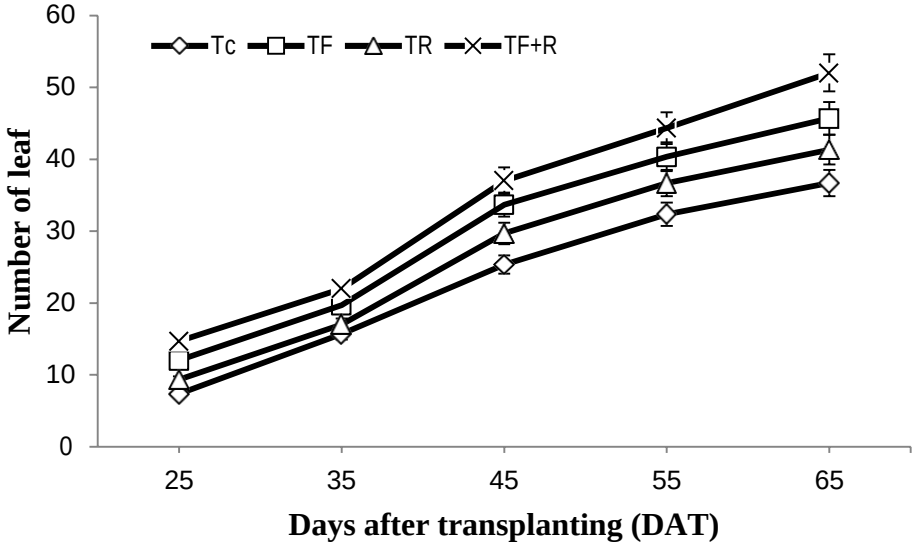


Fig 3. Number of leaves of tomato under different treatments.

T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar + Soil application.

Branch number

Significant variation was detected among treatments performance in terms of branch number. Branch number of Tomato exposed statistically significant inequality among T_C, T_F, T_R and T_{F+R} treatments. T_{F+R} (Foliar+Soil application; 10.3) were accorded topmost result in terms of branch number and it was statistically similar to T_F whereas T_C (Control; 5.3) was scored as inferior among others (Table 1).

SPAD value

Significant variation was received among the treatments in respect of spade value. Highest percentage was observed from T_{F+R} treatment (55.2 %) while lowest result in T_C treatment (46.3 %) (Table 1).

Flower cluster

Highly notable dissimilarity was found in tomato with respect to number of flower cluster. The higher number of flower cluster was recorded from T_{F+R} (18) treatment whereas the lowest number (9) of flower clusters was observed from T_C treatment (Table 1).

Flower number

Number of flower varies from treatment to treatments. The highest number of flower found from T_{F+R} treatment (50.3) whereas the lowest number was noticed from T_C treatment (33.6) (Table 1).

Flower/cluster

Different treatments significantly influenced the number of flower per cluster. The maximum flower per cluster (6.7 flower/cluster) was found from T_{F+R} treatment while the minimum flower per cluster (5.6 flower/cluster) was found from T_C treatment (Table 1).

Table 1. Branch number, SPAD value, number of cluster, flower number and flower per cluster of tomato under treatments.

	Branch		SPAD value		Cluster		Flower no.		Flower per cluster	
T_c	5.3	c	46.3	c	9.0	c	33.6	d	5.6	b
T_F	9.0	a	53.2	ab	16.3	ab	42.8	b	6.0	ab
T_R	7.3	b	47.9	bc	14.6	b	38.2	c	6.0	ab
T_{F+R}	10.3	a	55.2	a	18.0	a	50.3	a	6.7	a
CV(%)	10.2		5.7		7.8		4.4		11.9	
LSD	1.6		5.8		2.2		3.6		1.4	

T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar + Soil application.

Fruit diameter (mm)

Fruit diameter varies treatment to treatments. The highest diameter was observed from T_{F+R} treatment (49.5 mm) whereas the lowest one was found from T_C treatment (45.0mm) (Table 2).

Fruit length (cm)

The fruit length differs significantly with the change of different treatments. The largest fruit was found from T_{F+R} treatment whereas the smallest fruit was noticed form T_C treatment (Table 2).

Fruit number

Significant variation was recorded for fruit number among tomato under different position of nitrobenzene application. Results indicated that highest fruit number (29.3) was recorded from T_{F+R} treatment while T_C was the lowest flower (26.6) one. There was insignificant variation in T_F and T_R treatment (Table 2).

Fruit weight (g)

Significant variation was recorded for fruit weight among tomato in nitrobenzene application at different position of tomato plant. Results indicated that maximum fruit weight was recorded from T_{F+R} treatment (84.3g) while minimum from T_C treatment (82.3g) (Table 2).

Yield/plant (kg)

It was observed from the results that tomato yield statistically differed by means of the total fruit weight per plant due to nitrobenzene application at different position of tomato plant. Maximum yield per plant (2.5kg) was found from T_{F+R} treatment whereas the lowest yields form T_C treatment (2.2kg) (Table 2).

Yield/ha (t/ha)

There was significant variation in fruit yield per hector. Highest yield was observed from T_{F+R} treatment (96.5ton) while the lowest one from T_C treatment (89.6ton) (Table 2).

Table 2. Yield related attributes (fruit diameter, fruit length, fruit number, fruit weight (g), yield/plant (kg) and yield/ha of tomato under nitrobenzene application at different position of tomato plant

Treatment	Fruit diameter (mm)		Fruit length (cm)		Fruit number		Fruit weight (g)		Yield per plant (kg)		Yield per ha (t/ha)	
T_c	45.0	d	46.7	d	26.6	b	82.3	b	2.2	b	89.6	d
T_F	47.9	b	54.0	b	27.6	ab	83.8	ab	2.5	a	93.5	b
T_R	47.0	c	50.9	c	27.3	ab	83.0	ab	2.2	b	92.4	c
T_{F+R}	49.5	a	61.1	a	29.3	a	84.3	a	2.5	a	96.5	a
CV(%)	0.7		1.2		4.4		1.3		4.2		0.08	
LSD	0.6		1.3		2.4		2.3		0.2		0.1	

T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar + Soil application.

Exp. 2. Growth and yield attributes of brinjal an influenced by application of nitrobenzene

Plant height (cm)

Plant height of brinjal varied differently in different treatments of nitrobenzene. The tallest plant was found from T_{F+R} treatment whereas the shortest one from T_C treatment (Figure 4).

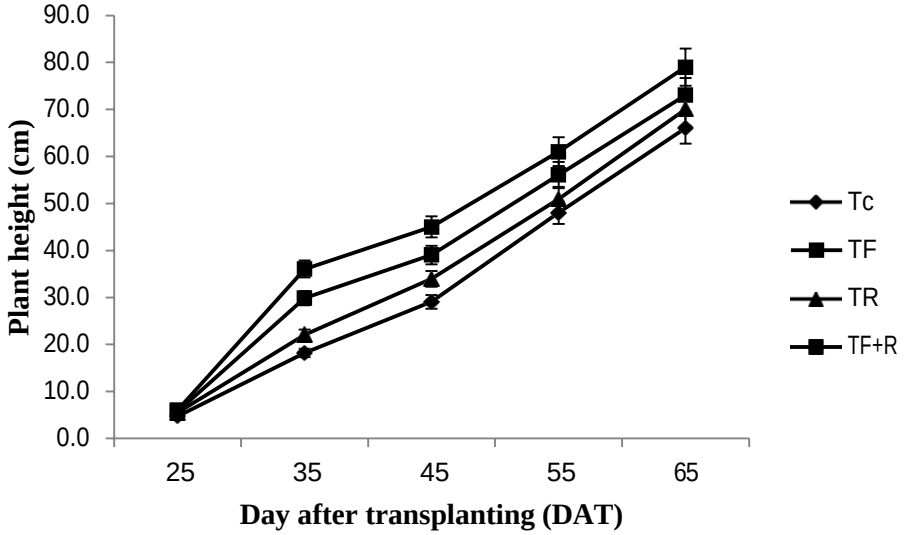


Fig.4. Plant height of brinjal at different treatments.

T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar + Soil application.

Leaf number

The Figure 5 shows significant variation of leaf number due to application of nitrobenzene at different position of brinjal. The maximum leaf number was counted from T_{F+R} treatment while the minimum leaf number was found from T_C treatment.

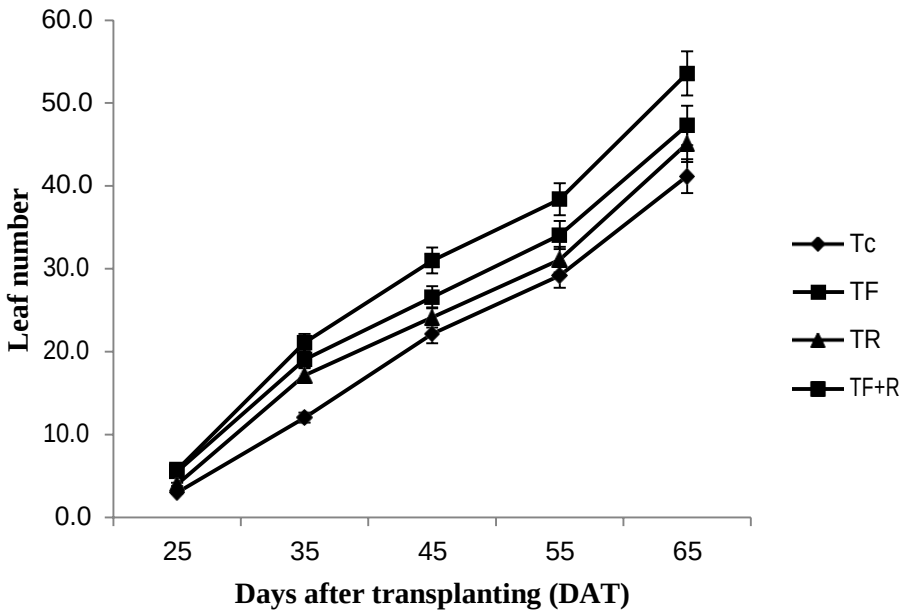


Fig.5. Leaf number of brinjal at different treatments.

T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar + Soil application.

Branch number

Significant variation was detected among treatments performance in terms of branch number. The highest leaf area was found from T_{F+R} treatment (12.7) while the lowest branch number from T_C treatment (7.0) (Table 3)

Fruit length (cm)

Fruit length of brinjal varied treatment to treatment. The largest fruit was observed from T_{F+R} treatment (18.5cm) whereas the smallest one (16.5cm) from T_C treatment (Table 3).

Fruit diameter (mm)

Fruit diameter was significantly differing from treatment to treatment. The highest fruit diameter was counted from T_{F+R} treatment (48.6mm)

while the smallest diameter was found from T_C treatment (44.5mm) (Table 3).

Fruit weight (g)

Fruit weight showed significant variation with nitrobenzene application at different position of brinjal plant. The highest fruit weight was found in T_{F+R} treatment (80.8g) followed by T_F treatment (77.0g) treatments and lowest one from T_C treatment (64.0g) (Table 3).

Table 3. Growth related attributes of branch number, fruit length, fruit diameter and fruit weight of brinjal under nitrobenzene application at different position

Treatment	Branch no.		Fruit length (cm)		Fruit diameter (mm)		Fruit weight (g)	
T_c	7.0	c	16.5	d	44.5	d	64.0	d
T_F	10.0	b	18.5	B	46.7	b	77.0	b
T_R	9.0	b	17.9	C	46.2	c	70.1	c
T_{F+R}	12.7	a	18.5	A	48.6	a	80.8	a
CV(%)	6.8		1.2		0.5		2.3	
LSD	1.9		0.6		0.5		3.4	

T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar + Soil application.

SPAD Value

Significant variation was recorded for spade value among different treatments. Results indicated that highest value was recorded from T_{F+R} treatment (56.6) while lowest from T_C treatment (41.5) (Table 4).

Flower number/plant

Number of flower per plant was exposed significant inequality with nitrobenzene application at different position of brinjal. The highest flower number was observed in T_{F+R} treatment (40.8) followed by T_F treatment (37.3) whereas minimum from T_C treatment (32.2) (Table 4).

Fruit number/plant

Fruit number was varied significantly with application of different treatments. Maximum fruit number of brinjal was found in T_{F+R} treatment (24.1) followed by T_F treatment (22.6) whereas lowest in control (20.1) (Table 4).

Yield/ha

The Table 6 shows that highest yield was found from T_{F+R} treatment (37.8t) and it was higher than T_F treatment (36.9t) whereas the lowest yield from T_C treatment (35.6t) (Table 4).

Table 4. Yield related attributes of Brinjal under application of nitrobenzene on different positions of plant

Treatment	SPAD Value		Flower No./plant		Fruit/plant		Yield (t/ha)	
T_c	41.5	d	32.2	d	20.1	d	35.6	d
T_F	52.6	b	37.3	b	22.6	b	36.9	b
T_R	47.8	c	35.6	c	21.2	c	36.5	c
T_{F+R}	56.6	a	40.8	a	24.1	a	37.8	a
CV(%0	0.6		1.1		2.3		0.2	
LSD	0.6		0.8		1.0		0.3	

T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar + Soil application.

Exp. 3. Growth and yield attributes of chili an influenced by application of nitrobenzene

Plant height (cm)

Plant height of chili varied differently in different treatments of nitrobenzene applications. The tallest plant was found from T_{F+R} treatment whereas the shortest one from T_C treatment. There was

insignificant correlation between T_R and T_{F+R} treatments at 40 days after transplanting (Fig 6).

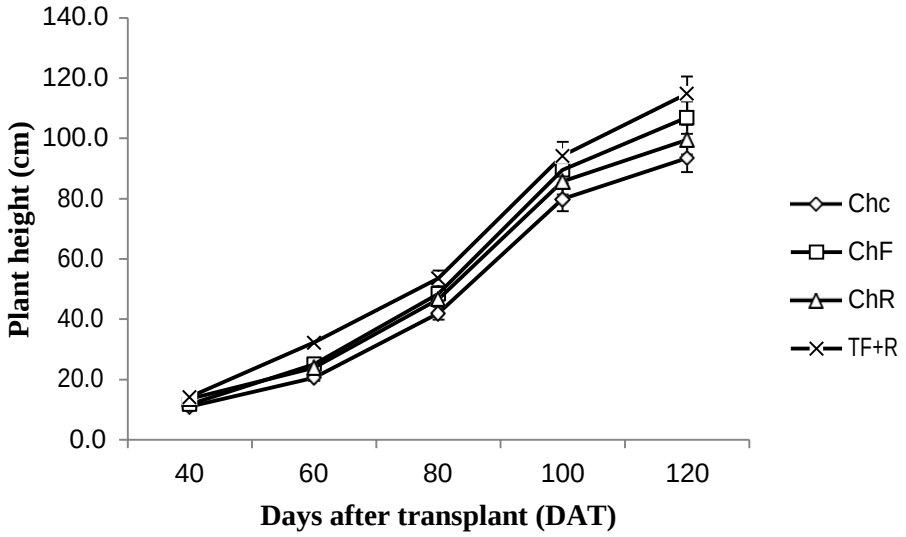


Fig6. Plant height of chili at different treatments.

T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar + Soil application.

Leaf number

The Figure 7 shows significant variation of leaf number due to application of nitrobenzene at different position of chili. The maximum leaf number was counted from T_{F+R} treatment while the minimum leaf number was found from T_C treatment.

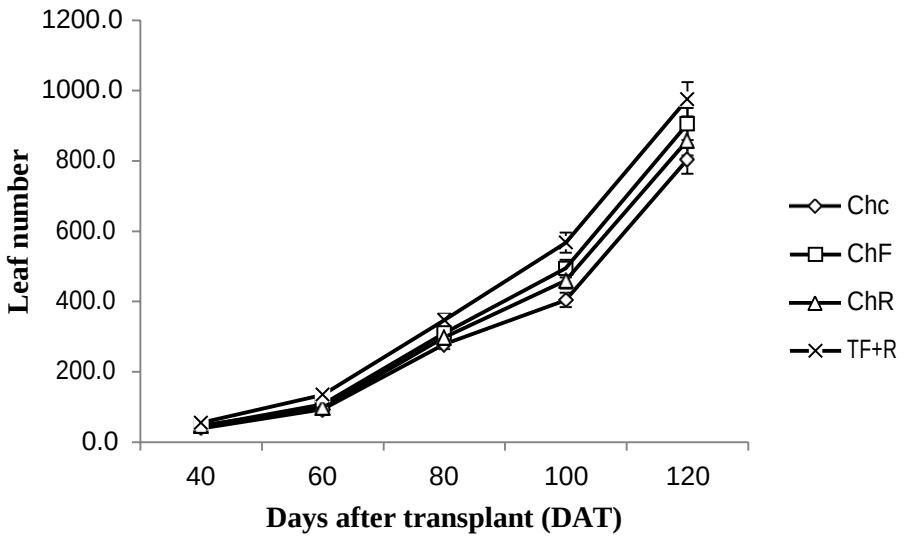


Fig7. Leaf number of chili at different treatments.

T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar + Soil application.

SPAD value

Significant variation was detected among treatments performance in terms of spade values. The highest value was found from T_{F+R} treatment (69.2) while the lowest leaf area from T_C treatment (49.6) (Table 5). There was insignificant correlation was observed from T_c and T_R treatment.

Branch/plant

Branch number of Chili varies treatment to treatment. The highest branch number was observed from T_{F+R} treatment (19.3) whereas the lowest one from T_C treatment (12.0) (Table 5).

Flower/plant

The number of flower directly correlated to yield of chili. The highest flower number was counted from T_{F+R} treatment (104.3) while the lowest number was found from T_C treatment (79.0) (Table 5).

Fruit/plant

Fruit per plant showed significant variation with application of nitrobenzene at different position of chili. The highest fruit number was found in T_{F+R} treatment (86.7) while lowest in control (77.7) (Table 5).

Table 5. Growth related attributes of SPAD Value, branch number, flower/plant and fruit/plant of chili under nitrobenzene application at different position

Treatment	SPAD Value		Branch/plant		Flower/plant		Fruit/plant	
Tc	49.6	c	12.0	d	79.0	d	77.7	b
TF	51.0	c	16.3	b	91.3	b	79.3	b
TR	58.8	b	14.7	c	88.0	c	79.0	b
TF+R	69.2	a	19.3	a	104.3	a	86.7	a
CV(%)	1.9		3.6		1.0		1.2	
LSD	2.1		1.1		1.9		1.9	

T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar + Soil application.

Fruit length (cm)

Significant variation was recorded for fruit length among different treatments. Results indicated that maximum fruit length was recorded from T_{F+R} treatment (16.8cm) while minimum from T_C treatment (13.8cm) (Table 6). There was insignificant variation was found from T_C and T_F treatment.

Fruit diameter (mm)

Fruit diameter was exposed significant inequality with nitrobenzene application at different position of chili. The highest diameter was

observed in T_{F+R} treatment (11.8mm) whereas minimum from T_C treatment (9.6mm) (Table 6).

Single fruit weight (g)

Single fruit weight varied significantly with different treatments. The highest single fruit weight of chili was found in T_{F+R} treatment (9.2g) and it was slightly higher than T_F treatment (8.9g) whereas lowest in T_C treatment (7.9g) (Table 6).

Yield/plant (kg)

The Table 6 shows that highest yield per plant was found from T_{F+R} treatment (799.0kg) whereas the lowest yield from T_C treatment (616.0kg).

Yield/ha

Yield per hector varies significant with different treatments. The highest yield was found from T_{F+R} treatment (29.5ton) whereas the lowest yield from T_C treatment (22.7ton) (Table 6).

Table 6. Yield related attributes of chili under different treatments

Treatments	Fruit length (cm)		Fruit diameter (mm)		single fruit weight (gm)		Yield/plant (kg)		yield/ha (ton)	
T_c	13.8	c	9.6	c	7.9	c	616.0	d	22.7	d
T_F	15.3	c	10.9	ab	8.9	a	709.0	b	26.2	b
T_R	15.0	b	9.9	bc	8.4	b	664.0	c	24.6	c
T_{F+R}	16.8	a	11.8	a	9.2	a	799.0	a	29.5	a
CV(%)	1.9		4.7		2.5		3.0		2.9	
LSD	0.6		1.0		0.4		42.3		1.5	

T_C: Control, T_F: Foliar application, T_R: Soil application, T_{F+R}: Foliar + Soil application.

CHAPTER V

SUMMARY AND CONCLUSIONS

The experiment was conducted at the Horticulture Research Farm of Sher-e-Bangla Agricultural University, Dhaka during October, 2018 - March, 2019 to investigate the influence of nitrobenzene on growth and yield of tomato, chili and brinjal. The seedling of tomato, chili and brinjal were collected from ACI biotech lab. The experiment consisted of single factor. Four nitrobenzene application level: T_C= Control, T_F= Foliar application, T_R= Soil application, T_{F+R}= Foliar+Soil application were used in this experiment. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Data on different growth and yield parameters were recorded.

Application of nitrobenzene on different positions of plant had significant impact on growth and yield parameters of tomato. The tallest tomato plant was found from T_{F+R} treatment which was application of nitrobenzene on both foliar and Soil position whereas the shortest one from T_C treatment (Control). Similarly, the maximum number of leaves was found from T_{F+R} treatment while the lowest one forms T_C treatment. The highest branch number (10.3), SPAD value (55.2%), flower/cluster (18), flower number (50.3), fruit/cluster (6.7), fruit length (61.1 cm), fruit diameter (49.5 cm), fruit number (29.3), fruit weight (84.3 g), yield/plant (2.5 kg) and yield/ha (96.5 t) were found from T_{F+R} treatment whereas the lowest plant height, leaf number branch number (5.3), SPAD value (46.3), flower/cluster (9.0), flower number (33.6), flower/cluster (5.6), fruit length (46.7 cm), fruit diameter (45.0 cm), fruit number (26.6), fruit weight (82.3g), yield/plant (2.2 kg) and yield/ha (89.6 t) were observed from T_C treatment.

Different nitrobenzene application on various positions greatly influences vegetative and reproductive growth of brinjal. The tallest plant and highest number of leaf's was found from T_{F+R} treatment whereas the lowest one from T_C treatment. The maximum Branch number (12.7), fruit length (18.5 cm), fruit breadth (48.6cm), single fruit weight (80.8g), spade value (56.6), flower/plant (40.8), fruit/plant (24.1) and yield/plant (37.8kg) were found from T_{F+R} treatment while the lowest value of Branch number (7.0), fruit length (16.5cm), fruit breadth (44.5cm), single fruit weight (64.0gm), spade value (41.5), flower/plant (32.2), fruit/plant (20.1) and yield/plant (35.6 ton) were observed from T_C treatment.

The growth and yield parameters of chili varied application of different treatment. The highest plant height and leaf number were found from T_{F+R} treatment whereas the lowest one from T_C treatment. The maximum chlorophyll % (69.2), branch/plant (19.3), flower/plant (104.3), fruit/plant (86.7), fruit length (16.8 cm), fruit diameter (11.8 cm), single fruit weight (9.2 gm), yield/plant (799.0 gm) and yield/ha (29.5 ton) was observed from T_{F+R} whereas the lowest values of these parameters were found T_C treatment.

CONCLUSIONS

Application of nitrobenzene in foliar and Soil position was found to be beneficial for plant growth and yield. Therefore, foliar and Soil combination treatment (T_{F+R}) was found to be effective high values vegetable production.

Chapter VI

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Chapter VII

APPENDICES

Appendix I. Analysis of variance on plant height of tomato at different days after transplanting

Source of Variation	Degrees of freedom (df)	Mean square of plant height		
		25 Days	35 Days	45 Days
Factor A	3	9.127*	314.854*	434.750*
Error	6	1.947	11.979	6.250
*: Significant at 0.05 level of probability				

Appendix II. Analysis of variance on Leaf number of tomato at different days after transplanting

Source of Variation	Degrees of freedom (df)	Mean square of leaf number	
		25 Days	35 Days
Factor A	3	30.556*	23.861*
Error	6	2.139	4.528
*: Significant at 0.05 level of probability			

Appendix III. Analysis of variance on Flower number, Fruit number and Single Fruit weight of tomato at different treatments

Source of Variation	Degrees of freedom (df)	Mean square of		
		Flower number	Fruit number	Single Fruit weight
Factor A	3	146.663*	3.861*	2.297*
Error	6	67.416	1.528	1.332
*: Significant at 0.05 level of probability				

Appendix IV. Analysis of variance on Yield/plant and Yield/ha of tomato at different treatments

Source of Variation	Degrees of freedom (df)	Mean square of	
		Yield/plant	Yield/ha
Factor A	3	0.013*	23.941*
Error	6	0.023	0.005
*: Significant at 0.05 level of probability			

Appendix V. Analysis of variance on the plant height of chili at different days after transplanting

Source of Variation	**Degrees of freedom**	**Mean Square for plant height**				
		20DAT	**30DAT**	**40DAT**	**50DAT**	**60DAT**
Replication	2	8.732	23.144	23.790	29.119	33.093
Factor A	3	6.370*	72.393*	68.922*	110.365*	256.059*
Error	6	0.659	0.331	0.478	0.462	3.357
*: Significant at 0.05 level of probability						

Appendix VI. Analysis of variance on the number of leaves of chili at different days after transplanting

Source of Variation	**Degrees of freedom**	**Mean Square for Number of leaves**				
		20DAT	**30DAT**	**40DAT**	**50DAT**	**60DAT**
Replication	2	13.290	27.440	320.002	162.583	144.083
Factor A	3	133.477*	1029.164*	2508.567*	13961.000*	15944.889*
Error	6	0.704	1.722	24.536	4.250	7.639
*: Significant at 0.05 level of probability						

Appendix VII. Analysis of variance of the data Branch, SPAD value, Diameter of chili lines

Source of Variation	Degrees of freedom	Mean Square of		
		Branch	SPAD value	Diameter
Replication	2	9.083	26.173	2.723
Factor A	3	28.306*	242.139*	2.883*
Error	6	0.306	1.143	0.246

***: Significant at 0.05 level of probability**

Appendix VIII. Analysis of variance of the data on fruit length, fruit weight and flower number of chili lines

Source of Variation	Degrees of freedom	Mean Square of		
		Fruit length	Fruit weight	Flower no.
Replication	2	1.213	0.509	25.083
Factor A	3	4.376*	0.987*	330.444*
Error	6	0.082	0.045	0.861

***: Significant at 0.05 level of probability**

Appendix IX. Analysis of variance of the data on fruit number, yield/ha and fruit length of chili lines

Source of Variation	Degrees of freedom	Mean Square of	
		Fruit no.	Yield/ha
Replication	2	25.083	14.159
Factor A	3	49.556*	25.317*
Error	6	0.972	0.556

***: Significant at 0.05 level of probability**