# EFFECTS OF PLANT GROWTH REGULATORS ON FLOWERING BEHAVIOUR AND YIELD OF CUCUMBER

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# EFFECTS OF PLANT GROWTH REGULATORS ON FLOWERING BEHAVIOUR AND YIELD OF CUCUMBER

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# *CERTIFICATE*

**This is to certify that thesis entitled,** "EFFECTS OF PLANT GROWTH REGULATORS ON FLOWERING BEHAVIOUR AND YIELD OF CUCUMBER" **submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of** MASTER OF SCIENCE **in** AGRICULTURAL BOTANY, **embodies the result of a piece of bona fide research work carried out by** UMME FARHANA, Registration No. 09-03605 **under my supervision and 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, 2015**
**Dhaka, Bangladesh**

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Supervisor

DEDICATED TO
MY
BELOVED PARENTS

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# ABSTRACT

A field experiment was conducted at the farm of Sher-e-Bangla Agricultural University, Dhaka, during the period from February, 2015 to July 2015 to study the effects of plant growth regulators on flowering behaviour and yield of cucumber. The experiment considered of nine plant growth regulators viz. $T_0$= 0 ppm (control), $T_1$= MH 100 ppm , $T_2$= Silver nitrate 250 ppm, $T_3$= Ethophon 250 ppm, $T_4$= $GA_3$ 300 ppm , $T_5$= MH 200 ppm, $T_6$= Silver nitrate 500 ppm, $T_7$= Ethophon 500 ppm, $T_8$= $GA_3$ 500 ppm. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Data were collected on stem length, number of primary branches per plant, days required to first female flower and male flower, days to 50% flowering per plot, total number of male and female flowers per pant, number of fruit per plant, fruit length and diameter, weight fruit per plant, yield of fruits. A statistically significant variation was recorded in terms of all the characters related to growth and yield of cucumber. The maximum stem length and number of branches per plant was produced by 500 ppm gibberelic acid. The $GA_3$ 500 ppm required the earliest of days of female first flowering and 50% flowering. The maximum number of male flowers per plant was produced by Silver nitrate 250 ppm treatment. The maximum number of fruit per plant, fruit length and fruit diameter were produced by $GA_3$ 500 ppm treatment. The maximum yield of fruits per plant (2.38 kg) was produced by $GA_3$ 500 ppm treatment. The minimum yield of fruits per plant (1.13 kg) was produced from control treatment. The maximum yield of fruits per hectare (16.72 tones) was obtained $GA_3$ 500 ppm treatment and the minimum yield of fruits per hectare (6.74 tones) was obtained from control treatment. Finally, it can be said that it is possible to increase female flower as well as yield of cucumber by suppressing male flower with the help of applying $GA_3$ at the rate of 500 ppm.

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## LIST OF ABBREVIATION AND ACRONYMS

| | | |
|---|---|---|
| AEZ | = | Agro-Ecological Zone |
| BARI | = | Bangladesh Agricultural Research Institute |
| BBS | = | Bangladesh Bureau of Statistics |
| FAO | = | Food and Agricultural Organization |
| N | = | Nitrogen |
| B | = | Boron |
| $GA_3$ | = | Gibberellic acid |
| *et al.* | = | And others |
| TSP | = | Triple Super Phosphate |
| MOP | = | Muirate of Potash |
| RCBD | = | Randomized Complete Block Design |
| DAT | = | Days after Transplanting |
| $ha^{-1}$ | = | Per hectare |
| g | = | gram (s) |
| kg | = | Kilogram |
| SAU | = | Sher-e-Bangla Agricultural University |
| SRDI | = | Soil Resources and Development Institute |
| wt | = | Weight |
| LSD | = | Least Significant Difference |
| $^0C$ | = | Degree Celsius |
| NS | = | Not significant |
| Max | = | Maximum |
| Min | = | Minimum |
| % | = | Percent |
| NPK | = | Nitrogen, Phosphorus and Potassium |
| CV% | = | Percentage of Coefficient of Variance. |

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# Chapter 1

# Introduction

# Chapter I

# INTRODUCTION

Cucumber *(Cucumis sativus* L.) is an annual trailing vine vegetable with a main stem with its branches which belongs to the family Cucurbitaceae. It is a warm season crop and has little or no tolerance to frost. Growth and development of cucumber are favored by temperature above 20°C. The optimum temperature for growing is between 20°C and 30°C. Cucumber is an important vegetable crop of Bangladesh,which is considered as a good source of nutrients for human body as it is mostly taken as fresh. It is a primary source of vitamins and mineral of man (AVRDC, 1999). Nutrition council of Bangladesh recommended at least 235 g/day/person of vegetables for Bangladeshi adult but the availability is only 65.5 g/day/person. The Annual production of vegetables in Bangladesh is only 29,93,000 tons including potato but we need around 11.15 million tons vegetable for our population (BBS, 2011). The total vegetable production in Bangladesh is far below the requirement. In 2012-2013 cucumber cover an area 19827 Acrs with a total production of 48685 metric tons(BBS, 2015).

Cucumber is widely consumed both fresh and as a processed food (Jarrick, 1986). Based on the use it may be three types as; salad type, pickling type and cooking type. In Bangladesh, cucumber is available in all the year round. As ours is a tropical country, it is cultivated both in summer and rainy season. It is mainly cultivated for its young tender fruits which are being used as ‘salad’ sometimes mature fruits are cooked as vegetable and pickled. The plant starts flowering early and producing marketable fruits within about two or three months depending upon cultivar, region, and soil climate, etc. Flowering in cucurbits is very important phase of development because fruiting and yield depends on this process. Cucumber generally is a monoecius plant, the first flowers to appear near the base of a cucumber plant are male. A week after Male flower initiation take place after one week the female flowers appear with the small cucumber fruit at the base (Bantoc, 1964).

In the integrated plant growing, growth regulators are widely applied for seed soaking. In case of vegetables, growth regulators are used mainly to improve seed germination power, increase yield, plants become resistant to diseases and unfavorable growth conditions (Kadiri *et al*., 1997; Saglam *et al*., 2002; Halter *et al*., 2005; Jankauskienė and Survilienė 2009; Mukhtar, 2008; Turan *et al*., 2009).

The effectiveness of plant growth regulators by reducing longitudinal shoot growth and improving functional and qualitative aspects of several plants is well known. The growth retardants used commercially to inhibit transplant heights are B-Nine, Cycocel, Bonzi, A-Rest, and Sumagic, which are applied for seed soaking, inflorescences spraying, shoot and plant watering or spraying through leaves. The plant growth regulating properties of these compounds are mediated by their ability to alter the balance of important plant hormones including gibberellic acid, ABA and cytokinins. They also inhibit gibberellin and ergosterol biosynthesis in plants and fungi, respectively (Cutler and Schneider, 1990; Rademacher, 2000; Mander, 2003; Boehme *et al*., 2005; Abdul Jaleel *et al*., 2007; Kishorekumar *et al*., 2007; Martinez *et al*., 2007; Banon *et al*., 2009).

The role of plant growth regulators in various physiological and biochemical process in plant is well known from its identification. Growth regulators are known to have an effect on produced of earliest flower, yield (Gedam *et al*., 1998), ratio of male/female flower (Bisaria, 1974), number of fruits, weight of fruit (Gopalkrishman and Choudhury, 1978). Initiation of flower bud, development of flowers and fruits are controlled by physiological process. In many agricultural plants, these processes can often be used to alter by proper application of plant growth substances. Exogenous application of growth regulators has shifted the sex expression towards femaleness by increasing the production of female flower and suppressing that of male flowers in cucurbit. Ethephon has been most effective including early female flowers at lower. However, very few researches were conducted to improve the femaleness and yield of local variety of cucumber by hormone application.Therefore, this experiment will be conducted to determine the effects of plant growth regulators on flowering behaviour and yield of cucumber.

Considering the above facts, the present experiment has been undertaken with the following objectives:

1. To know the effect of plant growth regulators on sex expression of cucumber.

2. To observe the effect of plant growth regulators on yield and yield attributes of cucumber.

3. To select the best plant growth regulators for development of parental line for hybrid seed production.

# Chapter 2
# Review of literature

# Chapter II

# REVIEW OF LITERATURE

Cucumber is one of the most popular salad vegetable of the world as well as Bangladesh. The crop received much attention to the researcher of different countries including Bangladesh. But a few investigations have been taken on the effect of plant growth regulators on cucumber production. There is a little or no combined research work to the effect of plant growth regulators on growth and yield of cucumber in Bangladesh. The literature and research results related to the present study are reviewed in this chapter.

## 2.1 Effect of plant growth regulators on the growth and yield of Cucumber

The ratio of male and female flower reduced when maleic hydrazide at 150 ppm was sprayed on the plant of bitter gourd reported by Prasad and Tyagi, 1963.

Choudhury and Pahatak (1959) reported the effects of growth regulators on sex expression of cucumber. They observed that MH 200 ppm and NAA 100 ppm significantly increased number of female flowers and MH 600 and 800 ppm, NAA 100 ppm and IAA 200 ppm greatly suppressed the number of male flower over control. All treatments increased the female to male flower ratio when compared with the control.

Singh and Upadhaya (1967) studied the effect of IAA and NAA on tomato and reported that the regulators activated growth, increased the fruit set, size and yield of fruit and induced parthenocarpic fruit. The chemicals could be applied on seeds, roots, whole plants or flowers, but foliar application was very effective for increasing the size of fruit and the yield.

Choudhury *et al*. (1967) reported that NAA 100 ppm, IAA 100 ppm and 200 ppm and MH 50 ppm and 200 ppm were equally effective in suppressing the male flowers and increasing the number of female flowers in cucumber. The effects subsequently increased the percentage of fruit set and ultimately the yield.

Irving *et al.* (1968) found that TIBA at 25 ppm was particularly effective in promoting the femaleness in cucumber. The increased TIBA stimulation of female flowers ranged from 100 to 200 percent. TIBA also increased the number of female flowers but lowered the male and female ratio.

McMurray and Miller (1969) found that cucumber seedlings treated with ethephon at concentrations of 120 ppm, 180 ppm and 240 ppm increased the number of pistillate flowers. The staminate to pistillate flower ratio was approximately 10:1. But in case of ethephon treated plants, the staminate to pistillate flower ratio ranged from 1:6 to 1:14, depending on the concentration of ethephon used.

Ravindran (1971) reported that bitter gourd seedlings were sprayed with ethral at concentrations ranging from 200 ppm to 600 ppm. Stunting, growth retardation and pollen sterility were induced in proportion to the dose applied and the production of male flowers was significantly reduced.

Pandey and Singh (1973) found that soil application of up to 100 kg/N increased the number of pistillate and staminate flower and the yield; the sex ratio was not affected in bottle gourd. Maleic hydrazide approximately doubled the proportion of female flowers and also increased yield. Combined application of N and maleic hydrazide gave a further increased in the proportion of female flowers and the highest yield.

In India, Kaushik *et al.* (1974) carried out an experiment with the application of $GA_3$ at 1, 10 or 100 mg/l on tomato plants at 2-leaf stage and then at weekly interval until 5 leaf stage. They reported that $GA_3$ increased the number and weight of fruits per plant at higher concentration.

Bisaria (1974) found that foliar spray of NAA 100 ppm increased the number of female flower per plant and the sex ratio is reduced in cucurbits.

Patnaik *et al.* (1974) reported that application of Cycocel in 1000 ppm concentration produced maximum number of pistillate flowers, while 500 ppm produced the maximum number of staminate flowers. Fruit yield was observed to be highest in the treatment of 100 ppm Cycocel followed by 2000 ppm and 500 ppm. Ethrel was found to be toxic to the plants and yield was markedly reduced with its application.

Pandey *et al.* (1976) stated that the effects were compared of seed soaking for 24 hrs in solutions of 2, 4-D at 1.5 ppm, MH and NAA, each at 200 ppm and $GA_3$ at 50 ppm and foliar spraying with 2, 4-D at 0.5-1.0 ppm, applied at the 2 true leaf and 4-5 true leaf stages. The number of pistillate flowers of *Lagenaria cylindrica (Lagenaria aegyptiaca)* was increased by seed treatment with MH and NAA at 200 ppm and by spraying with NAA at 100 and 150 ppm, MH at 100-200 ppm and $GA_3$ at 10 ppm; staminate flower numbers were decreased by MH at 200 ppm, NAA at 100 ppm and $GA_3$ at 10 ppm. The ratio of pistillate: staminate flower numbers was increased by all treatments except 2, 4-D and $GA_3$ at 25 and 50 ppm. Fruit set was enhanced by all treatments except $GA_3$ at 50 ppm and 2, 4-D. Yields were increased by seed treatment with NAA at 200 ppm and by spraying with NAA and MH at 150 and 200 ppm respectively.

Gopalkrishman and Choudhury (1978) reported that in contrast with TIBA, GA in general produced the largest number of male flowers; GA at the lowest concentration of 10 ppm produced more number of female flowers in first year. In the first year MH 100 ppm to 600 ppm as well as NAA and IAA at 50 ppm to 150 ppm induced a reduction in the mean number of female flowers. Treatment with TIBA at 50 ppm, 100 ppm and 200 ppm excelled all the other treatments in producing a favorable female to male flower ratio. TIBA from 50 ppm to 200 ppm gave a significant increased in the number of fruits and weight of fruits of watermelon.

Saleh and Abdul (1980) conducted an experiment with $GA_3$ (25 and 50 ppm), which were applied 3 times in June to early July. They reported that GA3 stimulated plant growth. It reduced the total number of flowers per plant, but increased the total yield compared to the control. $GA_3$ also improved fruit quality.

Choudhury and Phatak (1981) studied the effect of concentration of MH, NAA, 1AA and 2, 4-D on the sex expression and sex ratio of cucumber. They found that MH 200 ppm and NAA 100 ppm increased the number of female flower significantly over the control. MH 600 ppm and 800 ppm, NAA 100 and IAA 200 ppm and IAA 100 ppm suppressed the number of male flowers over the control IAA 100 ppm and 200 ppm and NAA 200 ppm stimulated the growth.

Mangal *et al.* (1981) conducted an investigation to study the influence of various chemicals (Ethrel, NAA, Cycocel, MH, PCPA, Ascobric acid and Boron) on the growth, flowering and yield of bitter gourd. PCPA at 100 ppm improved plant growth significantly. The treatment of CCC at 250 and 500 ppm produced female flowers about 12 days earlier in comparison to control plant. Maximum fruit yield per plant (3123gm) was produced under Cycocel 250 ppm followed by Ascorbic acid 25 ppm and Cycocel 500 ppm.

Sidhu *el al.* (1982) conducted an experiment to study the effect of pruning and growth regulators on musk melon. They recommended that the foliar spray of ethephon 500 ppm for obtaining maximum fruit yield in both pruned and un pruned muskmelon cv Hara Madhu.

Gosh and Basu (1983) found that spraying with IAA at 17.5 or 35 mg/1 increased the number of female flowers. Ethrel at 25 mg/1 increased female flowers. All GA application reduced the ratio of male to female flowers.

Hume and Lovell (1983) reported that application of ethephon to field-grown plants of both bush and trailing forms of *Cucurbita maxima* and *C. pepo* caused leaf epinasty, suppression of male flowers and earlier production and increase in numbers of female flowers. This gave rise to an increase in the ratio of female to male flowers per plant and a decrease in the total number of flowers. The sex of the main bud at the first five to six nodes is usually determined at this stage but the secondary buds still have bisexual potential. The change in sex expression was brought about by all male flower buds that had formed by the spraying time aborting, and all buds that developed (both main and secondary) for at least 7 days after spraying became female flowers. Thus, nodes five and six had male flowers in the controls, whereas in ethephon-sprayed plants the presumptive male flowers aborted at the bud stage at these nodes and secondary primordial developed into functional female flowers.

Verma *et al.* (1984) reported that ethrel 100 ppm delayed the appearance of first male flowers of cucumber MH 200 ppm and Boron 3 ppm and 4 ppm produced the earliest female flowers but at a higher node, while ethrel 100 ppm induced the first staminate and pistillate flower at the lowest nodes at 6.5 and

9.5 respectively. Boron 4 ppm also proved superior to all the other chemicals in producing the maximum fruits and yield.

Sreeramula (1987) reported that ethrel 100 g/1 increased the number of pistillate flowers and also hastened appearance of the female flower compared to the control in sponge gourd. It also delayed the appearance of the first staminate flower and also decreased the total number of male flowers.

Vadigeri and Madalageri (1989) found that Seedlings of Poinsette and Belgaum Local at the 4-6 leaf stage were sprayed with Ethrel (ethephon) at 200 ppm or 400 ppm and $GA_3$ (gibberellic acid) 5 ppm or 10 ppm and subsequently evaluated for sex ratio (male : female flower) and yield. Ethrel at 400 ppm had the greatest effect on both genotypes, significantly increasing the number of female flowers and fruits/plant compared with the untreated controls.

Islam *et al.* (1990) reported that the bottle gourd plants treated with NAA 200 ppm produced fruits of maximum length and girth, whereas fruits to minimum length and girth in control. Numbers of fruits per plant were also found maximum in plants where NAA 200 ppm was applied. Hormone application at the rate of 200 ppm NAA produced maximum yield (48.15 t/ha).

Ying *et al.* (1994) conducted an experiment on hormonal control of sexual differentiation in bottle gourd. They reported that the sex expression of cucurbit flowers can be modified by plant growth regulators, especially ethylene. The treatment of leaves or shoot tips of bottle gourd with ethephon (3.5 mm) resulted promoted the production of female flowers. Female flower production and ethylene evolution increased with the earliness of the cultivar. They also reported that ethylene response was inversely correlated with the amount of 1-(molonylamino) clyclopropane -1- carboxylic acid (ACC) in the tissue. Treatment with ACC changed the direction of sexual differentiation in potentially male buds to female buds. At last the scientists concluded that ethylene induces female flowers in bottle gourd by suppressing the differentiation of stamen primordial and thereby promoting that of pistil primordial.

Samdyan *et al.* (1994) carried out an experiment on bitter gourd with different plant growth regulators. They reported that thickness or weight of rind and fruit rind: flesh ratio were recorded maximum with MH 50 mg/1, while maximum thickness or weight of flesh, dry matter vitamin 'C' and T.S.S. contents were observed with cycocel 250 mg/1 $GA_3$ 25 mg/1 resulted in maximum seeds in fruits, while MH 25 mg/1 and ethrel 100 mg/1 caused maximum weight loss of fruits 2 DAS or 4 DAS, respectively. N 50 kg/ha + ethrel 100 mg/1 or $GA_3$ 25 mg/1 improved the shape index and seed control of fruits, respectively.

Kim *et at.* (1994) reported that application of auxin transport inhibitors, naptalam (N-I-naphthylphthalamic acid) and T1BA to the ovary or peduncle of cucumber flowers (cultivars Khira and Pandex and their $F_1$ hybrid) significantly increased the IAA content of the ovary. The ratio of IAA:1BA in pollinated or naptalam-or TIBA-treated ovaries was also higher than that in unpollinated controls. The unpollinated ovaries of genetically parthenocarpic cv. Pandex showed 92% fruit set, whereas the non-parthenocarpic cv. Khira ovaries failed to set fruit and the F1 hybrid had only 8% fruit set. Application of auxins, NAA and 4-CPA, $GA_3$ cytokinins, BA and CPPU (forchlorfenuron) to the ovary at anthesis, however, induced over 60% parthenocarpic fruit set in Khira and the $F_1$ hybrid.

Arora *et al.* (1994) reported that flower application of plant growth regulator had significant effect on growth, flowering and yield of long melon. The experiment was conducted during the summer seasons of 1991 and 1992 to study the effect of ethephon, $GA_3$ maleic hydrazide (MH), and NAA on melon. Growth regulators were applied at the 2-and 4-leaf stages. $GA_3$ at 25 mg/litre resulted in the longest vine length (3.97m), whereas vine length in controls (water sprayed) was 2.82 m. Ethephon at 250 mg/litre resulted in the highest number of braches/plant (10.8), shortest internode length (8 cm), lowest male : female flower ratio (3.1), fewest days to first female flower (68 days), highest number of female flower/plant (27) and fruits /plant (17.7) and highest plant yield (1.36 kg/plnat). Ethephon at 250 mg/litre also gave the highest fruit yield/ha (29.76 t), while $GA_3$ at 25 mg/litre gave the lowest (11.08 t).

Baruah and Das (1997) stated that NAA (25 and 100 ppm) and Maleic hydrazide (50 and 100 ppm), applied at the 2-true leaf stage and sowing dates (15 day intervals from 10 September to 25 October) had significant influence on the growth of *Lagenaria siceraria* (cv. Kiyari Lao) during rabi 1994 to 1995 in India. They observed that treated plants with NAA at 25 ppm and MH at 50 ppm produced the best yields (5.48 and 4.86 kg/plant respectively). Yield decreased with later sowing dates from 5.49 to 2.62 kg/plant.

Gedam *et al.* (1998) conducted an experiment on bitter gourd plants treated with 15 ppm, 25 ppm or 35 ppm $GA_3$ 50 ppm or 150 ppm NAA, 50 ppm, 100 ppm or 150 ppm ethephon, 100 ppm, 200 ppm or 300 ppm maleic hydrazide, 2 ppm, 4 ppm or 6 ppm boron or with water (control). $GA_3$ at 35 ppm produced the earliest male flower and NAA at 50 ppm produced the earliest female flower. Fruit maturity was earliest in plants treated with 50 ppm NAA or 4 ppm boron.

Das and Rabhal (1999) reported that in a greenhouse experiment on cucumber cultivars Chinese green, Pusa Sanyog and Poinsette, NAA was applied at 30 ppm or 100 ppm, kinetin at 10 ppm or 50 ppm and Ethrel at 250 ppm or 500 ppm at the 4 to 5 leaf stage and at flower bud appearance. NAA application produced the largest fruits with the highest flesh: placenta ratio. TSS and ascorbic acid content were highest when Ethrel was applied.

Al-Masoum (1999) reported that Cucumber cv. Beit Alpha was grown in a greenhouse in 1996-97 and ethephon applied at 250 ppm, 350 ppm or 450 ppm at the seedling stage (2-4 true leaves). Data were collected on the total yield, early, late yield, number of female flowers; number of male flowers; days to the first female flowers; days to the first male flowers; number of nodes to first female flower, number of nodes to the first male flower and plant height. Positive result was found from ethophon treated plants in case of all parameters. Greater fruit yield was given from the ethephon treated plants because ethephon induced femaleness (pistillate flowers) on the main stem. Ethephon induced femaleness (pistillate flowers) on the main stem that led to greater fruit production.

Ameena and George (2002) was conducted an experiment to assess the allelopathic effect of aqueous extracts of purple nutsedge (*Cyperus rotundus*) on the germination and seedling growth of bitter gourd (Momordica charantia). In petri plate bioassays, the aqueous extracts of nutsedge dry plant parts inhibited the germination and seedling growth of bitter gourd.

Wang and Wang (2001) conducted an experiment on the effect of CPPU (forchlorfenuron) application on growth and endogenous phytohormone contents of *Momordica charantia* cv. Kaihua Changbai was determined. Application of CPPU to the ovary at anthesis within the concentration of 10-50 mg/litre accelerated fruit growth by increasing the length, diameter and fresh weight of fruits, while 100 mg/litre inhibited fruit growth. HPLC analysis showed that the endogenous ZT (zeatin) content of fruit was lowered and the endogenous ABA (abscisic acid) content was improved by CPPU treatments at the concentration of 20 and 100 mg/litre, and that the endogenous contents of IAA and $GA_3$ (gibberellic acid) were significantly improved by application of CPPU at 20 mg/liters, reaching a peak value 6 days after anthesis.

Hossain (2004) conducted an experiment to study the effect of “Crops care” (Napthalene Acetic Acid, NAA 4.5%) and “Ripon-15” (15% Ethephon) on the flower initiation, fruit set and yield of cucumber (Barishal HYV) and bitter gourd (Tia HYV). “Crops care” and “Ripen-15” showed positive effects on different yield attributing characters of cucumber and bitter gourd treated plants compared to the control. Early female flowers (6 to 7 days) and early fruit maturation (5 days) were found in both cucumber and bitter gourd plants treated with “Crops care” (0.5 ml) and “Ripen-15” (3 ml) compared to control. “Crops care” (0.4 ml) gave about (30%) more female flower in cucumber and (32%) more in bitter gourd. About (45%) more female flower was recorded in cucumber from the plants treated with 2.0 ml of “Ripen-15” and (56%) more female flower was recorded in bitter goud treated with 2.5 m of “Ripen-15”. About 7 ton more yield was found from 0.4 ml of “Crops care” both in cucumber and bitter gourd. 2.0 ml of “Ripen- 15” gave 7.6 t/ha and 7.85 t/ha more yield in cucumber and bitter gourd respectively over the control.

Jasim *et al.* (2007) conducted to find out the effect of garlic extract at (1: 0.5) and (1:1) (wt:volume) concentration and Liqurous extract at 1.25 and 2.50 mg/

L and growth regulator IAA at 25 ,50 and 75 mg/ L and ethephon at 100,200,300 mg/ L on endogenous hormones (auxins and gibberellins) and carbohydrates at three growth stage of snak cucumber and cucumber which were ; third to fourth true leaf stage, male flower appearance stage and female appearance stage . Gibberellins contents decreased significantly by Liqurous at 2.50 gm/L for both plants in the second season only whereas, auxins contents increased by treatment of garlic (1:1) and Liqurous (2.5 gm/L) in cucumber for both seasons. Carbohydrates contents decreased at IAA (25 and 50 mg/L) for both season and increased in second season by ethephon in snake cucumber and by IAA (75mg/L) in the first season in cucumber. Male flowers appearance stage gave highest gibberellins contents compare to other stages. Female flowers appearance stage gave highest auxins and carbohydrates contents compare to other stages. Ethephon at 300mg/L treatment at female flower appearance stage gave the lowest gibberellins and highest auxins and carbohydrates for both plant and seasons.

Influence of growth regulators on seed germination energy and biometrical parameters of vegetables was investigated at the Lithuanian Institute of Horticulture in 2007. The seeds of cucumber ‘Krukiai’ F1, red beet ‘Joniai’, radish ‘Babtų žara’, tomato ‘Arvaisa’ F1 were soaked in the solutions of growth regulators Biojodis, Biokal 01, Bioforce, Agronom effect, Inzar, Oksichumat, Penergetic p. Control – the seeds soaked in water. After soaking seeds were sown into multicell flats, in which plants were grown for 30 days in greenhouse. It was established seed germination energy and seedling biometrical measurements (plant height, weight, leaf number, leaf area) were carried out. Plant growth regulators Oksichumat, Agronom effect, Bioforce, Penergetic p positively influenced seed germination energy of radish, tomato and the growth and development of cucumber, red beet, tomato and radish seedlings ( Julė Jankauskienė and Elena Survilienė, 2009).

Ozgur (2011) carried out with paclobutrazol (Bonzi), daminozide (B-Nine) and chlormequat chloride (Cycocel) in order to study their effect on control of elongation in cucumber seedlings. The seeds of cucumber cv. 'Maraton F1' were soaked into 500 and 1000 mg/L solutions of paclobutrazol, and 7500 and 15000 mg/L solutions of daminozide and chlormequat chloride, each for 12 and 24 hours. After soaking the seeds were sown into peat medium in which the plants were grown for 20 days in a greenhouse. Measurements of height and quality of seedlings were measured from control and treated seedlings. Paclobutrazol applications were effective on seedling height, whereas daminozide and chlormequat chloride had lower inhibition. Both concentrations of paclobutrazol caused shortening in hypocotyl and epycotyl lengths. The transplant heights were reduced as 63.4% at 500 mg/L and 74.9% at 1000 mg/L. The application of paclobutrazol for 24 h showed effective seedling height control than that of 12 h. Paclobutrazol applications had no significant effect on stem diameter, however, decreased the leaf area and dry weight of both leaves and stems. Applying daminozide and chlormequat chloride to seeds for 12 h was ineffective on plant height, while 24 h applications of 15000 mg/L daminozide and chlormequat chloride reduced the plant height.

Thappa *et al.* (2011) examined of altering the plant frame and inducing femaleness at early stages in the development of cucumber for productivity enhancement and early development using various plant growth regulators. Three plant growth regulators were sprayed onto plants at the two-, four- and six-leaf and full-bloom stage using the cucumber variety Cucumber Long Green. Two of the growth regulators, maleic hydrazide and ethephon, were each applied at two different concentrations of 100 and 200 ppm and the third, naphthalene acetic acid, was applied at 50 and 100 ppm, and some combined applications of growth regulators were also tested. The experiment comprised 15 treatments and was laid out in a randomized block design with three replications. The results revealed that the influence of the plant growth regulators was variable on the morphological traits of cucumber but the floral and yield traits were significantly affected by a combined application of 100 ppm maleic hydrazide and 100 ppm ethephon. This treatment induced early development, maximized the sex ratio with regard to yield and was comparatively helpful in reducing plant expansion. This treatment also produced the best economic results for the production of cucumber.

Kumar and Wehner (2012) conducted to determine whether the rate of natural out crossing could be increased using growth regulators, plot size management, and node of fruit position for seed harvest. The experiment was a factorial in a randomized complete block design with 2 year (1997 and 1998), two growth regulators (treated and none), two plot sizes (single plant hills and small plots), two nodes of harvest (crown and top), and four replications (six in 1998). Plots or hills were planted to white-spined ‘Sumter’ and were surrounded by rows of black-spined ‘Wisconsin SMR 18’ pollenizer. Plots or hills of Sumter were treated with ethrel to induce gynoecy, and pollenizer rows were treated with silver nitrate to induce androecy. Untreated isolation blocks remained monoecious. Progeny of the harvested white-spined plants were planted the following year to evaluate spine color, with black-spined plants indicating an outcross. Results showed that node of harvest had no effect on outcrossing rate. However, growth regulators and plot size had a significant effect. Treated small plots, treated hills, and untreated hills had high out crossing rates (54%) relative to untreated plots (30%). Therefore, if families are to be intercrossed in isolation blocks, they should be treated with growth regulators for maximum out crossing.

An experiment was conducted to the effect of plant growth regulators on callogenesis and gametic embryogenesis from anther cultures of cucumber (*Cucumis sativus* L.) was investigated. Results showed significant differences among the various types and concentrations of plant growth regulators for callogenesis and gametic embryogenesis from anther cultures of two cucumber cultivars. Use of 2,4-D in combination with 1.5 _M Kinitine showed the highest callogenesis percentage in cultured anthers of Esfahani cultivar. Application of 2-4-D in combination with 1.0 and 0.5 _M BAP in Esfahani cultivar and also use of 2-4-D combined with 1.0 _M BAP and 1.5_M Kinitine in Beta Alfa cultivar produced the highest embryogenic calli. Furthermore, the highest mean number of embryo per anther obtained with combined use of 2 _M 2-4-D and 1.0 _M BAP in both cucumber cultivars (Hamidvand *et al,* 2013).

# Chapter 3

# Materials and Methods

# MATERIALS & METHODS

This chapter deals with the major information’s that were considered to conduct the experiment.

## 3.1 Experimental site

The experiment was conducted at the farm of Sher-e-Bangla Agricultural University, Dhaka. It was carried out during the period from February, 2015 to July 2015. The location of the site in 23°74" N latitude and 90°35" E longitude with an elevation of 8.2 meter from sea level (Anon, 1989).

## 3.2 Climate

The experimental site is located in subtropical region where climate is characterized by heavy rainfall during the months from April to September (Kharif season) and scanty rainfall during rest of the month (Rabi season). The maximum and minimum temperature, humidity rainfall and soil temperature during the study period are collected from the Bangladesh Meteorological Department (Climate division) and have been presented (Appendix-1).

## 3.3 Soil

The soil of the experimental area belongs to the Madhupur Tract (UNDP, 1988).Soil analysis report of the experimental area was collected from Khamarbari, Dhaka which was determined by SRDI, Soil testing Laboratory.

The analytical data have been presented in appendix-II. The experimental site was a medium high land and p of the soil was 5.4 to 5.6. The morphological characters of the soil as indicated by FAO (1988) are given below- AEZ No. 28 Soil series- Tejgaon General soil - Non -calcareous dark gray.

### 3.4 Plant Materials

Seed of Ufsi boro sasha (Baromashi) variety of cucumber was collected from Siddik bazar, Dhaka .

### 3.5 Treatments of the Experiment

The experiment was designed to study the effects of plant growth regulators on flowering behaviour and yield of cucumber. The experiment consisted of one factor as follows:

**Factor** A: **Plant growth regulators**

$T_0$= 0 ppm (control)

$T_1$= MH 100 ppm

$T_2$= Silver nitrate 250 ppm

$T_3$= Ethophon 250 ppm

$T_4$= $GA_3$ 300 ppm

$T_5$= MH 200 ppm

$T_6$= Silver nitrate 500 ppm

$T_7$= Ethophon 500 ppm

$T_8$= $GA_3$ 500 ppm

### 3.6 Experimental design and layout

The experiment was laid out in a factorial Randomized Complete Block Design (RCBD) with three replications. Each replication had nine plots where 9 treatments were allotted at random. The size of each plot was 1.5 m x 1m. The distance between two blocks and two plots both were lm.

### 3.7 Land preparation

The selected land for the experiment was opened 26 February, 2015 with the help of a power tiller and then it was kept open to sun for 4 days prior to further ploughing. Then the land was prepared well by ploughing and cross ploughing followed by well by laddering. Weeds and stubbles were removed and the basal dosed of fertilizers were applied and mixed thoroughly with the soil before final land preparation. The unit plots were prepared by keeping lm spacing in between two plots and 50 cm drain was dug around the land. The space between two blocks and two plots were made as drain having a depth of about 30 cm.

### 3.8 Pit preparation in the plots

The length and breadth of each pit was 30 cm and 30 cm respectively. There was 20 cm depth in pits and 45 cm distance from the border of the plots. The pits were prepared with necessary manures and fertilizers in 15 march, 2015.

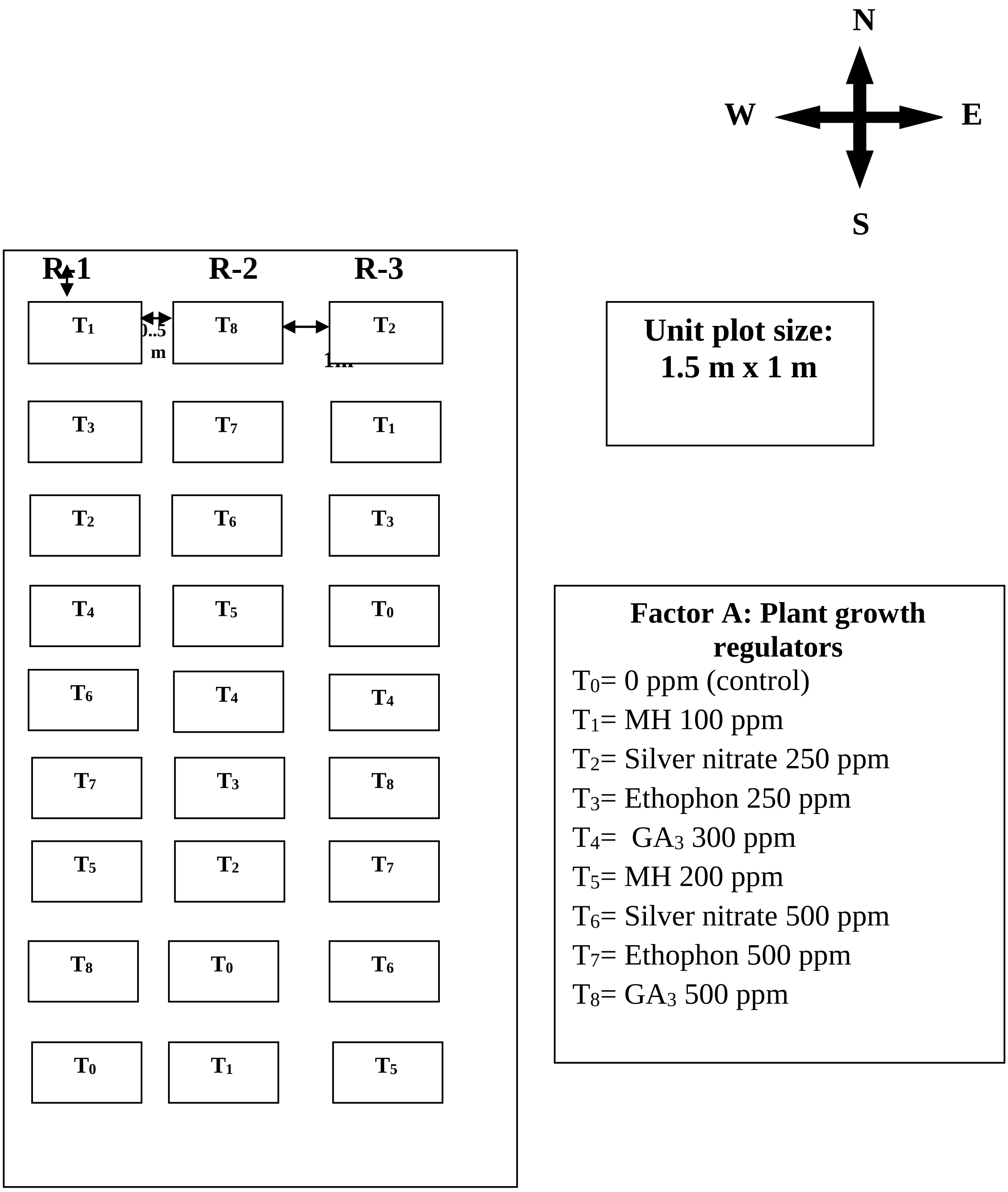


**Fig. 1. Layout of the experimental plot**

### 3.9 Application of manures and fertilizers

Following doses of manures and fertilizers were recommended for cucumber production by Rashid (1994). Manures and fertilizers dose per hectare cow dung 10 ton, Urea 150 kg, TSP 125 kg, MP 100 kg, Manures and fertilizers applied uniformly in the experimental plots and pits as per following doses in accordance with the recommended dose.

A common dose of cow dung @ 1 kg per pit, urea @7 gm per pit, TSP @ 12.5 gm per pit and MP @ 6 gm per pit was applied during pit preparation in the respective plots a week before seed sowing. The rest 8 gm urea and 4 gm MP per pit was given in two installments. 4 gm urea and 4 gm MP was given in each pit after 3 weeks of seed sowing and the rest 4 gm urea was given in each pit after 5 weeks of seed sowing.

### 3.10 Sowing of seeds and selection of seedlings

The seeds were sown directly in the pit on 1$^{st}$ April. 20156. 2 to 3 seeds were sown in each pit at 2 to 3 cm depth when the seedlings attained 10-15 cm height and hard enough then one healthy seedling was selected to remain in each pit and others were thinned out.

### 3.11 Application of hormone treatments

In the experiment each of the nine plant growth regulator solution were applied in three installments. 1st spray was done at 2 to 4 true leaf (fully expanded) stage of seedlings with the help of a hand sprayer on 15th April, 2015. 2nd spray was done after 7 days of 1st spray and 3rd spray was done after 7 days of 2nd spray to the leaves and twigs of the plants with a knapsack sprayer.

### 3.12 Intercultural operations

#### 3.12.1 Weeding:

Weeding was done whenever necessary to keep the crop free from weeds.

#### 3.12.2 Staking:

When the seedlings were established, staking was given to each plant. Stick of dhaincha plant was given to support the growing twig.

#### 3.12.3 Vine management

For proper growth and development of the plants the vines were managed upward by hand and with the help of iron rope and nylon net. So, the rainy and stormy weather could not damage the growing vines and fruits of the plants.

### 3.14.4 Irrigation

The experiment was done in summer season. So, irrigation was given when it is necessary. Sometimes rain was supplied sufficient water then irrigation was not required.

### 3.12.5 Plant protection

Cucumber is a very sensitive plant to various insect pests and diseases. So, various protection measures were taken. Melathion 57 EC and Ripcord was applied 2 ml against the insect pests like beetle, fruit fly, fruit borer and other. The insecticide application was made fortnightly from 10 days after seed sowing to a week before first harvesting. Food trap was also given to prevent fruit fly with a mixture of ripe sweet gourd and Cyperson in earthen pots. During cloudy and hot weather precautionary measures against viral disease like mosaic of cucumber was taken by spraying. Furadan 10 G was also applied @ *5* gm/pit during pit preparation.

### 3.13. Harvesting

When the green fruits were in marketable condition then they were harvested. Total eight times harvesting was done from every plant at three days interval from every plot.

### 3.14 Data collection

#### 3.14.1 Stem length (cm)

Stem length was taken at three times and measured in centimeter from ground level to tip of the main stem from each plant of each treatment and mean value was calculated.

#### 3.14.2 Number of primary branches per plant

Total number of primary branches was counted at last harvest from each plant of the treatment and mean value was calculated. The pruned branches number was also included in counting. Mean value was calculated by the following formula.

#### 3.14.3 Days to first male flower

Days to first male flower initiation was recorded. Number of days required from sowing to first flower initiation was recorded for every plant and average was calculated.

#### 3.14.4 Days to first female flower

Days to first female flower initiation was recorded. Number of days required from sowing to first flower initiation was recorded for every plant and average was calculated.

### 3.14.5 Days to 50% flowering per plot

Different dates of the 50% flowering from sowing data were recorded and then the observations were calculated.

### 3.14.6 Total number of male flowers per pant

Number of male flowers was also conducted from first flowering. Total number of male flowers was recorded from five plants of each treatment. It was calculated by one plant.

### 3.14.7 Total number of male flowers per pant

Number of female flower per plant was counted from first female flower appearance. Total number of female flowers was recorded from five plants of each treatment. It was calculated by one plant.

### 3.14.8 Number of fruit per plant

Number of fruit was counted from first harvest stage to last harvest. The total number of fruits per plant was counted and average number of fruit was recorded. It was recorded by the following formula.

### 3.14.9 Fruit length and diameter

Fruit length and diameter was taken by measuring tape in centimeter. diameter of fruit was measured at the middle portion of fruits from each plot and their average was taken. Average length of same fruits was also taken.

### 3.14.10 Weight fruit per plant (g)

After each harvest, the weight of randomly selected 10 plant per plot was recorded and then the average weight fruit per plant was calculated.

### 3.14.11 Yield of fruits

To estimate yield, all the six plants in every plot and all the fruits in every harvest were considered. Thus the average yield per plot was measured. The yield per hectare was calculated considering the area covered by the six plants.

## 3.15 Statistical analysis

The recorded data on different parameters were statistically analyzed using MSTAT software to find out the significance of variation resulting from the experimental treatments. The mean for the treatments was calculated and analysis of variance for each of the characters was performed by F (variance ratio) test. The differences between the treatment means were evaluated by LSD test at 5% probability.

# Chapter 4

# Results and Discussion

# CHAPTER IV

# RESULTS AND DISCUSSION

## 4.1 Stem length (cm)

The effect of plant growth regulators was significant on stem length. The maximum stem length (185.10 cm) was produced by $T_8$ (500 ppm gibberelic acid) which was followed by $T_1$ (180.40) and $T_5$ (179.10) and they were statistically similar. The minimum stem length (130.4 cm) was produced by $T_0$ (control) treatment (Fig. 2). Similar result reported by Bhosle *et al.* (2002) who reported that 30ppm $GA_3$ showed better effect on promotion the elongation of plant.

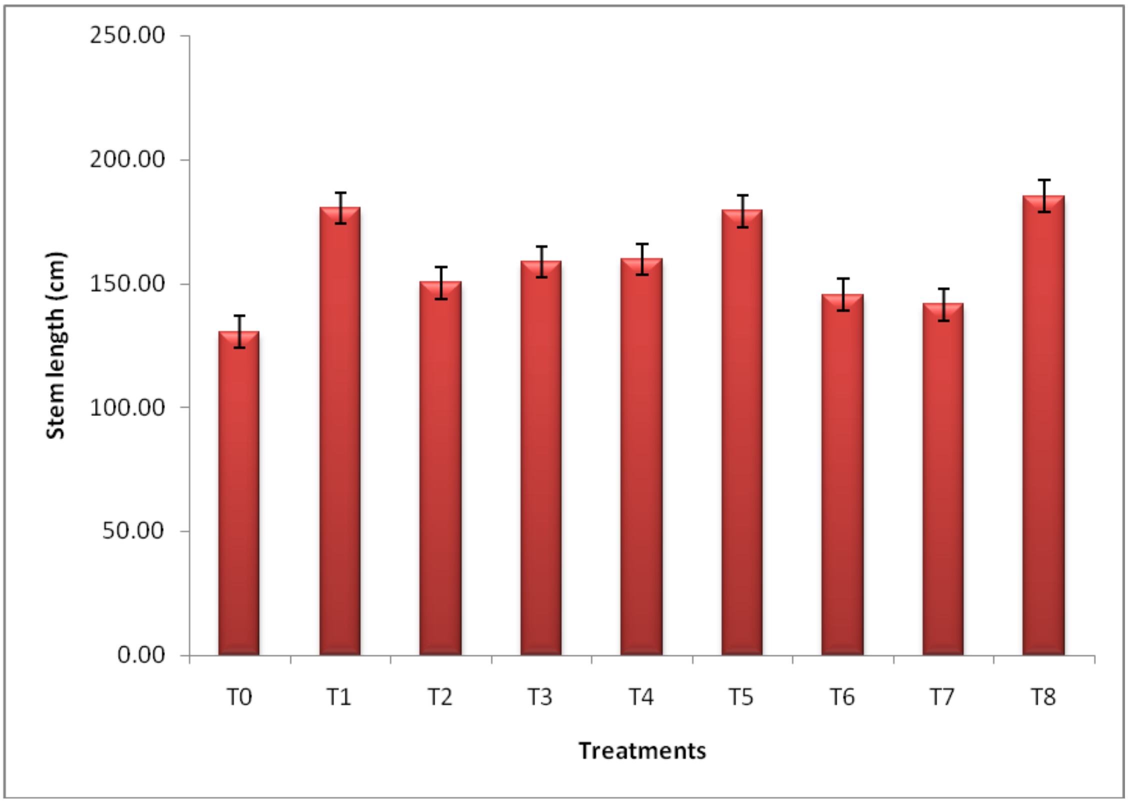


**Fig. 2. Effect of plant growth regulators on the plant height of cucumber**

**Here,**

$T_0$= 0 ppm (control)

$T_1$= MH 100 ppm

$T_2$= Silver nitrate 250 ppm

$T_3$= Ethophon 250 ppm

$T_4$= $GA_3$ 300 ppm

$T_5$= MH 200 ppm

$T_6$= Silver nitrate 500 ppm

$T_7$= Ethophon 500 ppm

$T_8$= $GA_3$ 500 ppm

### 4.2 Number of branches per plant

The plant growth regulators showed significant variation in the number of branches per plant. The maximum number of branches per plant (19.47) was produced by $T_8$ treatment, second and third highest was obtained from $T_4$ (15.32) and $T_3$ (11.32). The treatment $T_0$ produced the minimum number of branches per plant (3.57) (Fig 3). These results indicate that gibberelic acid increases the growth of cucumber.

### 4.3 Days to first male flowering

A significant variation was observed in days to first male flowering due to plant growth regulators (Table 1). The $T_4$ treatment required the earliest of days of male first flowering (28.60 days). The treatment $T_2$ and $T_8$ showed less time for days to male flowering than $T_{5,}$ which were (31.60 days) and (30.850 days) respectively statistically similar. The treatment $T_0$ showed the longest time for days to male flowering (42.10 days). The results indicated that minimum time of first male flower was produced by the application of plant growth regulators comparing with the control. Gedam *et al.* (1998) reported that $GA_3$ at 35 ppm produced the earliest male flower of bitter gourd.

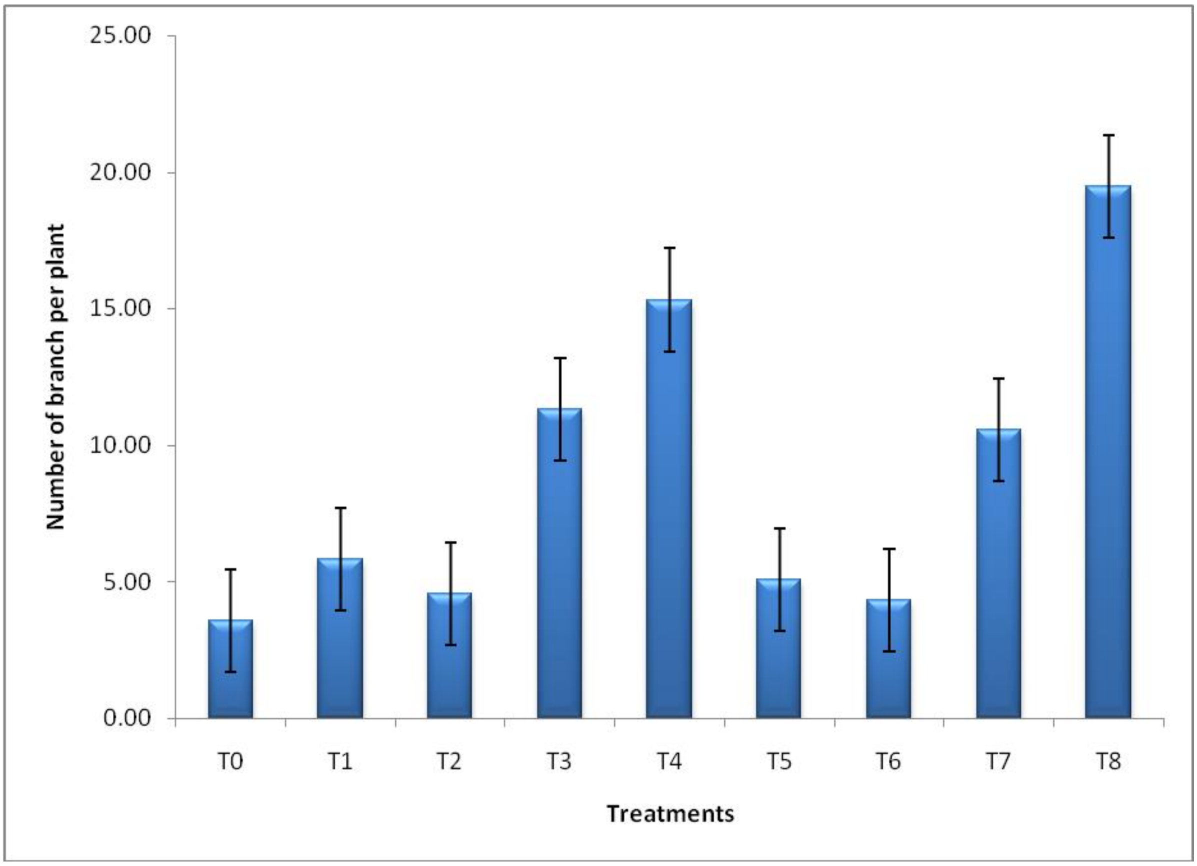


Fig. 3. Effect of plant growth regulators on the number of branch per plant of cucumber

Table 1. Effect of plant growth regulators on the days to first male and female flower and days to 50% flowering of cucumber

| Treatment | Days to first male flower | Days to first female flower | Days to 50% flowering |
|---|---|---|---|
| $T_0$ | 42.10 a | 41.57 a | 52.53 a |
| $T_1$ | 34.10 c | 35.07 de | 48.88 abc |
| $T_2$ | 31.60 d | 33.32 ef | 47.23 bc |
| $T_3$ | 35.60 bc | 37.07 cd | 50.53 ab |
| $T_4$ | 28.60 e | 31.82 fg | 46.93 bc |
| $T_5$ | 39.80 a | 40.77 ab | 49.13 abc |
| $T_6$ | 34.30 bc | 35.32 de | 47.61 bc |
| $T_7$ | 36.60 b | 38.37 bc | 50.68 ab |
| $T_8$ | 30.85 de | 29.32 g | 45.68 c |
| LSD(0.05) | 2.31 | 2.89 | 3.46 |
| CV(%) | 5.83 | 4.65 | 4.10 |

In column, means containing same letter indicate significantly similar under LSD at 5% level of significance.

### 4.4 Days to first female flowering

A significant variation was observed in days to first female flowering due to plant growth regulators (Table 1). The $T_8$ treatment required the earliest of days of female first flowering (29.32 days). The treatment $T_2$, $T_1$, and $T_6$ required more days to female flowering which were (33.32), (35.07) and (40.77) days respectively. The treatment $T_0$ (control) showed to require the longest time for days to female flowering (41.57 days).

### 4.5 Days to 50% flowering

The different plant growth regulators showed significant variation in the days to 50% flowering. The treatment $T_0$ required the maximum time for 50% flowering (52.53 days). The treatment $T_8$ showed the earliest time for 50% flowering (45.68 days) (Table 1).

### 4.6 Number of male flowers per plant

The plant growth regulators showed significant variation in the number of male flowers per plant (Table 2). The maximum number of male flowers per plant (20.57) was produced by $T_1$ (MH 100 ppm) treatment, which was followed by $T_3$ and $T_5$ treatment. The treatment $T_0$ produced the minimum number of male flowers per plant (9.87). The results indicated that minimum male flower was produced in control comparing with plant growth regulators.

## 4.7 Number of female flowers per plant

There was a significant difference among the plant growth regulators in the number of female flowers per plant (Table 2). The maximum number of female flowers per plant (25.58) was produced by $T_8$ treatment, which was followed by $T_4$ and $T_2$. The treatment $T_0$ produced minimum number of female flowers per plant (10.58). The results indicated that maximum female flower in number were produced by the application of plant growth regulators compared with the control. Al Masoum and Al Masri (1999) reported similar trends from their experiments. Chudhury *et al*. (1967) reported that NAA 100 ppm, IAA 100 ppm and 200 ppm and MH 50 ppm and 200 ppm were equally effective in suppressing the male flowers and increasing the number of female flowers in cucumber.

## 4.8 Number of fruits per plant

The plant growth regulators showed significant variation in the number of fruit per plant (Table 3). The maximum number of fruit per plant (15.40) was produced by $T_8$ treatment, which was statistically similar with $T_4$. The treatment $T_0$ produced the minimum number of fruit per plant (5.55). Similar results were observed by Hossain (2004).

## 4.9 Length of fruit (cm)

The plant growth regulators were exhibited significant variation in the length of fruit (Table 3). However, the longest fruit length (18.6 cm) was produced by $T_8$, which was closely followed by $T_4$ and $T_2$. The treatment $T_0$ produced the shortest fruit length (10.6 cm). It was found that fruit length increase with increasing plant growth regulators up to a certain level. Similar findings also reported by Gelmesa *et al.* (2010).

## 4.10 Diameter of fruit (cm)

The variation in the diameter of fruit plant growth regulators was exhibited significant (Table 3). The largest fruit diameter (7.37 cm) was produced by $T_8$, which was statistically similar with $T_4$ treatment. the shortest fruit (5.15 cm)was obtained from $T_0$ treatment. Similar findings also reported by Gelmesa *et al.* (2010).

Table 2. Effect of plant growth regulators on the total number of male and female flowers per pant of cucumber

| Treatment | Total number of male per pant | | Total number of female flowers per pant | |
|---|---|---|---|---|
| $T_0$ | 9.87 | g | 10.58 | g |
| $T_1$ | 20.57 | a | 16.58 | e |
| $T_2$ | 11.36 | ef | 21.26 | c |
| $T_3$ | 18.99 | b | 14.58 | f |
| $T_4$ | 13.57 | cd | 23.31 | b |
| $T_5$ | 14.57 | c | 13.88 | f |
| $T_6$ | 10.11 | g | 19.00 | d |
| $T_7$ | 10.57 | fg | 13.58 | f |
| $T_8$ | 12.42 | de | 25.58 | a |
| $LSD_{(0.05)}$ | 1.15 | | 1.73 | |
| CV (%) | 4.92 | | 5.68 | |

In column, means containing same letter indicate significantly similar under LSD at 5% level of significance.

Table 3. Effect of plant growth regulators on the yield contributing character of cucumber.

| Treatment | Number of fruit per plant | | Fruit length (cm) | | Fruit diameter (cm) | |
|---|---|---|---|---|---|---|
| $T_0$ | 5.55 | g | 10.60 | e | 5.15 | c |
| $T_1$ | 9.55 | d | 15.90 | bcd | 6.55 | ab |
| $T_2$ | 12.55 | b | 16.40 | bc | 6.95 | ab |
| $T_3$ | 8.55 | e | 15.45 | bcd | 6.25 | abc |
| $T_4$ | 14.55 | a | 17.28 | ab | 7.29 | a |
| $T_5$ | 8.15 | ef | 14.90 | cd | 6.00 | bc |
| $T_6$ | 11.55 | c | 14.40 | d | 6.75 | ab |
| $T_7$ | 7.63 | f | 14.00 | d | 5.85 | bc |
| $T_8$ | 15.40 | a | 18.60 | a | 7.37 | a |
| LSD(0.05) | 0.87 | | 1.73 | | 1.15 | |
| CV(%) | 4.81 | | 6.54 | | 10.32 | |

In column, means containing same letter indicate significantly similar under LSD at 5% level of significance.

**4.11 Fruits Yield (kg) per plant**

The plant growth regulator had significant effect on the yield of fruits per plant (Table 4). The maximum yield of fruits per plant (2.38 kg) was produced by $T_8$ treatment, which was closely followed by $T_4$, $T_2$ and $T_6$ treatments. The minimum yield of fruits per plant (1.13 kg) was produced from $T_0$. The results indicated that the maximum fruit weight was produced by the application of plant growth regulators compared with the control. Kaushik *et al.* (1974) reported that $GA_3$ increased the number and weight of fruits per plant at higher concentration.

**4.12 Total fruit yield per hectare (t/ha)**

The yield of cucumber per plot was converted into per hectare, and has been expressed in metric tons (Table 4). The different plant growth regulators had significant effect on the yield of fruits per hectare. The maximum yield of fruits per hectare (16.72 tones) was obtained $T_8$ treatment, which was followed by $T_4$ treatment and the minimum yield of fruits per hectare (6.74 tones) was obtained from $T_0$ treatment. The results indicated that maximum yield per hectare was produced by the application of plant growth regulators compared with the control. Chudhury *et al*. (1967) reported that NAA 100 ppm; IAA 100 ppm and 200 ppm and MH 50 ppm and 200 ppm were equally effective in suppressing the male flowers and increasing the number of female flowers in cucumber. The effects subsequently increased the percentage of fruit set and ultimately the yield per hectare increased**.**

Table 4. Effect of plant growth regulators on yield of cucumber

| Treatment | Weight of fruit per plant (kg) | Yield of fruits (t/ha) |
|---|---|---|
| $T_0$ | 1.13 e | 6.74 f |
| $T_1$ | 1.99 bcd | 11.99 C |
| $T_2$ | 2.18 ab | 12.57 C |
| $T_3$ | 1.27 e | 7.64 E |
| $T_4$ | 2.28 ab | 14.72 B |
| $T_5$ | 1.71 cd | 10.27 D |
| $T_6$ | 2.04 abc | 12.07 C |
| $T_7$ | 1.64 d | 9.85 D |
| $T_8$ | 2.38 a | 16.72 A |
| LSD(0.05) | 0.35 | 0.87 |
| CV(%) | 10.81 | 4.39 |

In column, means containing same letter indicate significantly similar under LSD at 5% level of significance.

# Chapter 5

# Summary and Conclusion

# CHAPTER V
# SUMMARY AND CONCLUSION

A field experiment was conducted at the farm of Sher-e-Bangla Agricultural University, Dhaka. It was carried out during the period from February, 2015 to July 2015 to study the effects of plant growth regulators on flowering behaviour and yield of cucumber. The experiment considered of one factor. Factors are plant growth regulators viz. $T_0$= 0 ppm (control), $T_1$= MH 100 ppm , $T_2$= Silver nitrate 250 ppm, $T_3$= Ethophon 250 ppm, $T_4$= $GA_3$ 300 ppm , $T_5$= MH 200 ppm, $T_6$= Silver nitrate 500 ppm, $T_7$= Ethophon 500 ppm, $T_8$= $GA_3$ 500 ppm. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Data were collected on stem length, number of primary branches per plant, days required to first female flower and male flower, days to 50% flowering per plot, total number of male and female flowers per pant, number of fruit per plant, fruit length and diameter, weight fruit per plant, yield of fruits. The recorded data on different parameters were statistically analyzed using MSTAT software to find out the significance of variation resulting from the experimental treatments.

A statistically significant variation was recorded in terms of all the characters related to growth and yield of cucumber. The maximum stem length (185.10 cm) was produced by $T_8$ (500 ppm gibberelic acid) and the minimum stem length (130.4 cm) was produced by $T_0$ (control) treatment. The maximum number of branches per plant (19.47) was produced by $T_8$ treatment and the treatment $T_0$ produced the minimum number of branches per plant (3.57).

The $T_8$ treatment required the earliest of days of female first flowering (29.32 days). The treatment $T_0$ showed the longest time for days to male flowering (42.10 days). The $T_3$ (Ethophon 250 ppm) treatment required the earliest of days of male first flowering (31.6 days). The treatment $T_0$ (control) showed to require the longest time for days to female flowering (41.57 days). The treatment $T_8$ was the earliest in 50% flowering (45.68 days). The treatment $T_0$ required the maximum time of days of 50% flowering (52.53 days).

The maximum number of male flowers per plant (8.84) was produced by $T_2$ (Silver nitrate 250 ppm ) treatment. The treatment $T_0$ produced the minimum number of male flowers per plant (9.87). The maximum number of female flowers per plant (25.58) was produced by $T_8$ treatment. The treatment $T_0$ produced minimum number of female flowers per plant (10.58).

The maximum number of fruit per plant (15.40) was produced by $T_8$ treatment. The treatment $T_0$ produced the minimum number of fruit per plant (5.50). The longest fruit length (18.6 cm) was produced by $T_2$ and $T_0$ produced the shortest fruit length (10.6 cm). The largest fruit diameter (7.37 cm) was produced by $T_8$ treatment. The treatment $T_0$ produced the shortest fruit (5.15 cm). The maximum yield of fruits per plant (2.38 kg) was produced by $T_8$ treatment. The minimum yield of fruits per plant (1.13 kg) was produced from $T_0$. The maximum yield of fruits per hectare (16.72 tones) was obtained $T_8$

treatment and the minimum yield of fruits per hectare (6.74 tones) was obtained from $T_0$ treatment.

From the study, it might be concluded that gibberelic acid 500 ppm performed early female flower, lowest ratio of male and female flower, more female flower, more fruit set and maximum yield among the different growth regulators.

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 gibberellic acid may be included for drawing conclusion.

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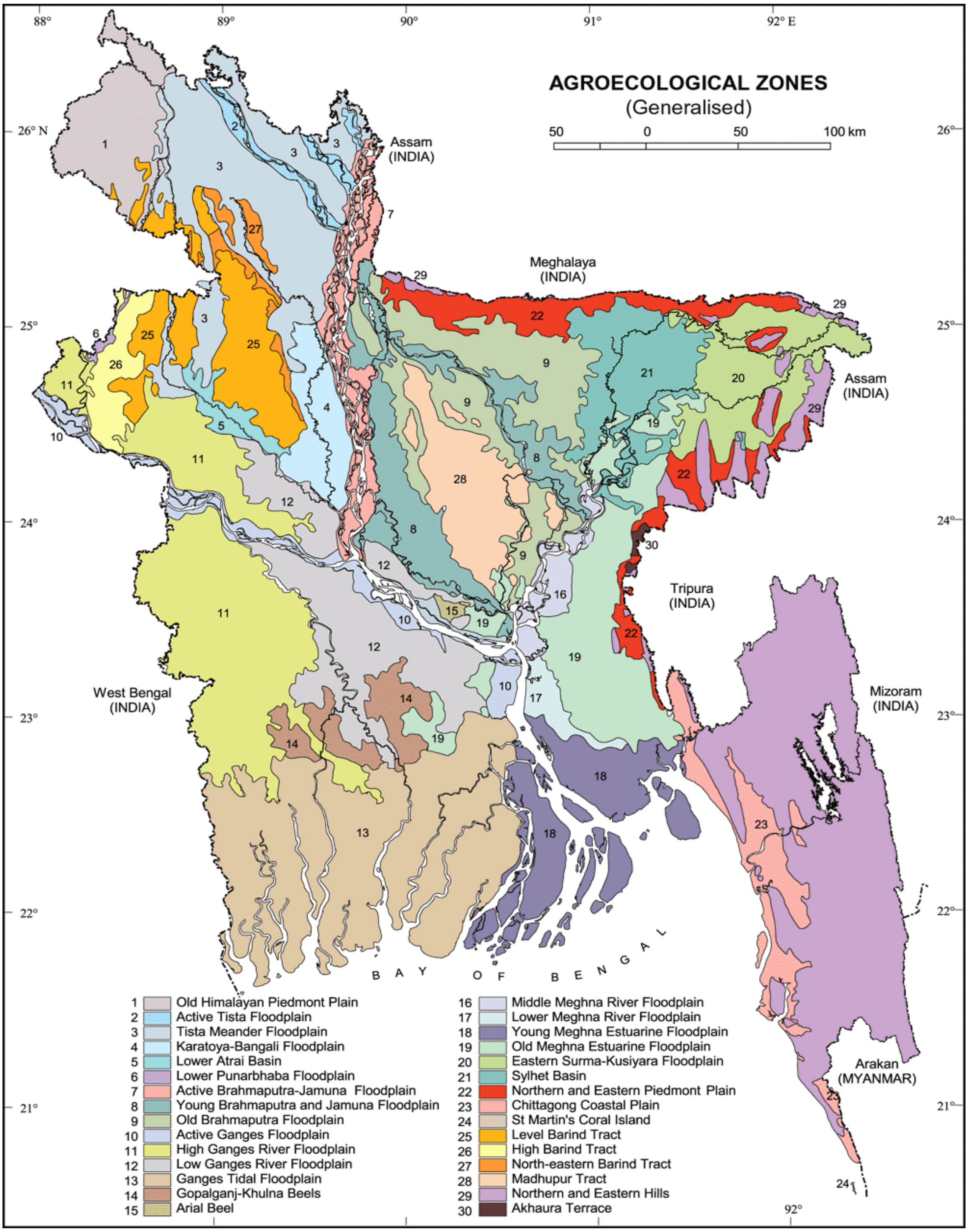
# APPENDICES

Appendix I: Experimental location on the map of Agro-Ecological Zones of Bangladesh



**Appendix II: Soil characteristics of Sher-e-Bangla Agricultural University Farm, Dhaka are analyzed by Soil Resources Development Institute (SRDI), Farmgate, Dhaka.**

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

| Morphological features | Characteristics |
|---|---|
| Location | SAU farm, Dhaka |
| AEZ | Modhupur tract (28) |
| General soil type | Shallow red brown terrace soil |
| Land type | High land |
| Soil series | Tejgaon |
| Topography | Fairly leveled |
| Flood level | Above flood level |
| Drainage | Well drained |
| Cropping pattern | N/A |

Source: Soil Resources Development Institute (SRDI)

**B. Physical and Chemical properties of the Initial soil**

| Characteristics | Value |
|---|---|
| Practical size analysis | |
| Sand (%) | 16 |
| Silt (%) | 56 |
| Clay (%) | 28 |
| Silt + Clay (%) | 84 |
| Textural class | Silty clay loam |
| Ph | 5.56 |
| Organic matter (%) | 0.25 |
| Total N (%) | 0.02 |
| Available P (µgm/gm soil) | 53.64 |
| Available K (me/100g soil) | 0.13 |
| Available S (µgm/gm soil) | 9.40 |
| Available B (µgm/gm soil) | 0.13 |
| Available Zn (µgm/gm soil) | 0.94 |
| Available Cu (µgm/gm soil) | 1.93 |
| Available Fe (µgm/gm soil) | 240.9 |
| Available Mn (µgm/gm soil) | 50.6 |

Source: Soil Resources Development Institute (SRDI)

**Appendix III: Analysis of variance of the data on Stem length and Number of primary branches per plant of cucurbit as influenced of plant growth regulators**

| Source | Degrees of Freedom | Mean Square | |
|---|---|---|---|
| | | Stem length | Number of primary branches per plant |
| Replication | 2 | 62.861 | 11.364 |
| Factor A | 8 | 1099.6* | 95.203* |
| Error | 16 | 7.111 | 0.444 |

*significant at 5% level of probability

**Appendix IV: Analysis of variance of the data on Days to first female flower, Days to first male flower and Days to 50% flowering per plot of cucurbit as influenced of plant growth regulators**

| Source | Degrees of Freedom | Mean Square | | |
|---|---|---|---|---|
| | | Days to first female flower | Days to first male flower | Days to 50% flowering per plot |
| Replication | 2 | 34.448 | 15.148 | 54.88 |
| Factor A | 8 | 49.101* | 55.192* | 14.125* |
| Error | 16 | 2.778 | 1.778 | 4 |

*significant at 5% level of probability

**Appendix V: Analysis of variance of the data on total number of male and female flowers per pant of cucurbit as influenced of plant growth regulators**

| Source | Degrees of Freedom | Mean Square | |
|---|---|---|---|
| | | Total number of male per pant | Total number of female flowers per pant |
| Replication | 2 | 13.474 | 19.188 |
| Factor A | 8 | 45.091* | 75.405* |
| Error | 16 | 0.444 | 1 |

*significant at 5% level of probability

**Appendix VI: Analysis of variance of the data on Number of fruit per plant, fruit length and fruit diameter of cucurbit as influenced of plant growth regulators**

| Source | Degrees of Freedom | Mean Square | | |
|---|---|---|---|---|
| | | Number of fruit per plant | Fruit length | Fruit diameter |
| Replication | 2 | 6.393 | 14.89 | 5.737 |
| Factor A | 8 | 33.213* | 15.431* | 1.572* |
| Error | 16 | 0.25 | 1 | 0.444 |

*significant at 5% level of probability

**Appendix VII: Analysis of variance of the data on weight of fruit per plant and yield of fruits of cucurbit as influenced of plant growth regulators**

| Source | Degrees of Freedom | Mean Square | |
|---|---|---|---|
| | | weight of fruit per plant | Yield of fruits |
| Replication | 2 | 1.217 | 20.342 |
| Factor A | 8 | 0.581* | 30.384* |
| Error | 16 | 0.04 | 0.25 |

*significant at 5% level of probability