

EFFECT OF PRUNING AND PLANT GROWTH REGULATORS ON GROWTH, FLOWERING, FRUITING AND YIELD OF CUCUMBER

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**EFFECT OF PRUNING AND PLANT GROWTH REGULATORS ON
GROWTH, FLOWERING, FRUITING AND YIELD OF CUCUMBER**

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CERTIFICATE

This is to certify that the thesis entitled, **EFFECT OF PRUNING AND PLANT GROWTH REGULATORS ON GROWTH, FLOWERING, FRUITING AND YIELD OF CUCUMBER** submitted to the **Department** of Horticulture and Postharvest Technology , 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 bonafide research work carried out by **Albela Afifa Mir** *Registration No. 27602/00749* under my supervision and my 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 has been availed during the course of this investigation have been duly acknowledged.

Dated:

Dhaka, Bangladesh.



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**DEDICATED
TO
MY PARENTS**

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The Author

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ABSTRACT

A field experiment was conducted in the Horticulture Farm of Sher-e Bangla Agricultural University, Dhaka, Bangladesh during the period from April to August 2006 to study the effect of pruning and different plant growth regulators on growth, flowering, sex ratio and fruit setting and yield of cucumber (Baromashi). The experiment was laid out in the two factors Randomized Complete Block Design (RCBD) with three replications. A statistically significant variation was recorded in terms of all the characters related to growth and yield of cucumber. Three different type of growth regulators viz. H (Maleic hydrazide 200 ppm), H₂ Ripen-15 (ethephon 300 ppm), H₃ Crops care (NAA 18 ppm) with control (No growth regulator, H₀) and two different shoot pruning practices; P₁ (Pruning to 3 primary branches), P₂ (pruning to 5 primary branches) with control (No pruning, P₀) were applied in the experiment. Maximum stem length (193.17 cm) at 50 DAS was found in H₀ treatment and minimum (167.5 cm) was found in H₂ treatment. Maleic hydrazide and NAA showed higher stem length than ethephon 300 ppm. However, the highest number of primary branches (12.37), secondary branches (24.31), female flower (22.94), fruit per plant (17.07), fruit setting percentage (74.81%), fruit weight (239.78 gm) and yield (45.82 t/ha) were recorded from H₂ treatment. The minimum values of the same parameters were observed in H₀ treatment or control. Maleic hydrazide and NAA were given lower yield than Ethephon but higher values than the control. Pruning to 5 primary branches showed better results in flowering fruit setting and yield of cucumber than pruning to 3 primary branches. The lowest yield (13.36 kg/plot) was found in P₀ and highest yield (19.92 kg/plot) was found in P₂ treatment. Six days early female flower initiation and four day early fruit maturity was recorded from H₂ treatment over control. The lowest male to female flower ratio (2.75) was found in Ethephon treated plant and highest ratio was found in control. Pruning did not give any significant value in terms of male to female flower ratio. In the interaction of pruning and growth regulators the maximum yield (53.73 t/ha) was found in P₂H₂ treatment and lowest (17.69 t/ha) was recorded in P₀H₀ treatment. The second highest (48.30 t/ha) yield was obtained from P₁H₂ treatment which was closely followed by P₂H₃ treatment (40.58 t/ha). The highest benefit cost ratio (3.54) was attained from the treatment combination of pruning to 3 primary branches and ethephon 300 ppm treated plants.

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LIST OF ABBREVIATED TERMS

FULL NAME	ABBREVIATION
Agro-Ecological Zone And others (at elli)	
Bangladesh Bureau of Statistics	AEZ <i>et al</i>
Centimeter	BBS cm
Degree Celsius	°C
Duncan’s Multiple Range Test Date	DMRT
After Transplanting Etcetera	DAT
Food and Agricultural Organization	etc
Gram	FAO
Hectare	g
Hour	ha
Kilogram	hr
Meter	kg
Millimeter	m
Month	mm
M urate of Potash	mo
Number	MP
Percent	no.
Randomized Complete Block Design	%
Sher-e-Bangla Agricultural University	RCBD
Square meter Triple Super Phosphate	SAU
	m ²
	TSP

INTRODUCTION

Cucumber (*Cucumis sativus*) is an annual trailing vine vegetable with a main stem and its branches, belongs to the family cucurbitaceae. It is a warm season crop and has little or no tolerance to frost. Growth and development 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. It 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 4.31 million tons including potato but we need around 11.15 million tons vegetable for our population (Anon, 2002).

Cucumber is widely consumed both fresh and as a processed food (Jarrick, 1986). Based on 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 of three months depending upon cultivar, region, soil climate, etc.

Flowering in cucurbits is very important phase of development because fruiting and yield depends on this process. Cucumber generally is a monoecious plant. The first flowers to appear near the base of a cucumber plant are male. In about a week after male flower initiation the female flowers appear with the small cucumber fruit at the base (Bantoc, 1964). Normally, fruits at the base of the plant are smaller than those borne on laterals or on the upper portion of the plant (Lower *et al.* 1986). Cucumber bears unisexual flowers, sex expression is genetically controlled, but it is amenable to modification by environmental factors and application of growth regulators. There is a wide range in sex ratio of cucumber. Female and Male flower ratio may vary up to 1:15 to 1:13. It can be minimized by some mechanical techniques and chemical practices.

Lower number of female flower compare to male flower is a problem for cucumber production in Bangladesh due to high temperature and humidity. So, it is necessary to increase the number of female flowers as well as fruiting for increasing the yield. High temperature and long photoperiod enhanced the number of male flower. On the other hand, low temperatures of 24°C to 25°C and photoperiod up to 12 h enhanced pistillate flower production. Photoperiod has no influence under gynoeocious stability under high temperature, above 30°C.

Exogenous application of growth regulators has shifted the sex expression towards femaleness by increasing the production of female flower and suppressing male flower of cucumber (Singh, 1984 and Arora *et al*, 1994). Moreover, pruning has a significant effect for decreasing the sex ratio in cucumber (Arora and Malik, 1989).

However in Bangladesh very limited research was conducted to improve femaleness in cucumber. Fanners of our country not use growth regulators. Fanners need to know about growth regulators with proper dose and effective measures to increase the production, quality and yield of cucumber. At present, at a very limited scale the fanners of our country started to use growth regulators to increase the yield of their vegetables as per recommendation of some commercial trader.

“Crops care” is a plant growth regulator in the class of organo-naphthalene, which stimulates cell division and tissue differentiation, promotes enlargement of sexual organs, induces fruit and promotes blossoming. “Ripen-15” is an organo phosphate compound and a growth regulating agent and the function of “Ripen- 15” is to increase female flower and the ratio female parts, promote blossoming in some plants and accelerate maturation (Hossain, 2004). Maleic hydrazide (MH) is a growth regulator which can stimulate female flowering and give higher fruiting percentage and fruit weight and yield of cucurbits (Samdyan *et al*. 1994).

The growth of plants and other factors can be modified by pruning according to human desires (Jarrick, 1986). There are many purposes for vine pruning treatments in cucumber, such as mechanical harvesting, hybrid seed production, to easily control insect and diseases, to use the higher plant population without significant yield reduction, and to obtain uniform fruits (Humphries and Vermillion, 1994). Actually, the use of 'Crops care', 'Ripen-15' and MH had influenced the production of cucumber.

However, very few research was conducted to improve the femaleness and yield of local variety of cucumber by hormone application and pruning practice. Therefore this experiment will be conducted to determine the effects of pruning and growth regulators on the flowering, fruiting and yield of cucumber.

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

1. To find out the effective Plant Growth Regulators on flowering (Sex ratio) of cucumber.
2. To know the effect of pruning on flowering, fruiting and quality fruit production cucumber.
3. To study the interactions between different hormones and pruning on flowering, fruiting and yield of cucumber.

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 pruning on cucumber production. There is a little or no combined research work to the effect of plant growth regulators and pruning 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 Review results of growth regulators:

Choudhury and Pahatak (1959) stated that cucumber plants treated with MH 200 ppm and NAA 100 ppm and IAA 100 increased the 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.

Bukovac and Wittwer (1961) reported that cucumber plants treated with gibberellins at a concentration of 100 ppm to young pickling type cucumber seedling hastened pistillate flowers formation earlier when cucumber plants were grown under short rather than long photoperiod.

Choudhury *et al.* (1967) carried out an experiment with NAA 100 ppm, IAA 100 ppm and 200 ppm and MH 50 ppm and 200 ppm. They found that the treatments were equally effective in suppressing the male flowers and increasing the number of female flowers in cucumber over control. There effects subsequently increase the percentage of fruit set and ultimately the yield.

Irving *et al.* (1968) reported 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 male flowers but lowered the male flowers but lowered the male and female ratio.

McMurray and Miller (1969) stated that cucumber seedlings treated with ethephon at concentrations of 120 ppm, 180 ppm or 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.

Sims and Gledhill, (1969) reported that application of ethephon at concentrations of 50-250 ppm at the fully expanded true leaf stage induced femaleness in the hybrid 'Piccadilly' and reduced the size of the plants by shortening the internodes.

Lower *et al.* (1970) reported that cultivar of cucumber Galaxy treated with ethephon at a concentration of 120 ppm at the one-leaf stage of at subsequent leaf stages increased pistillate flower formation.

Freytag *et al.* (1970) carried out an experiment on cucumber sex-expression modified by growth regulators. They found that TIBA 10ppm and 100ppm treated plant produced less number of female flowers which treatment with ethrel at 100ppm increased femaleness.

Randhawa and Singh (1970) stated that MH 200-300 ppm induced maximum number of hermaphrodite flowers thereby decreasing the sex ratio of cucumber. They suggested that maximum production of fruits can obtain from the use of MH 200-300 ppm in cucumber.

Robinson *et al.* (1971) reported that two application of 250 ppm ethephon produced gynoecia in cucumber plant and reduced internodes length and number of secondary braches.

Augustine *et al.* (1973) found that MCEB (5-methyl-7 chloro-4- ethoxycarbonylmethoxy-2, 1, 3-benzothiadiazole) had no effect on the androecious phenotype of cucumber while ethephon 500 ppm induced pistillate flowers. The effect of MCEB and ethphon treatment was a marked reduction in the number of staminate flowers. Ethylene induced pistillate flowers except when there was a 48-hour period between application of ethephon and MCEB In gynoecious phenotype, MCEB 75 ppm induced staminate flowers, ethephon had no effect, and the effect of MCEB and ethephon treatment was to induce staminate flowers at relatively high concentrations of MCEB 150 ppm.

Elassar *et al.* (1973) conducted an experiment on the normal and parthenocarpic fruit development. They reported that B-NOA (naphthoxyacetic acid), at rates lower than 100 ppm and IAA 10 ppm to 100 ppm were effective in normal fruit development and were less effective in producing parthenocarpic fruit, GA₃ (100- 1000 ppm) and GA₄+7 (50 ppm) slowed down the early rate of fruit development as compared with pollinated fruit, but were very effective in accelerating fruit development during later stages.

Beyer and Quebedeaux (1974) observed that a single application of NAA at concentration ranging from 500 to 5000 ppm increased number of pistillate flowers of cucumber to develop into fruits, while number of fruits were minimum on the controls. Fruits shape was normal but the growth was slightly retarded at 5000 ppm. They reported that application of N-l-naphthylphthalamic acid had positive effect on fruit set and development in cucumber.

Churata Masca and Awad (1974) observed improvement in early and total yield with ethephon 100-400 ppm applied twice to foliage prove beneficial in increasing fruit yield in monoecious cucumber.

Brokowski (1974) recommended ethephon 120 ppm for good fruit production of cucumber. He also reported that complete male flower sterility and maximum production of female flowers can occur with 240 ppm ethephon.

Bhandary *et al.* (1974) observed that the first female flower appeared earlier while male flower appearance was delayed after ethephon treatments 100-300 ppm sprayed at seedling stage in cucumber.

Bisaria (1976) reported that MH 200-300 ppm and chloroflurenol 40-200 ppm induced femaleness in cucumber plant.

Das and Swain (1977) reported that Alar 200 ppm produced the maximum number of fruits followed by its lower concentration and ethrel as compared to the control. Alar 200 ppm with 40 kg/ha nitrogen significantly produced more number of fruits followed by Alar 100 ppm with 40 kg/ha nitrogen and also produced heaviest fruit followed by ethrel 100 ppm with 40 kg/ha of nitrogen, ethrel 200 ppm with 20 kg/ha of nitrogen.

Gopalkrishnan 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. 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 increase in the number of fruits and weight of fruits of cucumber.

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.

Mangel *et al.* (1981) conducted an investigation to study the influence of various chemicals (Ethrel, NAA, Cycocel, MH, PCPA, Ascorbic acid and Boron) on the growth, flowering and yield of bitter melon. 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 *et 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 unpruned muskmelon cv Hara Madhu.

Gosh and Basu (1983) found that spraying with IAA at 17.5 or 35 mg/l increased the number of female flowers. Ethrel at 25 mg/l increased female flowers but 100 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 Bom 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/l 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 GA³ [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).

Rudich (1990) reported that the application of Ethrel (2-chloroethane phosphonic acid), an ethylene-releasing compound, to monoecious cultivars of cucumber and squash and an andromonoecious cultivar of muskmelon, caused a shift towards femaleness in all three species. The increase in femaleness manifested itself in several symptoms: a decrease in the number of staminate (male) flowers, an increase in the number of pistillate (female) or hermaphrodite (perfect) flowers, and a change in flowering pattern, namely, formation of female flowers at lower nodes in cucumber and squash and formation of hermaphrodite flowers on the main axis in muskmelon where normally only male flowers are formed in this cultivar.

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-(methylamino) cyclopropane -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 melon 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/l, while maximum thickness or weight of flesh, dry matter vitamin 'C' and T.S.S. contents were observed with cycocel 250 mg/l GA₃ 25 mg/l resulted in maximum seeds in fruits, while MH 25 mg/l and ethephon 100 mg/l caused maximum weight loss of fruits 2 DAS or 4 DAS, respectively. N 50 kg/ha + ethephon 100 mg/l or GA₃ 25 mg/l improved the shape index and seed control of fruits, respectively.

Kim *et al.* (1994) reported that application of auxin transport inhibitors, naptalam (N-I-naphthylphthalamic acid) and TIBA to the ovary or peduncle of cucumber flowers (cultivars Khira and Pandex and their F₁ 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, GA₃ cytokinins, BA and CPPU [forchlorfenuron] to the ovary at anthesis, however, induced over 60% parthenocarpic fruit set in Khira and the F₁ 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, GA₃ maleic hydrazide (MH), and NAA on melon. Growth regulators were applied at the 2- and 4-leaf stages. GA₃ 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 branches/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/plant). Ethephon at 250 mg/litre also gave the highest fruit yield/ha (29.76 t), while GA₃ 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 GA₃, 50 ppm or 150 ppm NAA, 50 ppm, 100 pptn 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). GA₃ 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 ethephon 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.

Hossain (2004) conducted an experiment to study the effect of “Crops care” (Naphthalene 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) during April to August, 2003 at the experimental farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur. Four concentrations of “Crops care” 0.2 ml (9 ppm), 0.3 ml (13.5 ppm), 0.4 ml (18 ppm) and 0.5 ml (22.5 ppm) and five concentrations of “Ripon-15” 1.0 ml (150 ppm), 1.5 ml (225 ppm), (300 ppm), 2.5 ml (375 ppm) and 3.0 ml (450 ppm) were applied in the experiment. “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 bittergourd.



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 bittergourd treated with 2.5 ml 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.

2.2 Review results of pruning

Gobeil and Gosselin (1989) conducted an experiment on the influence of pruning season of cucumber. They reported that summer pruning gave a high production of fruits.

Arora and Malik (1989) reported that pruning of ridge gourd plants to six primary branches with a medium spacing level (45 cm) produced the longest plants, gave maximum number of secondary branches, resulted in early appearance of pistillate flowers, lowered sex ratio and gave higher number and weight of fruits from early and total yield. The result of reduced sex ratio for pruning was due to more production of secondary branches on which pistillate flowers appeared in large number.

Thang (1995) reported that an experiment was carried out on the effect of six different pruning methods on the yield of cucumber variety Pong and evaluated from December 1995 to February 1996 at AVRDC-ARC experimental field, Kamphaengsaen, Nakhon Pathom, Thailand. The local cucumber variety Pong was chosen for the field experiment. The treatments of the experiment were No pinching (M_0), Pinching branches on main stem at node 10 up to down (M_1), Pinching branches on main stem at node 15 up to down (M_2), No pruning (P_0) and pruning branches at node 4 (P_1). The highest yield (total yield = 19.72 t/ha, marketable yield = 14.93 t/ha, non-marketable yield = 4.79 t/ha, early stage yield = 3.28 t/ha) was obtained by the treatment M_0P_1 , with no pinching of branches on main stem but pruning branches at node 4. The method of pruning branches had no significant effect on horticultural character such as fruit size and plant height. The pinching treatments had low yield. This was resulted because of the absence of sufficient branches. Nu (1996) stated that the effect of pruning (pinching out the branches on main stem at node 4 up to the bottom and prune when lateral shoots on main stem set fruit on first on second node of lateral shoot) on yield and fruit quality of four cucumber varieties, namely; Lanna-5 (Fi), Nopakao (Fj), Lan-Laem (op) and Pong (op) was evaluated using a 4×2 factorial experimental design with no pruning treatment. The experiment was carried out at the ARC-AVRDC experimental field, located at Kasetsart University, Nakhon Pathom, Thailand from November 1996 to February 1997. The no pruning treatment produced the highest total yield 22.18 ton/ha as well as highest non-marketable yield 7.70 t/ha while the pruning treatment produce low non marketable yield 5.16 t/ha and total yield 17.11. But, the number of branches, nodes and stem length was higher in the pruning treatment.

MATERIALS & METHOD

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 Horticulture farm of Sher-e-Bangla Agricultural University, Dhaka. The experiment was carried out during the period from April 2006 to July 2006. 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 Modhupur 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 'Baromashi' local variety of cucumber were obtained from BADC, Sher-e-Bangla Nagar, Dhaka .

3.5 Treatments of the Experiment

The experiment was designed to study the effects of different types of plant growth regulators and shoot pruning practices on growth, flowering and yield of cucumber. The experiment consisted of two factors as follows:

Factor A : Plant growth regulators (Four type)

- I. Ho (Control)
- II. Hi (Maleic Hydrazide 200 ppm)
- III. H₂ (Ehephon 300ppm)
- IV. H₃ (NAA 18 ppm)

Factor B : Pruning (Three type)

- I. Po (No pruning)
- II. Pi (Pruning to three primary branches)
- III. P₂ (Pruning to five primary branches)

There were altogether 12 treatments combination such as H₀P₀, H₀P₁, H₀P₂, H₁P₀,

H. P₂, H₂P₂, H₂P₀, H₂P₁, H₂P₂, H₃P₀, H₃P₁, H₃P₂

3.6 Experimental design and layout

It was a factorial experiment. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. An area of 24 m x 16 m was divided into six equal blocks. Each block was divided into six plots. First two blocks were included in first replication (R_1) and 3rd and 4th block was in second replication (R_2) and last two blocks were in third replication (R_3). Every replication had twelve plots where 12 treatments were allotted at random. The size of each plot was 3m x 1.8m. The distance between two blocks and two of plots both were 1m. A layout of the experiment has been shown in Fig. 1.

3.7 Land preparation

The selected land for the experiment was opened 23 March, 2006 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 stubble were removed and the basal dose of fertilizers were applied and mixed thoroughly with the soil before final land preparation. The unit plots were prepared by keeping 1m spacing in between two plots and 50cm 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

There were six pits in every plot. The length and breadth of each pit was 30cm and 30cm respectively. There was 20cm depth in pits and 45cm distance from the border of the plots. The pits were prepared with necessary manures and fertilizers in 7th April, 2006.

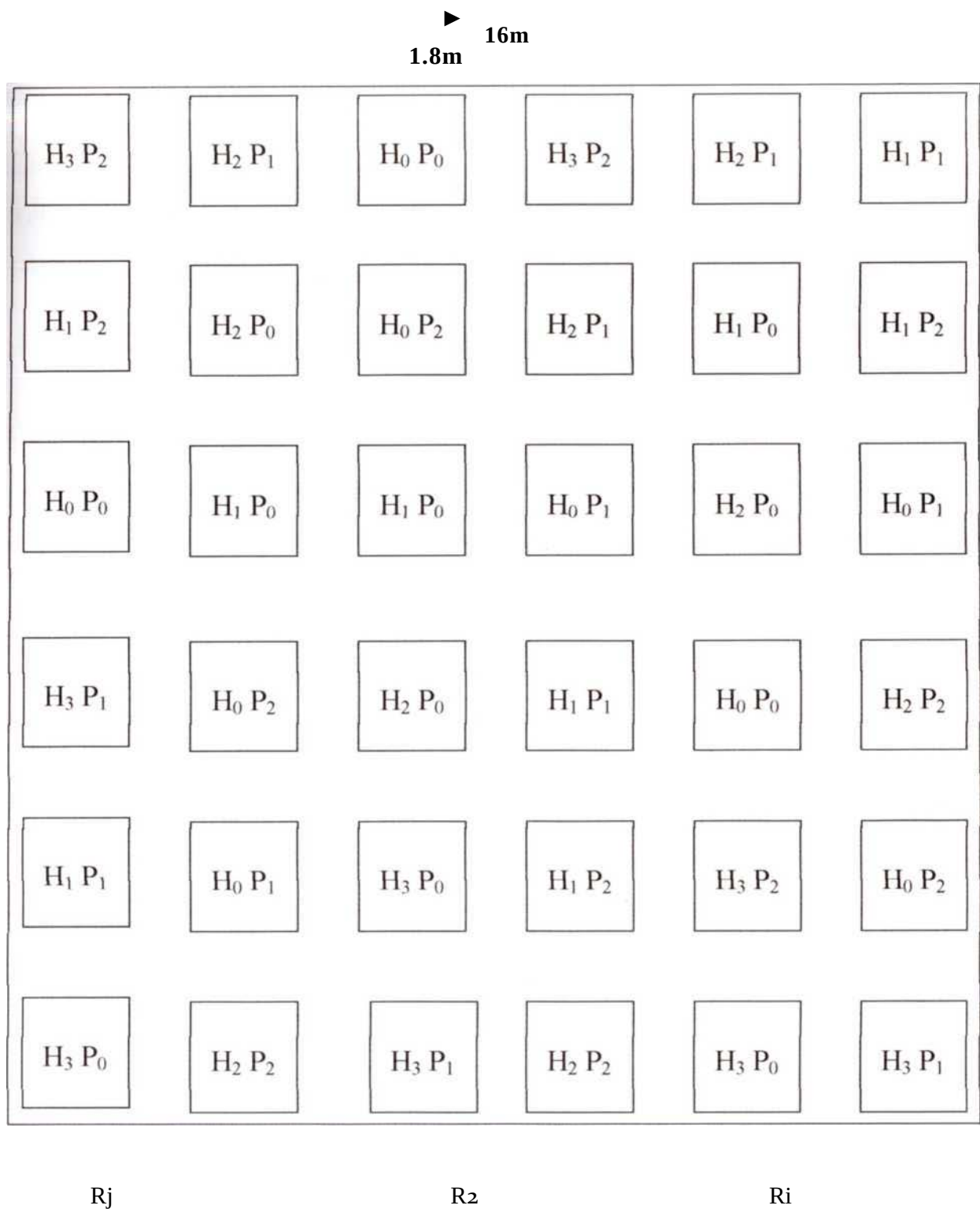


Fig 1. Layout of the experimental design

3.9 Application of manures and fertilizers

Following doses of manures and fertilizers were recommended for cucumber production by Rashid (1994).

<u>Manures and fertilizers</u>	<u>Dose per hectare</u>
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.

<u>Manures and fertilizers</u>	<u>Dose per plot</u>	<u>Dose per pit</u>
3.16.28 Cow dung	6 k	1 kg
3.16.29 Urea	90 g	15g
3.16.30 TSP	75g	12.5 g
3.16.31 MP	60 g	10 g

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 12th April. 2006. 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 Preparation of Plant Growth Regulators (PGR) solution

Three different plant growth regulators were used in the experiment. “Crops Care” (NAA 4.5%), “Ripen-15” 42.5% ethephon and maleic hydrazide powder were used to prepare NAA (18 ppm), ethephon (300 ppm) and maleic hydrazide (200 ppm) solutions respectively.

The solutions were prepared through following procedures:

- a) Maleic hydrazide 200 ppm (H₁): To make maleic hydrazide 200 ppm solution 0.2 gm maleic hydrazide powder mixed with 2ml NH₄OH solution. Then 2ml surfactant was added with the solution for increasing the additive value. Then the solution was made upto 1000ml by adding distilled water and shaken well.
- b) Ethephon 300 ppm (H₂): To make Ethephon 300 ppm solution 0.705ml “Ripen-15” was added with 2 ml surfactant for increasing the additive value. Then the solution made upto 1000 ml by adding distilled water and shaken well.
- c) NAA 18 ppm (H₃): To make NAA 18 ppm solution 0.40 ml “Crops Care” was added with 2 ml surfactant and then the solution was made upto 1000 ml by adding distilled water and shaken well.

3.12 Application of Hormone treatments

In the experiment each of the three 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 26th April, 2006. 2nd spray was done after 7 days of 1st spray and 3rd spray was done after 10 days of 2nd spray to the leaves and twigs of the plants with a knapsack sprayer.

3.13 Application of Pruning treatment

Side branches on main stem were pruned according to treatments. When the branches were appeared from the main stem and became 2-3 cm long then that was pruned. Pruning was done from the basal nodes of the plants according to treatments. First pruning was done on 4th May, 2006.

3.14 Intercultural Operations

3.14.1 Weeding:

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

3.14.2 Staking:

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

3.14.3 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 no need. When irrigation was supplied then it was given through drains of the plots.

3.14.5 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 1⁻¹ 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 as soil insecticide.

3.15. 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.

3.16 Data collection

3.16.1 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.

3.16.2 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.

$$\frac{\text{Total number of primary branches from six plants of each treatment}}{6} \text{ Number of primary branches} = \text{---}$$

3.16.3 Number of secondary branches

Total number of secondary branches was counted at final harvest from each plant of the treatment. Mean value was calculated by the following formula

$$\frac{\text{Total number of secondary branches}}{\text{from six plants of each treatment}} \text{ Number of secondary branches per plant} =$$

3.16.4 Node number for 1st female and male flower

When first female flower was appeared in any plant of each treatment then the node number of that plant was counted. This data was taken from each plant of each treatment and mean value was calculated. In the same way node for 1st male flower was also calculated.

3.16.5 Days to 50% flowering per plot

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

3.16.6 Total number of male and female flowers per pant

Number of female flower per plant was counted from first female flower appearance and it was take at three days intervals. Total number of female flowers was recorded from six plants of each treatment. It was calculated by the following formula.

Number of male flowers was also conducted from first flowering and at three days intervals. Total number of male flower was recorded from each treatment and was calculated by the following formula

3.16.7 Days required to first female flower and male flower

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

3.16. 8 Ratio of male and female flower per treatment

The ratio of male and female flower was calculated from total number of male and female flowers. Ratio of male and female flower was calculated by dividing of male flower by female flower.

3.16.9 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.

$$\frac{\text{Total number of fruits from six plants of each treatment}}{\text{Number of plants}} = \text{Number of fruits per plant}$$

3.16.10 Fruit length and girth

Fruit length and girth was taken by measuring tape in centimeter. Girth i.e. breath 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.

3.16.11 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.

3.16.12 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 1% or 5% probability.

RESULTS AND DISCUSSION

The present experiment was conducted to determine the effect of pruning and growth regulators on the yield contributing characters and yield of cucumber. The analysis of variance (ANOVA) of the data on different yield components and yield of cucumber are given in Appendix 1I1-V. The results have been presented and discussed, and possible interpretations have been given under the following headings:

4.1 Stem length (cm)

A statistically significant variation was found in stem length due to with different levels of pruning at 30 DAS, 40 DAS and 50 DAS. Length of the main showed a gradual decreasing trend start from no pruning to pruning to 5 primary branches at 30 DAS. The maximum stem length (90.59 cm) at 30 DAS was recorded from P_0 treatment which was closely followed by P_1 treatment (87.30 cm) consisting of pruning to 3 primary branches (Figure 2) and the minimum stem length (83.72 cm) was recorded from P_2 treatment comprising of pruning to 5 primary branches. At 40 DAS the maximum stem length (152.86 cm) was recorded in P_0 treatment and the minimum (146.71 cm) length was recorded from P_2 treatment. At 50 DAS the maximum stem length (181.50 cm) was recorded from P_0 treatment and the minimum stem length (176.25 cm) was recorded from P_2 treatment. The results indicated that maximum stem length was produced the cucumber plant without any pruning. It may be due to the plant suffered some shocking period of pruning which hindered the growth of main shoot and due to producing more lateral shoot over control.

In terms of stem length in relation with different type of plant growth regulators at 30 DAS, 40 DAS and 50 DAS a statistically significant difference was recorded

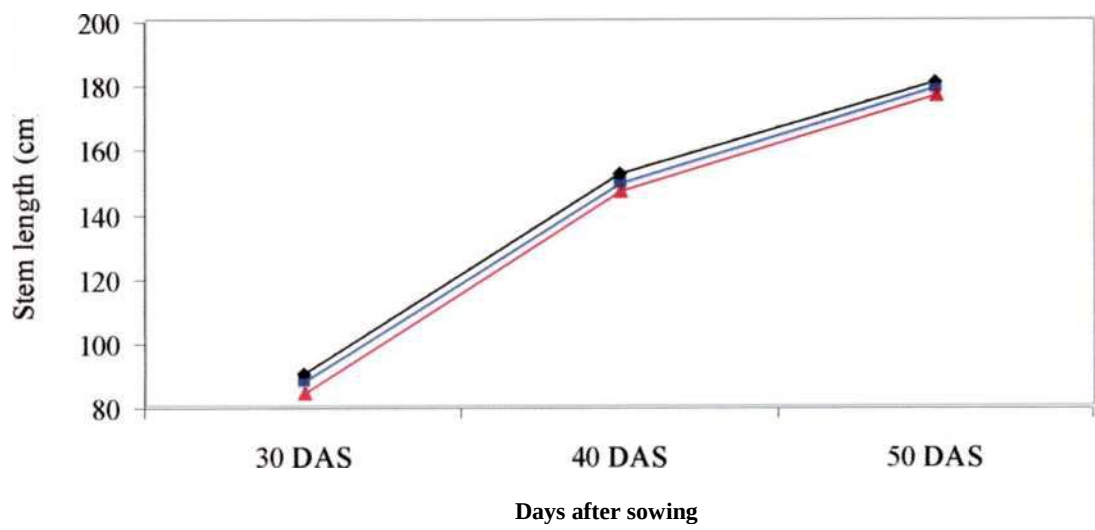


Figure 2. Effect of pruning on stem length at different days after sowing of cucumber PO: No priming; P1: Pruning to 3 primary branches and P2: Pruning to 5 primary branches

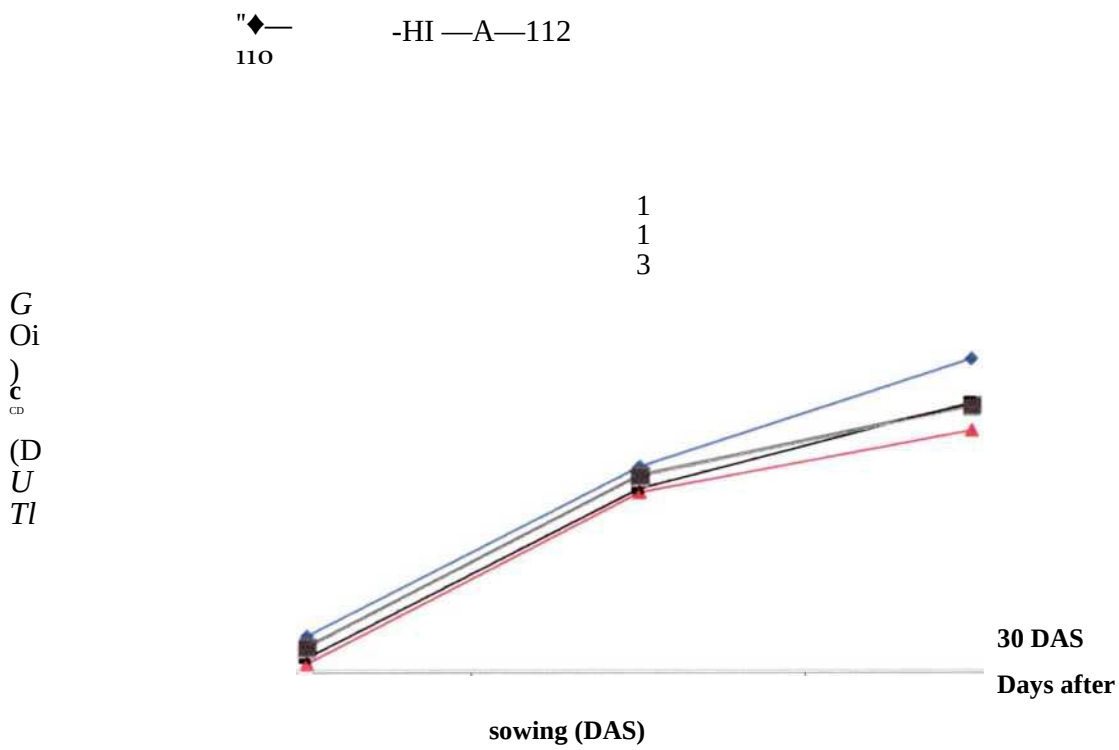


Figure 3. Effect of different growth regulator on stem length at different days after sowing of cucumber

HO: No hormone application; H1: Malcic hydrazide (200 ppm); H2: Ripon-15 (Ethepon-300 ppm) and H3: Crops care (NAA-18 ppm)

under the trial (Appendix 111). The maximum stem length (92.35 cm) at 30 DAS was recorded from H₀ treatment comprising of no hormone application (Figure 3) which was closely followed by H₁ treatment (88.59 cm) consisting of NAA-18 ppm and the minimum (82.46 cm) stem length was recorded from H₂ comprising of ethephon-300 ppm. At 40 DAS the maximum stem length (155.18 cm) was recorded from H₀ treatment and the minimum (144.40 cm) length was recorded from the H₂ treatment which was closely followed by H₁ treatment (147.08 cm) comprising of maleic hydrazide 200 ppm. At 50 DAS the maximum stem length (193.17 cm) was recorded from H₀ treatment and the minimum stem length (167.50 cm) was recorded from H₂ treatment. The results indicated that maximum stem length was produced by the H₁ treatment among the different growth regulators in every recorded day. Probably ethephon-300ppm decreases the stem length for all the commencing date.

The highest stem length (95.52 cm) at 30 DAS was recorded from the treatment combination P₀H₀ and the minimum (79.86 cm) in the treatment combination of P₂H₂ (Table 2). At 40 DAS the highest stem length (158.38 cm) was recorded from the treatment combination P₀H₀ and the minimum stem length (141.50 cm) was recorded from the treatment combination of P₂H₂. Similarly at 50 DAS the highest stem length (196.30 cm) was recorded from the treatment combination P₀H₀ and the minimum stem length (164.20 cm) was recorded from the treatment combination of P₂H₂. Results revealed that there were no interaction effect between pruning and growth regulators.

4.2 Number of primary branches

Number of primary branches showed a statistically significant variation in relation with different levels of pruning. The lowest number of primary branches (10.46) was recorded in P₀ treatment which was closely followed by P₁ treatment (11.55) and the highest number of primary branches (12.38) was recorded from P₂ treatment (Table 1). The results indicated that maximum number of primary branches was produced in the cucumber plant with pruning practices. It may be due to the pruning enhance to producing more primary branches.

In terms of number of primary branches in relation with different levels of plant growth regulators a statistically significant difference was recorded. The minimum number of primary branches (10.67) was recorded from H₀ treatment which was closely followed by H₁ treatment (11.17) and the maximum (12.37) number of primary branches was recorded from H₂ (Table 1) which was statistically similar with H₃ treatment (11.63). The results indicated that maximum number of primary branches was produced by the H₂ treatment among the different growth regulators. Probably ethephon-300 ppm increases the growth of auxiliary bud and shoots as well as number of primary branches.

The lowest (9.32) number of primary branches per plant was recorded from the treatment combination P(H₀) and the highest (13.20) was found in the treatment combination of P₂H₂ (Table 2). Results revealed that pruning and growth regulators did not exhibited any interaction effect.

4.3 Number of secondary branches

Number of secondary branches showed significant differences in relation with different levels of pruning. The lowest number of secondary branches (21.72) was recorded from P_q treatment, which was closely followed by P_> treatment (22.42) and the highest number of secondary branches (23.49) was recorded from P₂ treatment (Table 1). The results indicated that maximum number of secondary branches was produced the cucumber plant with following pruning practices. It may be due to the pruning of lower branches of plant which enhanced producing more lateral buds.

Growth regulators significantly influenced the growth of secondary branches .The minimum number of secondary branches (20.73) was given from H₀ treatment (Table 1) which was closely followed by H₁ treatment (21.82) and the maximum (24.31) was recorded in H₂ which was statistically similar with H₃ treatment (23.30). The results showed that maximum number of secondary branches was produced by the H₂ treatment among the different growth regulators. Probably ethephon-300 ppm increases the growth of auxiliary buds as well as number of secondary branches.

Interaction effect of pruning and plant growth regulators showed a statistically non significant dissimilarity in consideration of number of secondary branches per plant in the present study. The lowest (20.05) number of secondary branches per plant was recorded from the treatment combination P_0H_0 and the highest (25.50) was recorded from the treatment combination of P_2H_2 (Table 2). Results revealed that pruning and growth regulators did not exhibited any interaction effect in terms of number of secondary branches. Hume and Lovell (1983) reported that the sex of the main bud at the first five to six nodes is usually determined but the secondary buds still have bisexual potential.

4.4 Node for 1st male flower

Node for 1st male flower showed a significant variation in relation with different levels of pruning. The lowest (7.04) node for 1st male flower was recorded from P_0 treatment which was closely followed by P_1 treatment (8.33) and the highest (11.80) node for 1st flower was recorded in P_2 treatment (Table 1). The results indicated that without paining plant produced 1st male flower earlier with lower number of node of cucumber plant.

In terms of node for 1st male flower in relation with different levels of plant growth regulators a statistically significant difference was recorded under the present trial. The minimum (6.27) no of node for 1st male flower was recorded from H_1 treatment (Table 1) which was closely followed by H_3 treatment (9.04) and the maximum (11.27) was recorded from H_2 . The results indicated that maximum number of node were required for 1st male flower by the H_2 treatment among the different growth regulators.

Significant interaction effect was recorded between paining and plant growth regulators in consideration of node for 1st male flower under the present trial (Appendix III). The lowest (5.40) number of node for 1st male flower was recorded from the treatment combination $P|H_1|$ and the highest (14.81) was recorded from the treatment combination of P_2H_2 (Table 2).

4.5 Node for 1st female flower

Node for 1st female flower showed a significant variation in relation with different levels of pruning (Appendix III). The lowest (8.17) node for 1st female flower was recorded from P₀ treatment and the highest (8.89) node for 1st female flower was recorded from P₂ treatment (Table I). The results indicated that without pruning plant produced 1st female flower earlier with lower node of the plant.



Plate 1. First female Flower in lower node at ethylene treated plant.

Plate 2. First male Flower in lower node at control treatment.

Table 1. Main effect of pruning and plant growth regulators on stem length, number of primary and secondary branches and node for 1st male and female flower per plant of cucumber

Treatment	Stem length (cm) at			Number of	
	30 DAS	40 DAS	50 DAS	Primary branches/plant	Secondary branches/plant
Pruning					
Po	90.59 a	152.86 a	181.50	10.46 c	21.72 b
Pi	87.30 ab	148.88 ab	178.78	11.55b	22.42 ab
P ₂	83.72 b	146.71 b	176.25	12.38 a	23.49 a
Level of significance	*	*	NS	**	*
Plant growth regulators					
Ho	92.35 a	155.18a	193.17a	10.67 c	20.73 c
Hi	85.42 be	147.08 be	178.10b	11.17 be	21.82 be
h ₂	82.46 c	144.40 c	167.50 c	12.37 a	24.31 a
h ₃	88.59 ab	151.27 ab	176.60 b	11.63 ab	23.30 ab
Level of significance	*	**	**	**	**

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability 5% level of probability ** : Significant at 1% level of probability

P₀: No pruning

Pi :Pruning to 3 primary branches

P₂:Pruning to 5 primary branches

H₀: No hormone application H₁:

Maleic hydrazide (200 ppm) H₂:

Ripen-15 (Ethenon-300 ppm) H₃:

Table 2. Interaction effect of pruning and plant growth regulators on stem length, number of primary and secondary node for 1 male and female flower per plant of cucumber

Table 2. Interaction effect of pruning and plant growth regulators on stem length, number of primary and secondary node for 1 male and female flower per plant of cucumber

Treatment	Stem length (cm) at			Number of	
	30 DAS	40 DAS	50 DAS	Primary branches/plant	Secondary branches/plant
PoHo	95.52	158.38	196.30	9.32	20.05
PoH ₁	88.64	150.48	180.40	10.40	21.07
PoH ₂	85.57	147.82	170.70	11.30	23.35
PoH ₃	92.64	154.77	178.60	10.80	22.40
PiHo	93.95	154.95	192.42	10.30	20.95
PtHj	84.86	146.50	178.30	11.50	21.55
PiH ₂	81.96	143.87	167.60	12.60	24.08
PiH ₃	88.41	150.20	176.80	11.80	23.10
P ₂ H ₀	87.59	152.20	190.80	12.40	21.20
P ₂ H ₁	82.75	144.27	175.60	11.60	22.85
p ₂ h ₂	79.86	141.50	164.20	13.20	25.50
P ₂ H ₃	84.71	148.85	174.40	12.30	24.40
Level of significance	NS	NS	NS	NS	NS
CV (%)	6.76	3.74	3.41	6.62	6.92

NS : Not Significant

P₀: No pruning

P₁: Pruning to 3 primary branches

P₂:Pruning to 5 primary branches

H₀: NO hormone application

H₁!: Maleic hydrazide (200 ppm)

H₂: Ripen-15 (Ethepon-300 ppm)

A statistically significant difference was recorded for 1st female flower in relation with different levels of plant growth regulators. The minimum (5.42) node for 1st female flower was recorded from H₂ treatment (Table 1) which was closely followed by H_i treatment (6.07) and the maximum (15.24) was recorded from H_o treatment. The results indicated that lower number of node were required for 1st female flower by the H₂ treatment among the different growth regulators.

The lowest (4.20) number of node for 1st female flower was recorded from the treatment combination PoH₂ and the highest (15.22) was recorded from the treatment combination of PoH_o (Table 2). The result revealed that pruning and growth regulators did not exhibited any interaction effect in terms of node for 1st female flower under the present trial.

4.6 Days required for 1st male flowering

Days required for 1st male flowering showed a significant variation in relation with different levels of pruning. The lowest (31.77) days required for 1st male flowering was recorded from P_o treatment which was closely followed by P_i treatment (32.84) and the highest (34.03) days for 1st male flower was recorded from P₂ treatment (Table 3). The results indicated that without pruning plant produced 1st male flower earlier male flower with minimum number of node under the present study.

In terms of days required for 1st male flowering in relation with different levels of plant growth regulators a statistically significant difference was recorded under the present trial. The minimum (31.08) days required for 1st male flowering was recorded from H_o treatment (Table 3) which was closely followed by H_i treatment (32.25) and the maximum (34.84) was recorded from H₂ treatment which was closely followed by treatment (33.34).

The lowest (30.00) number of days required for 1st male flowering was recorded from the treatment combination P_oH_o and the highest (36.07) was recorded from the treatment combination of P₂H₂ (Table 4). Results revealed that pruning and growth regulators did not exhibited any interaction effect in terms of days required for 1st male flowering under the present trial.

4.7 Days required for 1st female flowering

Days required for 1st female flowering showed a significant variation in relation with different levels of pruning. The lowest (30.74) days required for 1st female flowering was recorded from P₀ treatment (Table 3), which was closely followed by P₁ treatment (32.20) and the highest (33.79) Days required for 1st female flowering was recorded from P₂ treatment.

In terms of days required for 1st female flowering in relation with different levels of plant growth regulators a statistically significant difference was recorded under the present trial. The maximum (35.89) Days required for 1st female flowering was recorded from H₀ treatment (Table 3) which was closely followed by H₁ treatment (32.39) and the minimum (29.68) was recorded from H₂ which was closely followed by H₃ treatment (31.02). The results indicated that minimum days were required for 1st female flower by the H₂ treatment among the different growth regulators. Treatment with ethephon 300 ppm changed the direction of sexual differentiation in potentially male buds to female buds and caused early female flowers in lower nodes of the main stem than male flowers. From the results it is evident that growth regulators had significant influence on the time to first female flower. Similar result was found in bitter melon by Mangal *et al.* (1981).

The highest number of days (36.42) required for 1st female flowering was recorded from the treatment combination P₂H₀ and the lowest (27.12) was recorded from the treatment combination of P₀H₂ (Table 4).

4.8 Days required for 50% male flowering

The highest days (49.56) required for 50% male flowering was recorded from P₁ treatment which was closely followed by P₁ treatment (48.39) consisting of and the lowest (47.32) node for 1st flower was recorded from P₂ treatment (Table 3).

The minimum (46.61) days required for 50% male flowering was recorded from H₀ treatment (Table 3) which was closely followed by H₁ treatment (47.80) and the maximum (50.39) was recorded from H₂ which was closely followed by H₃ treatment (48.89).

The lowest number of days (46.80) required for 50% male flowering was recorded from the treatment combination P_iH_o and the highest (51.62) was recorded from the treatment combination of P_oH_2 (Table 4). Results revealed that pruning and growth regulators did not exhibited any interaction effect in terms of days required for 50% male flowering under the present trial.

4.9 Days required for 50% female flowering

Days required for 50% female flowering showed a significant variation in relation with different levels of pruning. The lowest days (44.96) required for 50% female flowering was recorded from P_o treatment which was closely followed by P_i treatment (46.42) and the highest (48.01) days required for 50% female flowering was recorded from P_2 treatment (Table 3).

The maximum days (50.11) required for 50% female flowering was recorded in H_o treatment which was closely followed by H_i treatment (46.61) consisting of maleic hydrazide (200 ppm) and the minimum (43.90) was recorded from H_2 (Table 3) which was closely followed by H_3 treatment (45.24).

The highest number of days (50.64) required for 50% female flowering was recorded in the treatment combination P_2H_o and the lowest (41.34) was recorded in the treatment combination of P_oH_2 (Table 4). Results revealed that pruning and growth regulators did not exhibited any interaction effect in terms of days required for 50% female flowering under the present trial (Appendix IV).

4.10 Total number of male flower

Total number of male flower showed a significant variation in relation with different levels of pruning (Appendix IV). The lowest total number of male flower (92.92) was recorded from P_0 treatment and the highest (104.70) was recorded from P_2 treatment (Table 3) which was statistically identical by P_i treatment (99.37).

Total number of male flower was also influenced by different levels of plant growth regulators. A statistically significant difference was recorded with plant growth regulators under the present trial (Appendix IV). The maximum (134.91) total number of male flower was recorded in H_0 treatment comprising of no hormone application (Figure 4) which was closely followed by H_3 treatment (105.13) and the minimum (62.96) was recorded from H_2 treatment.

Significant interaction effect was recorded between pruning and plant growth regulators in consideration of total number of male flower under the present trial (Appendix IV). The lowest (56.29) total number of male flower was recorded from the treatment combination P_0H_2 and the highest (142.10) was recorded from the treatment combination of P_2H_0 (Table 4).

4.11 Total number of female flower

Total number of female flower showed a significant variation in relation with different levels of pruning. The lowest total number of female flower (18.15) was recorded from P_0 treatment which was closely followed by P_i treatment (20.72) and the highest (22.43) total number of female flower was recorded in P_2 treatment (Table 3). This may be due to highest number of secondary branches, which resulted for pruning and produced higher number of female flowers.

A statistically significant difference was recorded for total number of female flower in relation with different levels of plant growth regulators under the present trial (Appendix IV). The minimum total number of female flower (14.91) was recorded from H₀ treatment (Table 3) which was closely followed by H₁ treatment (19.51) and the maximum (22.94) was recorded from H₂ treatment (Table 3), which was closely followed by H₃ treatment (21.04). Choudhury and Pahatak (1959) stated that cucumber plants treated with MH 200 ppm and NAA 100 ppm and IAA 100 increased the number of female flowers. This is resulted because the exogenous application of plant growth regulators can alter the sexual differentiation in floral buds. Ethephon at 250 mg per liter resulted the highest number of female flower per plant (27) by Arora, *et al.* (1994).

Exogenous application of ethylene was correlated with the amount of 1- (inolonylamino) cyclopropane-1 carboxylic acid (ACC) in the time. ACC changed the direction of sexual differentiation in potentially male buds to female buds. Ultimately the total number of female flower was increased in cucumber plant under the present study. The same result was found in bottle gourd and reported by Ying *et al.* (1994).

The highest total number of female flower (25.27) was recorded from the treatment combination P₂H₀ and the lowest (13.52) was recorded from the treatment combination of P₀H₀ (Table 4). Results exposed that pruning and growth regulators did not exhibited any interaction effect in terms of total number of female flower under the present trial.

4.12 Ratio of male and female flower

The lowest (5.23) ratio of male and female flower was recorded in P₂ treatment (Table 3) and the highest (5.65) ratio was recorded from P₀ treatment. The results indicated that without pruning plant produced minimum ratio of male and female flower. Because pruning treatments gave higher number of female flowers as well as male flower than no pruning treatment which resulted higher ratio in pruning treatment.

Growth regulators significantly influenced the ratio of male and female flowers. The maximum (9.10) ratio of male and female flower was recorded from H_0 treatment (Table 3) which was closely followed by H_1 treatment (5.03) and the minimum (2.75) was recorded from H_2 treatment. Choudhury and Phatak (1959) studied the effects of growth regulators on sex expression of cucumber and reported that treatments increased the female to male flower ratio when compared with the control. 18 ppm NAA and 300 ppm ethephon increased femaleness and reduced maleness in cucumber that decreased male-female flower ratio. Hossain (2004) also found the same results in cucumber and bitter gourd.

The lowest (2.71) number of ratio of male and female flower was recorded from the treatment combination P_0H_2 and the highest (9.40) was recorded from the treatment combination of P_0H_0 (Table 4). Results revealed that pruning and growth regulators did not exhibited any interaction effect in terms of ratio of male and female flower under the present trial.

Hume and Lovell (1983) reported that 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 in main and secondary branches for at least 7 days after spraying become female flowers. Thus, nodes five and six had male flowers in the controls, whereas in ethephon- sprayed plant the presumptive male flowers aborted at the bud stage at these nodes and secondary primordia developed into functional female flowers.

4.13 Days required for harvest of green fruit

The lowest (9.44) days required for harvest of green fruit was recorded from P_0 treatment which was closely followed by P_2 treatment and the highest (9.68) days required for harvest of green fruit was recorded from P_1 treatment (Table 5).

The maximum (11.56) days required for harvest of green fruit was recorded from H_0 treatment (Table 5) which was closely followed by treatment (9.56) and the minimum (7.85) was recorded from H_2 treatment. Late maturation was found from the control plants. Early

fruit maturation from hormone treated plants was due to acceleration of physiological maturity by loss of chlorophyll and breakdown of carbohydrate, protein and RNA with the increasing activity of chlorophyllase, protease, ribonuclease, etc (Hossain, 2004).

Results revealed that pruning and growth regulators did not exhibited any interaction effect in terms of days required for harvest of green fruit under the present trial. The highest (12.00) days required for harvest of green fruit was recorded from the treatment combination P_2H_0 and the lowest (7.85) was recorded from the treatment combination of P_0H_2 and P_2H_2 (Table 6).

Table 3. Main effect of **pruning and plant growth regulators on days required for 1st flowering and ratio of male and female flower of cucumber**

Treatment	Days required for 1 st flowering		Days required for 50% flowering		Total number	
	Male	Female	Male	Female	Male	Female
Pruning						
Po	31.77b	30.74 b	49.56 a	44.96 b	92.92 b	
Pi	32.84 ab	32.20 ab	48.39 ab	46.42 ab	99.37 a	
P 2	34.03 a	33.79 a	47.32 b	48..01 a	104.70 a	
Level of significance	**	**	He	**	**	
Plant growth regulators						
Ho	31.08 c	35.89 a	46.61 c	50.11 a	134.91 a	
H,	32.25 be	32.39 b	47.80 be	46.61 b	92.98 c	
h ₂	34.84 a	29.68 c	50.39 a	43.90 c	62.96 d	
h ₃	33.34 ab	31.02 be	48.89 ab	45.24 be	105.13 b	
Level of significance	**	* *	**	**	**	

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability; ** : Significant at 1% level of probability

P₀: No pmning
 Pi :Pruning to 3 primary branches
 P₂:Pmning to 5 primary branches

H₀: No hormone application H₁:
 Maleic hydrazide (200 ppm) H₂:
 Ripen-15 (Ethepon-300 ppm) H₃:
 Crops care (NAA-18 ppm)

Interaction effect of **pruning and plant growth regulators on days required for 1***
of flower and ratio of male and female flower of cucumber

Table 4.

Interaction effect of **pruning and plant growth regulators on days required for 1st flowering and 50% flowering and ratio of male and female flower of cucumber**

Treatment	Days required for 1 st flowering		Days required for 50% flowering		Total number
	Male	Female	Male	Female	Male
PoHo	30.00	35.22	47.48	49.44	126.20
PoHi	31.55	32.18	48.75	46.40	91.94
PoH ₂	33.45	27.12	51.62	41.34	56.29
PoH ₃	32.07	28.45	50.40	42.67	97.25
PiHo	31.25	36.03	46.80	50.25	136.43
PiH ₁	32.00	31.40	47.55	45.62	93.54
PiH ₂	35.00	30.97	50.55	45.19	62.87
PiH ₃	33.12	30.72	48.67	44.64	104.63
P ₂ H ₀	32.00	36.42	45.55	50.64	142.10
P ₂ H ₁	33.20	33.60	47.10	47.82	93.46
P ₂ H ₂	36.07	30.97	49.00	45.19	69.72
P ₂ H ₃	34.85	34.18	47.62	48.40	113.50
Level of significance	NS	NS	NS	NS	NS
CV (%)	6.14	6.56	4.18	4.55	7.03

NS : Not Significant

P₀: No pruning

P₁: Pruning to 3 primary branches

P₂: Pruning to 5 primary branches

Ho: No hormone application Hi:

Maleic hydrazide (200 ppm) H₁:

Ripen-15 (Ethepon-300 ppm) H₂:

Total number of fruit per plant showed a significant variation in relation with different levels of pruning (Appendix V). The lowest (11.54) total number of fruit per plant was recorded from P₀ treatment and the highest (14.79) total number of fruit per plant was recorded from P₂ treatment. The results indicated that without pruning plant produced minimum number of fruit/plant in the present trial.

In terms of total number of fruit per plant in relation with different levels of plant growth regulators a statistically significant difference was recorded under the present trial (Appendix V). The maximum (17.07) total number of fruit/plant was recorded from H₂ treatment (Table 5) which was closely followed by H₃ treatment (14.39) and the minimum (9.60) was recorded from H₀ which was closely followed by H₁ treatment (12.99). Similar results was observed by Hossain (2004)

The highest (18.58) number of total of fruit per plant was recorded from the treatment combination P₂H₂ and the lowest (8.94) was recorded from the treatment combination of P₀H₀ (Table 6). Results revealed that pruning and growth regulators did not exhibited any interaction effect in terms of total number of fruit per plant under the present trial.

4.15 Fruit setting (%)

The lowest fruit setting (63.43%) was recorded from P₀ treatment (Figure 6) and the highest (68.13%) was recorded from P₁ treatment. A statistically significant difference was recorded In terms of fruit setting in relation with different levels of plant growth regulators .The maximum fruit setting (74.81%) was recorded from H₂ treatment (Figure 7) which was closely followed by H₃ treatment (68.25%) and the minimum (53.13%) was recorded from H₀ treatment (Table 5). This led to the effect that fruit set could be increased by plant growth substances required for its development and enhanced fruit set. Choudhury *et. al.* (1967) reported that plant growth regulators were equally effective in suppressing the male flowers and increased the number of female flower as well as the percentage of fruit set

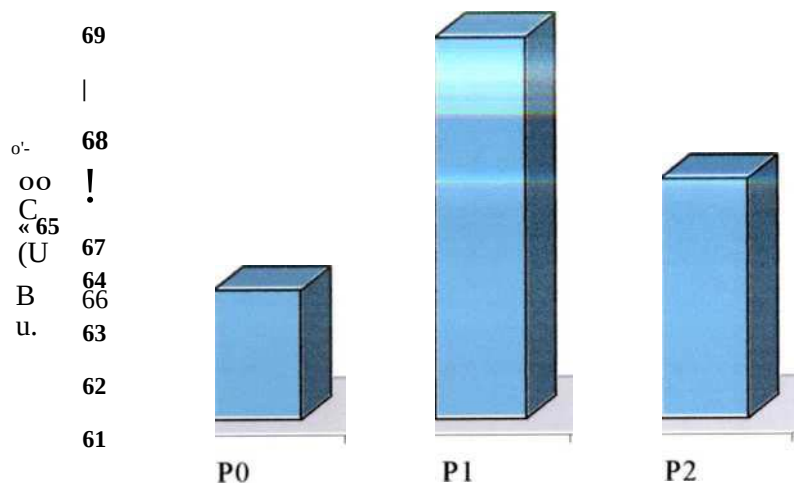
and ultimately the yield. Similar results also reported by Gopalkrishnan(1978) in water melon and Choudhury and Phatak (1959) in cucumber. The lowest (50.50%) fruit setting percentage was recorded from the treatment combination P_2H_0 and the highest (79.42%) was recorded from the treatment combination of P_1H_2 (Table 6). Results revealed that pruning and growth regulators did not exhibited any interaction effect in terms of fruit setting under the present trial.



Plate 3. First mature fruit at lower node in ethylene treated plant.



Plate 4. Fruit on secondary branches node in ethylene treated plant.



Pruning

Figure 4. Effect of pruning on fruit setting of cucumber

P0: No pruning; P1: Pruning to 3 primary branches and P2: Pruning to 5 primary branches

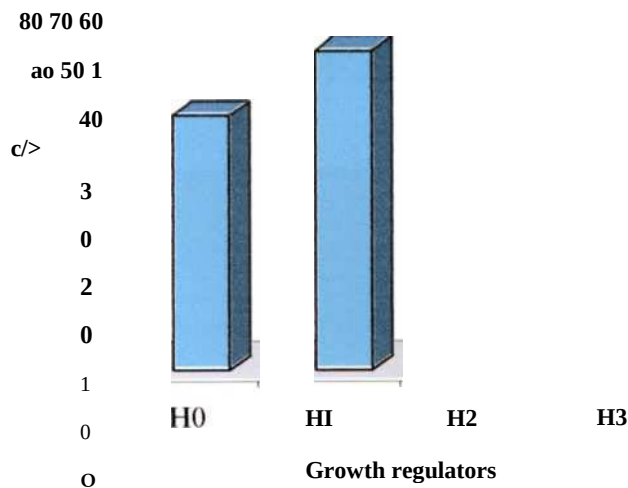


Figure 5. Effect of growth regulators on fruit setting of cucumber

H0: No hormone application; H1: Maleic hydrazide (200 ppm); H2: Ripen-15 (Ethephon-300 ppm) and H3: Crops care (NAA-18 ppm)

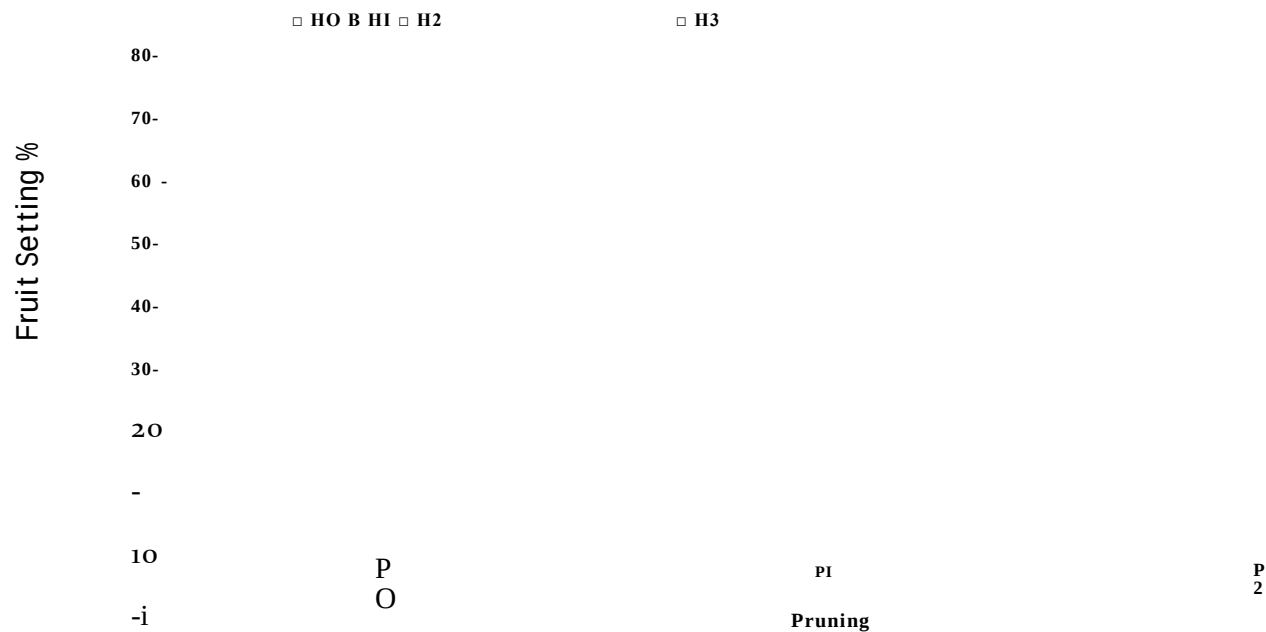


Figure 6. Interaction effect between pruning and growth regulators on fruit setting of cucumber

P₀: No pruning
P₁:Pruning to 3 primary branches
P₂:Pruning to 5 primary branches
H₀: No hormone application
H₁: Maleic hydrazide (200 ppm)
H₂: Ripen-15 (Ethepon-300 ppm)
H₃:

Crops care (NAA-18 ppm)

The lowest (15.79 cm) average length of individual fruit was recorded from P₀ treatment that was similar with P₁ treatment (16.75 cm) and the highest (18.24 cm) average length of individual fruit was recorded from P₂ treatment (Table 5).

In terms of average length of individual fruit in relation with different level of plant growth regulators a statistically significant difference was recorded. The minimum (14.27 cm) average length of individual fruit was recorded from H₀ treatment (Table 5) which was closely followed by H₁ treatment (16.55 cm) and the maximum (19.33 cm) was recorded from H₂ (ethephon-300 ppm) which was closely followed by H₃ treatment (17.55 cm). Islam *et. al.* (1990) reported that the bottle gourd plants treated with NAA 200 ppm produced fruits of maximum length, whereas fruits of minimum length in control. Growth regulators increased rate of photosynthesis activity, accelerated translocation and efficiency of utilization photosynthesis, thus resulting in the cell elongation and rapid cell division in the growing portion which ensure longest fruit length.

The highest average length (20.95 cm) of individual fruit was recorded from the treatment combination P₂H₂ and the lowest (13.43 cm) was recorded from the treatment combination of P₀H₀ (Table 6). Results revealed that pruning and growth regulators did not exhibited any interaction effect in terms of average length of individual fruit under the present trial.

4.17 Average girth of individual fruit (cm)

Average girth of individual fruit showed a significant variation in relation with different levels of pruning. The lowest (11.78 cm) average girth of individual fruit was recorded in P₀ treatment that was closely followed by P₁ treatment (13.06 cm) and the highest (14.16 cm) average girth of individual fruit was recorded in P₂ treatment (Table 5).

Growth regulators significantly influence the average girth of individual fruit. The minimum (11.77 cm) girth of individual fruit was recorded in H_0 treatment (Table 5) which was closely followed by H_1 treatment (12.53 cm) and the maximum (14.25 cm) was recorded from H_2 which was closely followed by H_3 treatment (13.46 cm). Weaver (1972) found increased fruit size in cucumber with growth regulators might be due to cell enlargement and cell division by auxinic action. Auxin-compound growth regulators caused cell enlargement in fruit cells through osmotic uptake of water and extension of existing cell area.

Results revealed that pruning and growth regulators did not exhibited any interaction effect in terms of average girth of individual fruit The highest (15.29) average girth of individual fruit was recorded from the treatment combination P_2H_2 and the lowest (10.97) was recorded from the treatment combination of P_0H_0 (Table 6).

4.18 Individual fruit weight (gm)

Individual fruit weight showed a significant variation in relation with different levels of pruning. The lowest (189.25 g) individual fruit weight was recorded from P_0 treatment that was closely followed by P_1 treatment (201.8 g) and the highest (218.75 g) was recorded from P_2 treatment (Table 5). Different plant growth regulators significantly influenced weight of individual fruit.

Weight of individual fruit was significantly influenced by different growth regulators The minimum (173.11 g) individual fruit weight was recorded from H_0 treatment (Table 5) which was closely followed by H_1 treatment (185.22 g) and the maximum (238.78 g) was recorded in H_2 treatment.

Results revealed that pruning and growth regulators did not exhibited any interaction effect in terms of individual fruit weight (g). The lowest individual fruit weight (163.00 gm) was recorded in the treatment combination P_0H_1 and the highest (260.33 gm) was recorded in the treatment combination of P_2H_2 (Table 6).

4.19 Yield (kg/plot)

Pruning and growth regulators significantly influenced yield. The lowest (13.36 kg/plot) yield was recorded from P₀ treatment, which was closely followed, by P₁ treatment (17.68 kg/plot) and the highest (19.92 kg/plot) yield was recorded from P₂ treatment (Table 5). The results indicated that pruning plant produced maximum yield due to having more branches and more fruits.

The minimum yield (10.00 kg/plot) was recorded from H₀ treatment (Table 5) which was closely followed by H₁ treatment (14.52 kg/plot) and the maximum (24.74 kg/plot) was recorded from H₂ which was closely followed by H₃ treatment (18.68 kg/plot). The results indicated that maximum yield was attained by the H₂ treatment among the different growth regulators.

Results revealed that pruning and growth regulators did not exhibited any interaction for yield per plot under the present trial. The highest yield (29.01 kg/plot) was recorded from the treatment combination P₂H₂ and the lowest yield (8.74 kg/plot) was recorded from the treatment combination of P₀H₀ (Table 6).

4.20 Yield (t/ha)

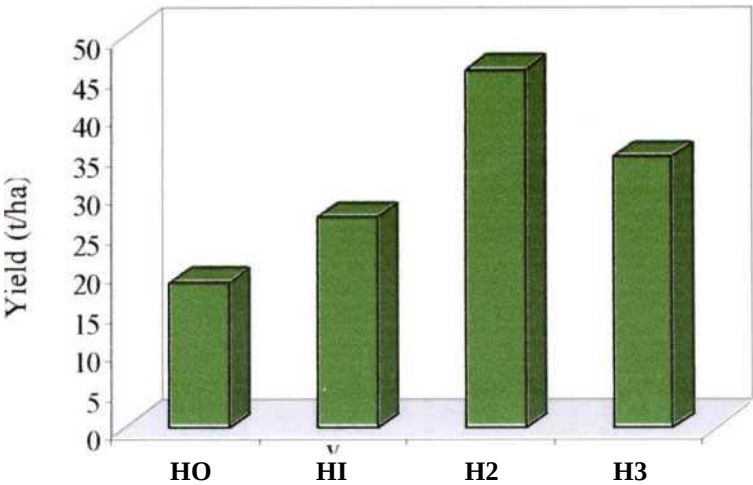
The lowest (25.12 t/ha) yield was recorded from P₀ treatment comprising of no pruning which was closely followed by P₁ treatment (32.75 t/ha) and the highest (36.90 t/ha) yield was recorded from P₂ treatment (Figure 8). The results indicated that pruning plant produced maximum yield under the present trial. Nu (1996) stated that the effect of pruning on yield and fruit quality of four cucumber varieties and reported that pruning had significant influence on yield of cucumber and gave lowest non-marketable yield over the control. Growth regulators significantly influence the yield of cucumber. The minimum (19.02 t/ha) yield was recorded from H₀ treatment (Figure 10) which was closely followed by H₁ treatment (26.89 t/ha) and the maximum (45.82 t/ha) was recorded in H₂ (ethepon-300 ppm) which was closely followed by H₃ treatment (45.24). The results indicated that maximum yield was attained by the H₂ treatment among the different growth regulators.

Pruning and plant growth regulators did not exhibit any interaction effect on yield of cucumber. The highest (53.73 t/ha) yield was recorded in the treatment combination P₂H₂ and the lowest (17.619 t/ha) was recorded from the treatment combination of P(>H₀) (Table 6).

Pruning

Figure 7. Effect of pruning on yield of cucumber

PO: No pruning; PI: Pruning to 3 primary branches and P2: Pruning to 5 primary branches



Growth regulators Figure 8. Effect of growth regulators on yield of cucumber

HO: No hormone application; HI: Maleic hydrazide (200 ppm); H2: Ripen-15 (Ethepon-300 ppm) and

Table 5. Main effect of pruning and plant growth regulators on days **required** for **harvest of green fruit, total number of fruit, fruit** setting percentage, length, girth and individual fruit weight and yield per plot and hectare of cucumber

Treatment	Days required for harvest of green fruit	Total number of fruit/plant	Fruit setting (%)	Average length of individual fruit (cm)	Average girth of individual fruit (cm)	Individual fruit weight (g)
Pruning						
Po	9.44	11.54b	63.43	15.79 b	11.78 c	189.25 c
Pi	9.68	14.21 a	68.13	16.75 b	13.06 b	201.83 b
P 2	9.60	14.79 a	65.49	18.24 a	14.16a	218.75 a
Level of significance	NS	**	NS	**	**	**
Plant growth regulators						
Ho	11.56 a	9.60 d	53.13 c	14.27 c	11.77c	173.11 c
Hi	9.32 b	12.99 c	66.53 b	16.55 b	12.53 be	185.22 c
H ₂	7.85 c	17.07 a	74.81 a	19.33 a	14.25 a	239.78 a
h ₃	9.56 b	14.39 b	68.25 b	17.55 b	13 .46 ab	215.00 b
Level of significance	**	**	**	**	**	* *

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability
1% level of probability

P₀: No pruning

P₁ :Pruning to 3 primary branches

P₂:Pruning to 5 primary branches

H₀: No hormone application

H₁: Maleic hydrazide (200 ppm)

H₂: Ripen-15 (Ethepon-300 ppm)

H₃: Crops care (NAA-18 ppm)

Table 6. Interaction effect of pruning and plant growth regulators on days required for harvest of green fruit to maturity, fruit setting percentage, length, girth and individual fruit weight and yield per plot and hectare of cucumber

T reatment	Days required for harvest of green fruit	Total number of fruit/plant	Fruit setting (%)	Average length of individual fruit (cm)	Average girth of individual fruit (cm)	Ind fruct weight (g)
PoHo	11.00	8.94 f	57.81	13.43	10.97	163.5
PoH ₁	9.33	11.11 de	65.53	15.22	11.48	174.5
PoH ₂	7.85	14.67 be	70.81	18.00	12.67	217.5
PoH ₃	9.56	11.45 d	59.55	16.50	12.00	203.5
Pi Ho	11.67	9.64 ef	51.09	14.17	11.78	173.5
PiH ₁	9.63	13.33 c	66.25	16.58	12.22	183.5
p ₁ h ₂	7.85	17.95 a	79.42	19.04	14.79	242.5
P ₁ H ₃	9.56	15.91 b	75.75	17.22	13.45	211.5
P ₂ Ho	12.00	10.22 def	50.50	15.22	12.55	185.5
p ₂ h ₁	9.00	14.54 be	67.82	17.85	13.89	198.5
p ₂ h ₂	7.85	18.58 a	74.21	20.95	15.29	260.5
P ₂ H ₃	9.56	15.80b	69.44	18.92	14.93	231.5
Level of significance	NS	*	NS	NS	NS	N
CV (%)	7.70	7.06	8.97	7.18	8.64	6.5

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability
5% level of probability

P₀: No pruning

P_i :Pruning to 3 primary branches

P_j:Pmning to 5 primary branches

H₀: No hormone application

H_i; Maleic hydrazide (200 ppm)

H_j: Ripen-15 (Ethepon-300 ppm)

4.21 Cost analysis

The economic analysis was done to find out the gross and net return and the benefit cost ratio in the present experiment and presented under the following headings-

4.21.1 Gross return

In the combination of pruning and plant growth regulators highest gross return (Tk. 644,760.00) was obtained from the treatment combination of P₂H₂ and the second highest gross return (Tk. 579,600.00) was obtained in P₂H₃. The lowest gross return (Tk. 212,280) was obtained in the control condition i.e. no pruning and no plant growth regulators (Table 7).

4.21.2 Net return

In case of net return different treatment combination showed different types of net return. In the combination of pruning and plant growth regulators highest net return (Tk.462,438.00) was obtained from the treatment combination of P₂H₂ and the second highest net return (Tk.397,278.00) was obtained in PiH₂. The lowest net return (Tk. 33,596.00) was obtained in the control condition.

4.21.3 Benefit cost ratio

In the combination of pruning and plant growth regulators highest benefit cost ratio (3.54) was attained from the treatment combination of P₂H₂ and the second highest benefit cost ratio (3.18) was acquired in PJH₂. The lowest benefit cost ratio (1.19) was obtained in no pruning and no plant growth regulators (Table 7).

Table 7. Cost and return of cucumber cultivation as influenced by pruning and plant growth regulators

T reatment Combination	Cost of production (Tk./ha)	Yield of cucumber (t/ha)	Gross return (Tk./ha)	Net return (Tk./ha)	Benefit cost ratio
PoH)	178684	17.69	212280	33596	1.19
PoH,	232863	21.50	279436	46573	1.20
PoH ₂	182322	35.44	425280	242958	2.33
PoH ₃	181873	25.84	310080	128207	1.70
P.Ho	178684	18.35	220200	41516	1.23
P.H,	232863	26.94	323280	90417	1.39
PiH ₂	182322	48.30	579600	397278	3.18
PiH₃	181873	37.39	448680	266807	2.47
P ₂ H.	178684	21.03	252360	73676	1.41
P ₂ H,	232863	32.24	386880	154017	1.66
P ₂ H ₂	182322	53.73	644760	462438	3.54
P₂H;	181873	40.58	486960	305087	2.68

P₀: No pruning
IVPmning to 3 primary branches
P₂:Pruning to 5 primary branches

H₀: No hormone application
H₁: Maleic hydrazide (200 ppm)
H₂: Ripen-15 (Kthepon-300 ppm)
1 Crops care (NAA-IK ppm)

Market price of Cucumber a Tk. 12,000/t
Gross return = t otal >ield (t/lia) x Ik. 12,000
Net return = Gross return - Total cost of production
Benefit Cost Ratio (BCR) = Gross retum/Total cost of production

SUMMARY

A field experiment was conducted in the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from April to August 2006 to study the effect of pruning and different plant growth regulators on growth, flowering, sex ratio and fruit setting in cucumber. The experiment considered of two factors. Factor A: pruning (3 levels) i.e. No pruning, pruning to 3 primary branches and pruning to 5 primary branches; Factor B: Different plant growth regulators (4 levels): No hormone (control), Maleic hydrazide (200 ppm), Ripen-15 (Ethepon-300 ppm) and Crops care (NAA-18 ppm). There were on the whole 12 (3 x 4) treatments combinations. The experiment was laid out in the two factors Randomized Complete Block Design (RCBD) with three replications. After emergence of seedlings, various intercultural operations were accomplished for better growth and development of the plant.

Data were collected on stem length of plant at different days after sowing, number of primary and secondary branches per plant, time to first flowering (days), number of nodes for first flower, total number of flower, number of fruits per plant, fruit length (cm), fruit girth (cm), weight of fruit (g), yield (kg/plot) and yield (t/ha). All collected data of the present study were analyzed statistically and the mean differences were adjudged by least significance difference (LSD) test.

A statistically significant variation was recorded in terms of all the characters related to growth and yield of cucumber. In consideration of pruning from terms of stem length at 50 DAS the maximum (181.50 cm) was recorded from P_0 treatment and the minimum (176.25 cm) was recorded from P_2 treatment comprising of pruning to 5 primary branches. In terms of stem length in relation with different type of plant growth regulators at 50 DAS the maximum (193.17 cm) stem length was recorded from H_0 treatment and the minimum (167.50 cm) was recorded from H_2 treatment (ethepon-300 ppm). In consideration of interaction effect of pruning and plant growth regulators at 50 DAS the highest (196.30 cm) stem length was recorded from the treatment combination P_0H_0 and the minimum (164.20 cm) was recorded from the treatment combination of P_2H_2 .

In consideration of pruning in terms of primary and secondary branches, node for 1st male and female flowering, days required for 1st and 50% male and female flowering minimum value was recorded from P₀ treatment and the maximum value was recorded from P₂ treatment. In terms of plant growth regulators the maximum was recorded from H₂ treatment and the minimum was recorded from H₀ treatment. In consideration of interaction effect of pruning and plant growth regulators lowest value was recorded from the treatment combination P₀H₀ and the highest value was recorded from the treatment combination of P₂H₂.

Total number of male flower showed a significant variation in relation with different levels of pruning and the lowest (92.92) male flower was recorded from P₀ treatment and the highest (104.70) was recorded from P₂ treatment. The maximum number of male flower (134.91) was recorded from H₀ treatment and the minimum (62.96) was recorded from H₂. The lowest (56.29) number of male flower was recorded from the treatment combination P₀H₂ and the highest (142.10) was recorded from the treatment combination of P₂H₀. On the other hand the lowest (18.15) total number of female flower was recorded from P₀ treatment and the highest (22.43) total number of female flower was recorded from P₂ treatment.

The minimum (14.91) number of female flower was recorded from H₀ treatment and the maximum (22.94) was recorded from H₂ treatment. The highest (25.27) total number of female flower was recorded from the treatment combination P₂H₀ and the lowest (13.52) was recorded from the treatment combination of P₀H₀. The highest value (9.40) in ratio of male and female flower was found from the treatment combination P₀H₀ and lowest (2.77) in the P₂H₂. In consideration of pruning from terms of fruit length, fruit girth and individual fruit weight the highest value was recorded from P₁ treatment and the minimum value was recorded from P₂ treatment. In terms of different type of plant growth regulators the maximum value was recorded from H₂ treatment and the minimum from H₀ treatment. In consideration of interaction effect of pruning and plant growth regulators lowest value was recorded from the treatment combination P₀H₁ and the highest value was recorded from the treatment combination of P₂H₂.

The lowest (25.12 t/ha) yield was recorded from P_0 treatment and the highest (36.90 t/ha) yield was recorded from P_2 treatment among different pruning practices. In terms of yield in relation with different levels of plant growth regulators the minimum (19.02 t/ha) yield was recorded from H_0 treatment and the maximum (45.82 t/ha) was recorded in H_2 . Significant interaction effect was recorded between pruning and plant growth regulators in consideration of yield under the present trial. The highest (53.73 t/ha) yield was recorded from the treatment combination P_2H_2 and the lowest (17.69 t/ha) was recorded from the treatment combination of P_0H_0 .

In the combination of pruning and plant growth regulators highest gross return (Tk. 644,760.00) was obtained from the treatment combination of P_2H_2 and the lowest gross return (Tk. 2,12,280) was obtained in the control condition. In the combination of pruning and plant growth regulators highest benefit cost ratio (3.54) was attained from the treatment combination of P_2H_2 and the second highest benefit cost ratio (3.18) was acquired in P_2H_1 . The lowest benefit cost ratio (1.19) was obtained in control condition.

CONCLUSION

From the study, it might be concluded ethephon 300 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. Different pruning practices showed significant effect on stem length, number of branches, total number of flower, yield and other yield contributing character. But pruning did not perform early female flower over control. In the combination of pruning and plant growth regulators best results performed form P_2H_2 comprising of pruning to 5 primary branches and ethephon (300 ppm) treated plants over control. Further such type of research work may be conducted for more confirmation.

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Appendix I: Monthly recorded of air temperature, rainfall, relative humidity and sunshine hours during the period from April 2006 to August 2006

Year	Month	Average air temperature (°C)			Total rainfall (mm)	Average humidity (%)	Total sunshine hours
		Maximum	Minimum	Mean			
2006	April	33.74	23.87	28.81	185	69.41	234.6
	May	33.2	24.2	28.7	291	73	241.8
	June	33.4	26.8	30.1	259	79	96.0
	July	31.4	25.8	28.6	542	81	127.1
	August	32.0	26.6	29.3	361	82	108.5

Source: Dhaka meteorology center

Appendix II. Characteristics of Horticulture Farm soil is analyzed by Soil Resources Development Institute (SRDI), khamar Bari, Farmgate, Dhaka A. morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Horticulture Garden ,SAU, Dhaka
AEZ	Madhupur 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

Source: Soil Resources Development Institute (SRDI)



Source of variation	Degrees of freedom	Mean square				
		Stem length (cm) at			Number of	
		20 DAS	35 DAS	50 DAS	Primary branches/plant	Secondary branches/plant
Replication	2	50.238	0.776	88.156	0.340	0.32
Pruning (P)	2	141.425*	117.012*	82.724	11.132**	1.478
Plant growth regulators (H)	0 J	162.222*	201.76**	1018.72**	4.671**	4.609
Interaction (P x H)	6	3.471	0.298	1.216	0.735	0.03
Error	22	34.711	31.321	37.177	0.576	0.13

*: Significant at 5% level of probability
 ** : Significant at 1% level of probability

Source of variation	Degrees of freedom	Mean square				
		Days required for 1 st flowering		Days required for 50% flowering		
		Male	Female	Male	Female	Male
Replication	2	11.456	4.173	11.653	4.173	39.64
Pruning (P)	2	15.369*	27.923**	15.140*	27.923**	417.15
Plant growth regulators (H)	3	.23.034**	64.114**	23.274**	64.114**	7986.8
Interaction (P x H)	6	0.332	5.740	0.349	5.740	37.972
Error	22	4.071	4.476	4.091	4.476	48.376
						

Source of variation	Degrees of freedom	Mean square					
		Days required for harvest of green fruit	Total number of fruit/plant	Fruit setting (%)	Average length of individual fruit (cm)	Average girth of individual fruit (cm)	Indiv fruit (cm)
Replication	2	0.195	2.535	42.535	0.035	0.117	286
Pruning (P)	2	0.182	35.894**	66.641	18.263**	17.086**	2629
Plant growth regulators (H)	3	20.890**	86.922**	744.418**	40.054**	10.542**	8117
Interaction (P x H)	6	0.297	2.356*	81.067	0.243	0.529	83
Error	22	0.531	0.909	34.747	1.476	1.262	163

*: Significant at 5% level of probability
 **: Significant at 1% level of probability

Appendix VI. Per hectare production cost of Cucumber

A. Input cost

Treaunent Combination	Labour cost	Ploughing cost	Seed Cost	Water for seedling Establishment	Sticking	Pruning cost	Plant	Manure and fert		
							growth regulators	Cowdung	Urea	
*0 0 X 0	16000.00	9000.00	500.00	4500.00	5000.00	0.00	0.00	30000.00	1500.00	17
PoH,	16000.00	9000.00	500.00	4500.00	5000.00	1820.00	43200.00	30000.00	1500.00	17
POH ₂	16000.00	9000.00	500.00	4500.00	5000.00	1820.00	1203.00	30000.00	1500.00	17
PoH;	16000.00	9000.00	500.00	4500.00	5000.00	1820.00	830.00	30000.00	1500.00	17
Pi Ho	16000.00	9000.00	500.00	4500.00	5000.00	0.00	0.00	30000.00	1500.00	17
P.H,	16000.00	9000.00	500.00	4500.00	5000.00	1820.00	43200.00	30000.00	1500.00	17
P,H:	16000.00	9000.00	500.00	4500.00	5000.00	1820.00	1203.00	30000.00	1500.00	17
P,H ₃	16000.00	9000.00	500.00	4500.00	5000.00	1820.00	830.00	30000.00	1500.00	17
P:H ₀	16000.00	9000.00	500.00	4500.00	5000.00	0.00	0.00	30000.00	1500.00	17
P:H,	16000.00	9000.00	500.00	4500.00	5000.00	1820.00	43200.00	30000.00	1500.00	17
P,H;	16000.00	9000.00	500.00	4500.00	1 5000.00	1820.00	1203.00	30000.00	1500.00	17
P,H ₃	16000.00	9000.00	500.00	4500.00	I 5000.00	1820.00	830.00	30000.00	1500.00	I 17

Urea Tk. 10/ka: TSP ® Tk. 15 Vg: MP a Tk. 12 kalia: Labour cost <' Tk. 70 day

- P₀: No pruning
- H₀: No hormone application
- P₁:Pruning to 3 primary branches
- H₁: Maleic hydrazide (200 ppm)
- P₂:Pruning to 5 primary branches
- H₂: Ripen-l5 (Ethepon-300 ppm)

Appendix VI. Contd.,

B. Overhead cost (1 k./ha)

Treatment Combination	Cost of lease of land for 6 months (13% of value of land Tk. 6,00000/year	Miscellaneous cost (Tk. 5% of the input cost	Interest on running capital for 6 months (Tk. 13% of cost/year	Sub (Tk) (B)
PoHo	78000	10329	10906	99234
PoH ₁	78000	16181	14212	108393
PoH ₂	78000	10721	11128	99849
PoH ₃	78000	10673	11100	99773
PiHo	78000	10329	10906	99234
P.Hi	78000	16181	14212	108393
PiH ₂	78000	10721	11128	99849
PiH ₃	78000	10673	11100	99773
P:H ₀	78000	10329	10906	99234
P ₂ H ₁	78000	16181	14212	108393
p ₂ h ₂	78000	10721	11128	99849
P ₂ H ₃	78000	10673	11100	99773

P₀: No pruning

P₁:Pruning to 3 primary branches

P₂:Pruning to 5 primary branches

H₀: No hormone application

H₁: Maleic hydrazide (200 ppm)

H₂: Ripen-15 (Ethepon-300 ppm)

H₃: Crops care (NAA-18 ppm)