MORPHOLOGICAL AND YIELD ATTRIBUTES OF BRINJAL IN RESPONSE TO GIBBERELLIC ACID

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CERTIFICATE

This is to certify that the thesis entitled ***"MORPHOLOGICAL AND YIELD ATTRIBUTES OF BRINJAL IN RESPONSE TO GIBBERELLIC ACID"*** *submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfilment of the requirements for the degree of* ***MASTER OF SCIENCE*** *in* ***HORTICULTURE****, embodies the result of a piece of bona fide research work carried out by* ***Md. Al Imran,*** *Registration number* ***07-02503*** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

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The Author

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ABSTRACT

The experiment was conducted to investigate the growth and yield of brinjal with GA_3 at Horticultural farm, Sher-e-Bangla Agricultural University, Dhaka during period from Octobor 2012 to February 2013. Two factors experiment included 3 brinjal varieties viz. V_1 (BARI Begun-4), V_2 (BARI Begun-7), V_3 (BARI Begun-8) and 4 Gibberellic Acid (GA_3) concentrations viz. G_0 (Control), G_1 (50 ppm GA_3), G_2 (100 ppm GA_3) and G_3 (150 ppm GA_3) was outlined in Randomized Complete Block Design (RCBD) with three replications. Experimental results showed that variety had significant effect on all parameters except days to 1st flowering and days to 1st fruit set. The highest yield (50.4 t/ha) was recorded in V_1 while the minimum yield (38.0 t/ha) was recorded in V_3. Concentration of GA_3 also significantly influenced all the growth and yield attributes except number of leaves, number of branches, days to 1st flowering and days to 1st fruit set.The results showed that G_2 produced maximum yield (51.6 t/ha) while the minimum yield (32.4 t/ha) was recorded in G_0 plants. For combined effect, the highest yield (59.2 t/ha) was recorded in V_1G_2 and the lowest (28.6 t/ha) in V_3G_0. So, it can be concluded that 'BARI Begun-4' treated with 100 ppm GA_3 combindly gave the maximum yield.

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CHAPTER I
INTRODUCTION

Brinjal or Eggplant (*Solanum melongena* L.) is also known as Aubergine or Guinea squash an economically important vegetable crop widely cultivated in the tropics, subtropics and warm temperate regions (Sihachakr *et al.* 1994). It was originated in South East Asia (Lester and Hasan, 1991) and belongs to the Solanaceae family. Maximum genetic diversity and closely related species of Solanum are grown in this region (Zeven and Zhukovesky, 1975). It is also a popular vegetable crop in France, Italy, USA, Mediterranean and Balkan areas (Bose and Som, 1986). It is a versatile crop adapted to different agro-climatic regions and can be grown throughout the year. It is a perennial but grown commercially as an annual crop. The fruits are known for being low in calories and having a mineral composition beneficial for human health. It is also a rich source of Potassium, Magnesium, Calcium and Iron (Zenia and Halim, 2008). Per 100 g of edible portion it contains the following proportion of food values- Water- 93 g, Vit-A- 70 IU, Protein – 1.2 g, Thiamine- 0.05 mg, Fat – 0.1 g, Riboflavin – 0.08 mg, Carbohydrate- 4.0 g, Niacin – 0.09 mg, Fibre – 1.2 g, Calories- 20, Calcium- 16 mg, Fe – 0.9 mg (Bose and Some, 1986). Brinjal is known to have ayurvedic medicinal properties and is good for diabetic patients. It has also been recommended as an excellent remedy for those suffering from liver complaints (Shukla and Naik 1993).

The world production was estimated at 32 million tons in 2009 with China (18 million tons) and India (8.4 million tons) as the greatest producers (FAO STAT 2009).

Brinjal is locally known as “Begoon” the most popular and preferred vegetable, widely grown in Bangladesh. It is the second most important vegetable crop next to potato in Bangladesh in respect of acrease and production (BBS, 2011). It is grown round the year both as Rabi and Kharif crops (Rashid, 1993). It is largely cultivated in almost all districts of Bangladesh. A number of cultivars

are grown in Bangladesh, consumer preference being dependent upon fruit color, size and shape (Gopalan *et al*. 2007). About eight million farm facilities are involved in eggplant cultivation (Islam, 2005). This gives small, marginal and landless farmers a continuous source of income and provides employment facilities for the rural people.

The total area of brinjal cultivation is 78000 ha where 44000 ha is grown in Kharif season (summer) and 34000 ha in Rabi season (winter) with a total annual production of 246000 mt (BBS, 2011), which is very low in comparison to that of other countries like India, China, Egypt etc. The reasons behind such low yield are lack of high yielding varieties, poor crop management, soil type and improved technologies. A large number of brinjal varieties are grown which are of exotic origin and were developed long before. Most of them lost their potentiality due to genetic deterioration and disease contamination. Hence in order to improve the present situation of brinjal production, it is essential to promote better varieties to the growers of the country. Recently, the Bangladesh Agricultural Research Institute developed 8 high yielding varieties & 4 hybrid varieties with good yield contributing characters.

Plant growth regulators like promoters, inhibitors or retardants play a key role in controlling internal mechanisms of plant by interacting with key metabolic processes such as, nucleic acid metabolism and protein synthesis. Use of plant growth regulators (PGRs) might be a useful alternative to increase crop production. Recently, there has been global realization of the important role of PGR's in increasing crop yield. The plant often produces parthenocarpic (seedless) fruits after using hormones/growth regulators (Northmann and Koller, 1975). Gibberellic acid is an important growth regulator that may have many uses to modify the growth, yield and yield contributing characters of plant (Rafeekher *et al*. 2002). Plant growth regulators are used widely to improve plant performance. Gibberellic acid is one of those growth regulators that have positive effect on plant growth through the effect on cell division and elongation (Batlang *et al*. 2006). It was recorded that dipping of brinjal

seedling roots in NAA at 0.1 or 0.2 ppm for 24 hours influenced growth and development (Sambasiva *et al*. 1980). Therefore, it was thought that the different concentration of GA_3 might be effective in promoting the fruit set that will eventually lead to enhance yield of brinjal. In fact the use of growth regulators improved the production of brinjal including other vegetables in respect of better growth and quality which ultimately lead to the general interest among scientists and farmers for commercial application of this substance.

Considering the above mentioned facts the present investigation was under taken with the following objectives:

(i) To study the effect of GA_3 on growth and yield of brinjal.

(ii) To investigate the yield potential of three brinjal varieties developed by Bangladesh Agricultural Research Institute.

(iii) To find out the best combination of different varieties and concentration of Gibberellic Acid (GA_3) on yield and yield contributing characters of brinjal.

CHAPTER II

REVIEW OF LITERATURE

Brinjal is one of the most important and widely used vegetables worldwide. The production level of brinjal is very low compared the other country which never meets the demand of Bangladesh. The reasons behind such low yield are lack of high yielding varieties, poor crop management, soil type and improved technologies. Many researchers were done the research to find out the effect of GA_3 on different crop but there is very limited research about the effect of GA_3 on brinjal inside the country or the world. However, literature available in this aspect in the country and abroad were reviewed and it will be contributed a positive justification and for further use in future.

2.1 Effect of GA_3 on Brinjal

Boyaci *et al.* (2011) set an experiment on Eggplants to determine the relationship between flower development and gibberellic acid (GA_3) levels in parthenocarpic and non-parthenocarpic eggplant (*Solanum melongena* L.) genotypes. A single crop was grown in an unheated greenhouse at the Bati Akdeniz Agricultural Research Institute, Antalya, Turkey, and samples were collected from November to March, GA_3 levels were measured with reverse phase high performance liquid chromatography at five different stages between small buds and small fruits. The results showed that there was no relationship between flower development and GA_3 levels in parthenocarpic and non-parthenocarpic eggplant genotypes.

Patil *et al*. (2008) conducted an experiment on the effect of growth regulators and fruit load on seed yield and quality in brinjal hybrid seed production. The results revealed that, GA_3 50 ppm recorded significantly more seed yield (33.96 g) per plant, germination (75.52%), root length (7.81 cm), shoot length (6.86 cm), seedling vigour index (1297) and seedling dry weight (14.12 mg) compared to

NAA 40 ppm and control (30.97 g, 71.89%, 7.38 cm, 6.28 cm, 859 and 12.39 mg, respectively) irrespective of growth, 4 fruit retention per plant recorded significantly highest germination, root length, shoot length, seedling vigour index and seedling dry weight (83.28%, 8.43 cm, 7.48 cm, 1136 and 16.85 mg, re respectively) compared to retention of all fruits per plant.

Sharma (2006) conducted an experiment in split-plot design with three replications to assess the effect of plant growth regulators (PGRs) on morphological characters and yield of brinjal cvs. Pusa Purple Long (PPL) and Pusa Purple Cluster (PPC) as main plot factor at Khajura, Banke district during summer-rainy season of 2004. The sub-plot treatments composed of fresh water (control), 40 ppm NAA, 10 ppm GA_3, 2 ppm 2, 4-D, 300 ppm ethephon, 30 ppm BAP and 5 ppm triacontanol. The first spray was at flowering stage and the others at 20 days interval. The PGRs had no significant effect on plant height and stem diameter at the end of crop period and days to 100% plant flowering whereas the cultivars differed significantly. The PPL was earlier to 100% plant flowering, which took 33 days after transplanting. The treatments had no significant influence in fruit number per plant and fruit yield. The interaction effect showed that the. PPL did not produced statistically different fruit number per plant with respect to growth regulators, while it had significantly higher fruit yield (17.76 t/ha) at 40 ppm NAA than that at 10 ppm GA_3 and 30 ppm BAP. The PPC produced significantly higher fruit number per plant and higher fruit yield (t/ha) at 30 ppm BAP than all other treatments except 5ppm triacontanol.

Meena *et al.* (2005) set an experiment carried out during the year 1997–98 to find out the economics of plant growth regulators in brinjal under semi-arid condition of Rajasthan. It was found that the yield of brlnjal can be increased significantly by two successive sprays of GA_3 and NAA at 35 and 45 days after transplanting. The maximum net profit of Rs. 107498.07/ha was obtained with the spray of 100

ppm GA_3 followed by 50 ppm NAA (Rs. 102383.27/ha) as compared to control (Rs. 78493.07/ha). The maximum cost: benefit ratio (1: 5.60) was found with the spray of 50 ppm NAA. However, the higher concentrations of GA_3 and NAA were found uneconomic.

Pablo (2000) carried out an experiment conducted in the Dominican Republic to determine the effect of several plant growth regulators on the yield of `Jira' eggplant. Treatments consisted of aqueous solutions of folcysteine (25, 50, 75 ppm), giberellic acid 3 (10, 20, 30 ppm), kinetine (25, 50, 75 ppm), naphthalenacetic acid (NAA) (25, 50, 75 ppm), 2,3,4-dichloro-phenoxy-triethyl-amine hydrochloride (DCPTA) (25, 50, 75 ppm), triacontanol (5, 10, 15 ppm), ethanol (5, 10, 15%), and chlormequat (50, 100, 150 ppm) sprayed at early flowering, directed to the crop upper leaves and flowers. A control treatment (no plant growth regulators applied) was also included. A randomized complete-block design with four replications was utilized. Eggplant fruit set and yield were determined after 10 harvests performed at 3-day intervals. `Jira' eggplant fruit set and yield was significantly improved by folcysteine, giberellic acid 3, and NAA, but not by kinetine, DCPTA, ethanol, triacontanol, or chlormequat. Eggplant yield increased as folcysteine rate increased from 0 to 50 ppm, but no further yield increase was obtained when increasing the rate from 50 to 75 ppm. Similarly, eggplant yield significantly increased as gibberellic acid increased from 0 to 20 ppm, but not when rates increased from 20 to 30 ppm. With NAA, eggplant fruit set and yield significantly increased above that of control plants when 25 ppm was applied, with no significant yield increase at higher rates. Results indicate that the yield of `Jira' eggplants could be enhanced by the treatments with folcysteine, NAA, or gibberellic acid hereby described.

Sharma *et al.* (1992) reported that brinjal Pusa Purple Long sprayed with 300 ppm GA_3 flowered earliest and had the highest number of fruits and yield per plant.

Bisaria *et al.* (1978) conducted an experiment on brinjal (*Solarium melongena* L.) cv. 'Pusa kranti' were sprayed with IAA and GA_3 at 0, 10, 25, 50, 100 and 200 ppm. IAA stimulated the vegetative growth upto a concentration of 100 ppm and suppressed at 200 ppm. GA_3 promoted the vegetative growth at all the concentrations used. IAA increased formation of flowers, fruits and yield upto 100 ppm and reduced them at 200 ppm. GA_3 enhanced the formation of flowers, fruits, and yield progressively with increasing concentration.

2.2 Effect of GA_3 on others crop

Kumar *et al.* (2014) set an experiment to determine the effects of Gibberellic acid (GA_3) on growth, fruit yield and quality of tomato. The experiment consisted of one tomato variety- Golden, and six treatments with five levels of gibberellic acid (GA_3- 10 ppm, 20 ppm, 30 ppm, 40 ppm and 50 ppm), arranged in randomized block design with three replications. The highest plant height, Number of leaves, Number of fruits, Fresh fruit weight has been observed and ascorbic acid, total soluble solid (TSS) was estimated for GA_3 50 ppm.

Ranjeet *et al.* (2014) set a field experiment was carried out to assess the growth, flowering, fruiting yield and quality traits of Tomato cv. KASHI VISHESH (H-86). The experiment was laid out in randomised block design with three replications for tomato crop consisted of 10 treatments namely, Control, GA_3 20 ppm, GA_3 40 ppm, GA_3 60 ppm, NAA 10 ppm, NAA 20 ppm, NAA 30 ppm, 2, 4-D 10 ppm, 2, 4-D 15 ppm and 2, 4-D 20 ppm to find out the effect of the growth, flowering, fruiting, yield and quality of tomato and various horticulture characters namely; plant height (cm), number of branches, number flowers per plant, number of clusters per plant, number of fruits per clusters, number of fruits per plant, average fruit length (cm), average fruit diameter (cm), average fruit weight (g), fruit yield per plant (kg), fruit yield per plot (kg), fruit yield per hectare (q), acidity (%) and total soluble solids TSS (0 Brix). However, application of the plant bio

regulators had a significant influence on plant growth, flowering, fruiting, yield and quality traits of tomato and GA_3 gave the highest yield than other plant growth regulators. So, GA_3 was superior among all treatments under investigation for response tomato production.

Choudhury *et al.* (2013) conducted a field experiment at Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh, to assess the effect of different plant growth regulators on tomato during summer season 2011. Different plant growth regulators (PGR) viz. PGR = Control, 0 PGR_1 = 4-CPA (4-chloro phenoxy acetic acid) @ 20 ppm, PGR_2 = GA_3 (Gibberellic Acid) @ 20 ppm and PGR_3 = 4-CPA + GA_3 @ 20 ppm of each were used in the study. The growth and yield contributing characters were significantly differed due to different plant growth regulators. The maximum plant height at 60 DAT (86.01cm), number of flowers cluster per plant (10.60), number of flowers per plant (39.69), number of fruits per plant (36.54), single fruit weight (74.01 g) and yield (28.40 t ha 1) were found in PGR_3 and the minimum for all the parameters were found in control (PGR_0) treatment.

Prasad *et al.* (2013) conducted a field trial on the effect of GA_3 and NAA was conducted on tomato cv. Kashi Vishesh during the rabi season of 2011-12. The different concentration of GA_3 (20, 40, 60 and 80 ppm) and NAA (25, 50, 75 and 100 ppm) were sprayed on the crop to study the growth behavior and yield and yield attributes of tomato. It was found that there was a linear increase in growth parameters like plant height and number of branches per plant with increasing level of GA_3 and NAA. The maximum plant height was recorded as 85.3 cm and 82.3 cm with the application of GA_3 @ 80 ppm and NAA @ 100 ppm, respectively after 60 days of transplanting. Similarly, the yield and yield attributes were also affected significantly with increasing concentrations of GA_3 and NAA.

A maximum yield of 483.6q/ha and 472.2 q/ha was obtained with the use of GA_3 @ 80 ppm and NAA @100 ppm, respectively.

Shahid *et al*. (2013) conducted an experiment on plant growth regulators (PGRs) affect various aspects of plant physiology, mainly vegetative and reproductive traits including yield and seed production. Therefore, different concentrations (0, 50, 100 & 200 ppm) of gibberellic acid (GA_3) and naphthalene acetic acid (NAA), alone or in different combinations were sprayed on okra plants at 2-true leaf stage, to ascertain their impact on plant growth, pod production, seed yield and seed quality. All variables regarding vegetative and reproductive growth were significantly influenced by different concentrations of the growth regulators except number of days taken to flowering. Growth regulators were less effective when applied individually as compared to their combined use; however, performance of plants treated with individual PGR was better than the untreated plants. The number of leaves plant-1 and plant height was higher in plants when sprayed with GA_3 and NAA @ 200+100 ppm as well as with GA_3 and NAA @ 200+200 ppm. The number of pods plant-1, pod length, pod fresh and dry weight, seed yield and seed quality (in terms of germination percentage and 1000-seed weight) was maximum in plants receiving foliar spray of both GA_3 and NAA @ 200+200 ppm. These results signify the role of GA_3 and NAA in okra pod production for fresh consumption as well as for seed yield.

Yahaya and Gaya (2012) conducted field trials in the 2008/2009 and 2009/2010 dry seasons to assess the efficacy of various rates of giberrellic acid on the growth and yield of tomato (*Lycopersicon lycopersicum* L. karst. The treatments consisted of seven rates (0, 50, 100, 150, 200, 250 and 300 ppm) of giberrellic acid. These were laid in a randomized complete block design and replicated three times. Data were recorded on plant height, number of leaves, number of branches, number of flowers and fresh fruit weight. These were subjected to analysis of variance.

Where treatment means differed significantly, they were compared using DMRT. Results of the study showed that giberrellic acid concentration had significantly ($P \leq 0.05$) enhanced the growth, yield components as well as total yield of tomato. Best results were recorded from plants treated with 300 ppm giberrellic acid compared to all other rates applied. It is suggested that tomato be treated with 300 ppm giberrellic acid for improved yield.

Roy *et al.* (2011) conducted a research to study the effect of GA_3 on growth and yield of cabbage. Single factor experiment consisted of four concentrations of GA_3, viz., 0, 25, 50 and 75 ppm. Significantly the minimum number of days to head formation (43.54 days) and maturity (69.95 days) was recorded with 50 ppm GA_3 and 50 ppm GA_3 gave the highest diameter (23.81 cm) of cabbage head while the lowest diameter (17.89 cm) of cabbage head was found in control (0 ppm GA_3) treatment. The application of different concentrations of GA_3 as influenced independently on the growth and yield of cabbage. Significantly the highest yield (45.22 kg/plot and 104.66 t/ha) was found from 50 ppm GA_3.

Abbas (2011) set an experiment to study the effect of foliar sprays of different concentrations of Gibberellic acid on growth and some physiological characterizes in Carrot plant (local white cultivar). The experiment treatments included three concentrations of Gibberellic acid (0, 50 and 100 ppm) and the results were recorded as follows: In using the Gibberellic acid concentration at (50 ppm) led to increase significantly the studied characteristics particularly plant height cm, number of branch per plant, number of flower per plant, shoot fresh weight (gm), fresh weight of biological weight gm per plant, shoot dry weight (gm), dry weight of biological weight gm per plant, chlorophyll content ($\mu g/cm^2$), when compared with the other concentrations levels and controlling plants. And GA_3 decreases significantly some of the studied characteristics as root fresh weight (gm), root dry

weight (gm) and soluble carbohydrate which that compared with the controlling plants.

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

Bokade *et al.* (2006) reported the maximum plant height (75.33 cm) with GA_3 50 ppm treatment compared to control (54.99 cm) in tomato.

Shittu and Adeleke (1999) investigated the effects of foliar application of GA_3 (0, 10, 250 or 500 ppm) on growth and development of tomatoes cv, 158-3 grown on pots. Plant height and number of leaves were significantly enhanced by GA_3 treatment. Plants treated With GA_3 with 250 ppm were the tallest plant the highest number of leaves.

Tomar and Ramgiry (1997) studied that tomato plant treated with GA_3 showed significantly greater number of branches plant than untreated controls.

Gabal *et al.* (1990) found that 100 ppm of GA_3 was more effective treatment in increasing leaf number $plant^{-1}$ compared to control.

Sanyal *et al.*(1995) studied that the effects of plant growth regulators (IAA or NAA at 15, 25 or 50 ppm or GA_3 at 50, 75 or 100 ppm) and methods of plant growth regulator application on the quality of tomato fruits. Plant growth regulators had profound effects on fruit length, weight and sugar : acid ratio. The effects of presoaking seeds and foliar application of plant growth regulators were more profound than presoaking alone.

Hathout *et al.* (1993) found that application of 10 ppm IAA as foliar sprays or to the growing media of tomato plants had a stimulatory effect on plant growth, development and fruit which was accompanied by increases in endogenous auxin, gibberellins and cytokinin contents. However, IAA at 80 ppm had an inhibitory effect on plant growth and development, which was accompanied by increase in the level and activity of indigenous inhibitors and by low levels of auxms, cytokines and gibberellins.

EI- Habbasha *et al.* (1999) carried out a field experiment with tomato cv. castel rock over two growing seasons (1993-94). The effects of GA_3 and 4-CPA on fruit yield and quality were investigated. Many of the treatments significantly increased fruit set percentage and total fruit yield, but also the percentages of puffy and parthenocarpic fruits compared to the controls.

Lilov and Donchev (1984) observed that by the application of GA_3 at 20, 40 or 100 mg/L the yields were reduced compared with the non-treated control.

Leonard *et al.* (1983) reported that inflorescence development in tomato plants grown under low light regimes was promoted by GA_3 application directly on the inflorescence.

Saleh and Abdul (1980) performed an experiment with GA_3 *(*25 or 50 ppm) applied 3 times in June or early July. They reponed that GA_3 stimulated plant growth. The substance reduced the total number of flowers per plant but increased the total yield compared with the control. GA_3 also improved fruit quality.

Chern *et al.* (1983) presented that one month old transplanted tomato plants were sprayed with 1, 10 or 100 ppm GA_3 and observed that GA_3 at 100 ppm increased leaf area, plant height and stem fresh and dry weight but 10 ppm inhibited growth.

Wu *et al.* (1983) sprayed one-month old transplanted tomato plants with GA_3 at 1, 10 or 100 ppm and reported that GA_3 100 ppm increased plant height and leaf area.

Bora and Selman (1969) working with tomato demonstrated that four foliar sprays of GA_3 (0, 5, 50 or 500 ppm) applied at 7, 17, 22, 27 or 37^0 increased the leaf area, weight and height of tomato plants. The best treatment was 5 ppm GA_3 at 22^0C.

Jansen (1970) reported that tomato plants treated with GA_3 neither increased the yield nor accelerated fruit ripening. He also mentioned that increasing concentration of GA_3 reduced both the number and size of fruits.

CHAPTER III

MATERIALS AND METHODS

This chapter illustrates information concerning methodology that was used in execution of the experiment. It comprises a short portrayal of location of experimental site, climatic condition, materials used for the experiment, treatments of the experiment, data collection procedure and statistical analysis etc.

3.1 Geographical location

The experimental area was situated at $23^0 77'$ N latitude and $90^0 33'$ E longitude at an altitude of 8.6 meter above the sea level (Anon., 2004).

3.2 Agro-Ecological Region

The experimental site belongs to the Agro-ecological zone of "The Modhupur Tract", AEZ-28 (Anon., 1988a). This was a region of complex relief and soils developed over the Modhupur clay, where floodplain sediments buried the dissected edges of the Modhupur Tract leaving small hillocks of red soils as 'islands' surrounded by floodplain (Anon., 1988b).

3.3 Climate

Experimental site was located in the subtropical monsoon climatic zone, set aparted by winter during the months from November to February (Rabi season). Plenty of sunshine and moderately low temperature prevails during experimental period, which is suitable for potato growing in Bangladesh.

3.4 Treatments of the experiment

Two sets of treatments included in the experiment were as follows:

Factor A: Germplasm

In experiment, three different varieties were used. This are-

1. V_1 – 'BARI Begun-4' (Kazla)
2. V_2 – 'BARI Begun-7'
3. V_3 – 'BARI Begun-8'

Factor B: Different concentrations of GA_3

GA_3 application on experiment are given below-

1. G_0 – No GA_3 application (Control)
2. G_1 – 50 ppm in concentration
3. G_2 – 100 ppm in concentration
4. G_3 – 150 ppm in concentration

Treatment combinations:

There were 12 (4×3) treatments combination such as V_1G_0, V_1G_1, V_1G_2, V_1G_3, V_2G_0, V_2G_1, V_2G_2, V_2G_3, V_3G_0, V_3G_1, V_3G_2 and V_3G_3.

3.5 Experimental design

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The size of each plot was 2.4 m× 2.4 m. The distance between two adjacent replication (blocks), plot to plot distance and plant to plant distance were 0.5 m, 0.5 m and 60 cm × 60 cm, respectively. In each plot there were having 16 plants. The intra block and plot spaces will be used as irrigation and drainage channels. The layout of the experiment has been shown in Figure 1.

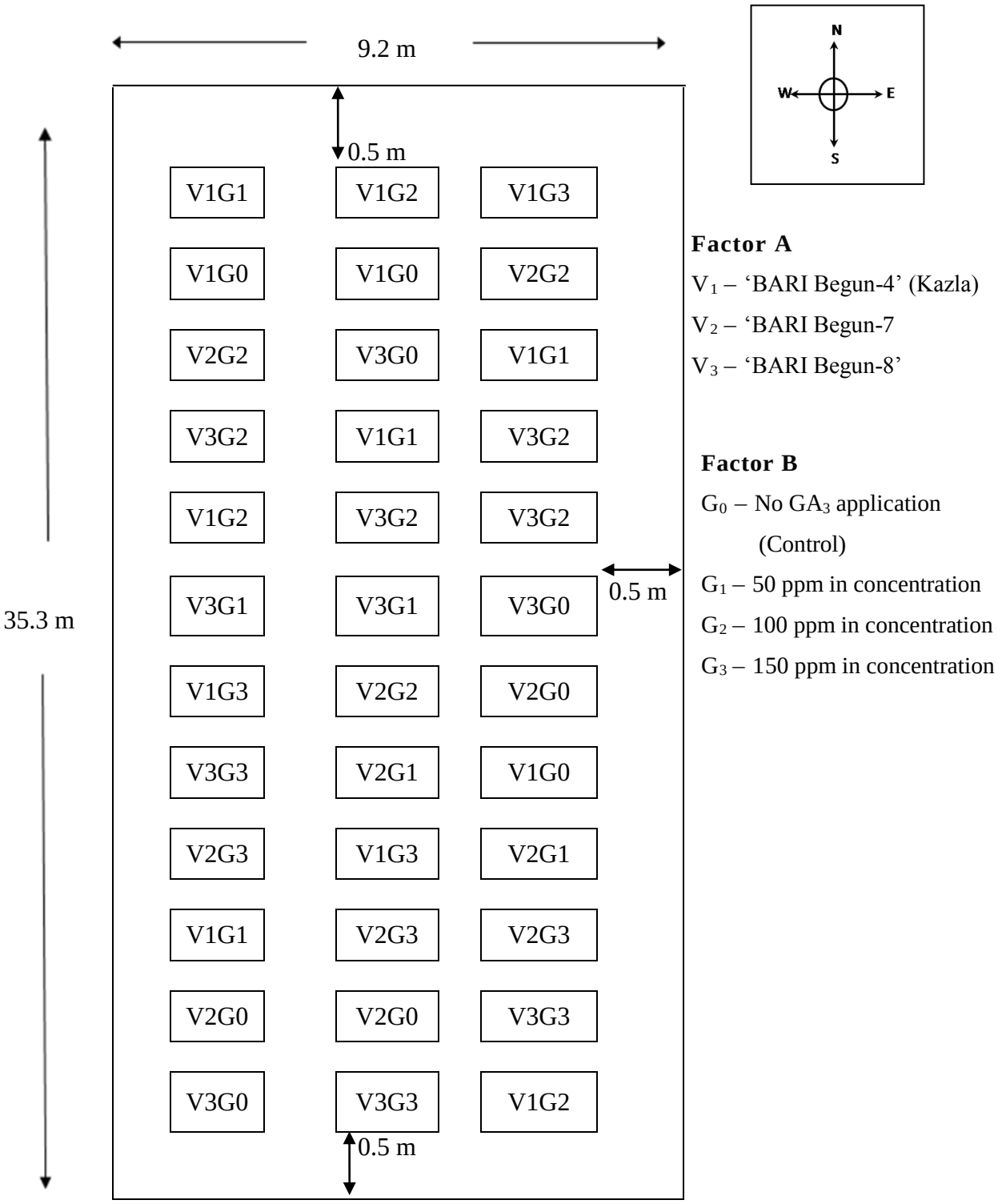

Fig 1: Layout of an experimental field

3.6 Planting material

The planting materials were 3 modern varieties of brinjal. ‘BARI Begun- 4’, ‘BARI Begun- 7’ and ‘BARI Begun- 8’.

3.7 Crop management

3.7.1 Seed collection

The seed of the variety was collected from, Oleiriculture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur.

3.7.2 Seed preparation

Collected seeds were tested for germination in the laboratory and the percentage of germination was 95%. Finally before sowing, the seeds were treated with Vitavex-200 @ 5 g/1 kg seed.

3.7.3 Raising of seedlings

For raising of seedlings, the soil was well ploughed and converted into loose friable and dried masses to obtain good tilth. All weeds, stubbles and dead roots were removed. Well rotten cowdung was applied to the seedbed at the rate 5 g/seed bed.

Brinjal seedlings were raised in seedbeds situated on a relatively high land in the Horticulture Farm.

The seeds were sown in the seed bed of 3 m × 1 m size on 28 Octobor, 2013. After sowing, the seeds were covered with a thin layer of soil or light soil. Complete germination took place within 10 days after sowing seeds in the beds. When the seeds germinated, shade by bamboo mat was provided to protect the young seedlings from scorching sun shine and rain. No chemical fertilizers were applied for raising the seedlings. Seedlings were not attacked by any kind of insect or diseases.

The healthy 30 day old seedlings were transplanted in the experimental field on 01 December, 2013.

3.7.4 Land preparation

Power tiller was used for the preparation of the experimental field. Then it was exposed to the sunshine for 7 days prior to the next ploughing. Thereafter, the land was ploughed and cross-ploughed to obtain good tilth. Deep ploughing was done to produce a good tilth, which was necessary to get better yield of this crop. Laddering was done in order to break the soil clods into small pieces followed by each ploughing. All the weeds and stubbles were removed from the experimental field. The plots were spaded one day before planting and the whole quantity of fertilizers were incorporated thoroughly before planting according to fertilizer recommendation guide (Islam, 2006).

3.7.5 Fertilizer and manure application

After opening the land, well decomposed cowdung was applied and thoroughly mixed up with soil. Before final land preparation, inorganic fertilizers were applied. Fertilizer and manure dose were calculated on the basis of fertilizer Recommendation Guide of BARC (Anonymous, 2004).

Manures and Fertilizers Applied in the Field

Fertilizer	Rate (kg ha^{-1})
Cowdung	10000
Urea	375
TSP	150
MP	250
Gypsum	100

- All Cowdung, Gypsum, TSP and half dose of MP were applied during land preparation.
- Urea and remaining half dose of MP were applied in the installments as side dressing.

3.7.6 Transplanting of seedlings

Healthy seedlings grown with intensive care in plastic tray were transplanted at the age of 30 days in the field in the afternoon followed by watering. Fifteen healthy seedlings were transplanted in each subplot of each block maintaining plant to plant distance 75 cm and line to line 75 cm (Islam, 2006).

The seedbeds were watered before uprooting the seedlings. At the time of uprooting care was taken so that root damage was minimum and some soil remained with the roots. Healthy and uniform sized seedlings of 30 days were taken separately from the seedbed and were transplanted in the experimental field on 01 December, 2013.

3.7.7 Intercultural operations

After 15 days of transplantation, one third Urea and Muriate of Potash were applied in ring method followed by weeding and irrigation. Remaining was applied after 35 and 55 days of transplantation.

Gap filling

When the seedlings were established, the soil around the base of each seedling was pulverized. Very few seedlings were damaged after transplanting and the damaged seedlings were replaced by new healthy seedlings from the same stock. Those seedlings were transplanted with a high mass of soil with roots to minimize transplanting shock.

Weeding

The plants were kept under careful observation. Weeding was done as and when necessary to keep the plots clean. Weeding was done at every 15 days interval from planting to the peak flowering stage. As the land was covered by plant canopy by that time weeding was discontinued. Spading was done from time to time specially to break the soil crust and keep the land weed free after each irrigation.

Irrigation

Irrigation was given as and when necessary by observing the soil moisture condition. Irrigation was given throughout the growing period. The first irrigation was done 40 days after planting followed by irrigation at 20 days after the first irrigation. Each fertilizing was followed by irrigation.

Gibberellic acid (GA_3) application

Gibberellic acid (GA_3) application was done at 4 different doses *viz*. no GA_3 application, 50 ppm, 100 ppm and 150 ppm in concentration. The required amount of GA_3 solution was prepared by dissolving in 1 mg per litre. The solution was poured into hand-hold sprayer and was directly sprayed on the plants three times at 30, 60 and 90 days after transplanting. Spraying was performed early in the morning to avoid rapid drying of the spray solution, due to transpiration.

Earthing Up

Earthing up was done as and when required by tahing the soil from the space between the rows.

Plant Protection

Insect Pest

As prevention measure against the insect pest like cutworm, shoot and fruit borer, leafhooper etc. Malathion 60 EC @ 2 ml per litre was applied to reduce the attack in the field. Many Cleaning practices were also done to reduce the insect attack. Ripcord was also applied to control the insect pest @ 85 ml/ha.

Diseases

Precationary measures against various diseases of bringal were taken. Neem powder mixed wih water @ 5.0% w/w and ash spraying were done to control the bacterial and fungal diseases of bringal.

Harvesting

Harvesting was started on the 20 January, 2014 and continued to 28 February, 2014. At each harvest, the number of fruits, individual weight of fruit (g), total weight of the fruits (kg) and individual fruit diameter (cm) was taken plot wise.

3.7.8 Parameters

Data were collected in respect of following parameters:

A. Crop growth characters

i. Plant height (cm)
ii. Number of leaves per plant
iii. Number of branch per plant

B. Yield and yield components

iv. Days to first flowering
v. Number of flower clusters per plant
vi. Number of flowers per cluster
vii. Days to first fruit setting
viii. Number of fruits per cluster
ix. Fruit length (cm)
x. Fruit diameter (cm)
xi. Fruit Weight (gm)
xii. Yield (ton/ha)

3.8 Data collection

Experimental data were collected from 30 days of growth duration and continued until harvest. A brief outline of the data recording procedure followed during the study is given below:

A. Crop growth characters

i. Plant height (cm)

Plant height was measured at 30, 45, 60, 75 and 90 DAT. The height of each plant was measured in cm by using meter scale and mean was calculated.

ii. Number of leaves and branches per plant

Number of leaves, branch and flower cluster per plant were recorded at 30, 45, 60, 75 and 90 DAT by counting all leaves and branch from each plant and mean was calculated.

B. Yield and yield components

i. Days to 1st flowering and 1st fruit set

Days to first flowering and first fruit set were counted the days from the date of brinjal seedling transplanting.

ii. Number of flower clusters per plant

Flower clusters were counted in every five plant and their average was taken.

iii. Number of flowers per cluster

Flower of each five cluster were counted in every plant and their average was taken.

iv. Number fruits per cluster

Fruit of each cluster were counted in every five selected plant and their average was taken.

v. Measurement of fruit weights

Fruit weight was measured by Electronic Precision Balance in gram. Total fruit weight of each plant was obtained by addition of weight of the total fruit

number and average fruit weight was obtained from division of the total fruit weight by total number of fruit.

vi. Fruit length and diameter measurement

Fruit length and diameter were measured using slide calipers in centimeter (cm). Mean was calculated from each treatment.

vii. Fruit yield per plant

A pan scale balance was used to take the weight or fruits per plot. It was measured by totaling of fruit yield from each unit plot during the period from first to final harvest and was recorded in kilogram.

viii. Fruit yield per hectare

It was measured by the following formula:

$$\text{Fruit Yield per hectare (ton)} = \frac{\text{Fruit yield per plot (kg)} \times 10000}{\text{Area of plot in square meter } (m^2) \times 1\,000}$$

3.9 Statistical analysis

Collected data were statistically analyzed using MSTAT-C computer package programme. Mean for every treatments were calculated and analysis of variance for each one of characters was performed by F–test (Variance Ratio). Difference between treatments was assessed by Duncan's Multiple Range (DMRT) test at 5% level of significance (Gomez and Gomez, 1984).

3.10 Economic analysis

The cost of production was analyzed in order to find out the most economic treatment of variety and GA_3. All input cost included the cost for lease of land and interests on running capital in computing the cost of production. The interests were calculated @ 13% in simple interest rate. The market price of brinjal was considered for estimating the cost and return. Analyses were done according to the procedure determining by Alam *et al.*, (1989). The benefit cost ratio (BCR) was calculated as follows:

$$\text{Benefit cost ratio (BCR)} = \frac{\text{Gross return per hectare (Tk.)}}{\text{Total cost of production per hectare (Tk.)}}$$

CHAPTER IV

RESULTS AND DISCUSSION

This chapter comprises presentation and discussion of the results obtained from the study to investigate the performance of different gibberellic acid (GA_3) concentrations on the growth and yield of three brinjal varieties. The results of the growth and yield characters of brinjal as influenced by different concentrations of GA_3 have been presented and discussed in this chapter.

4.1 Plant height (cm) of brinjal

4. 1.1 Effect of variety on plant height (cm)

Significant variation was found among the varieties in case of plant height (Appendix II and Figure 2). Plant height of brinjal varied significantly due to different variety at 30, 45, 60 and 75 DAT. The variety 'BARI Begun-7' (V_2) produced the tallest plant (76 cm) while 'BARI Begun-8' produced the shortest plant (62.5 cm) at 75 DAT in height.

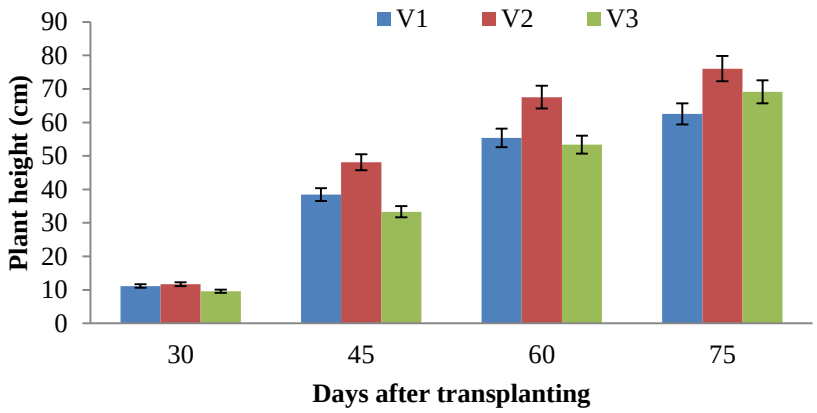

Figure 2. Effect of variety on the plant height of brinjal

4.1.2 Effect of GA_3 on plant height (cm) of brinjal

Plant height varied significantly due to application of different concentration of GA_3 (Appendix II and Figure 3). It was observed that at 30 DAT control (G_0)

produced the highest plant height and 50 ppm concentration of GA_3 (G_1) produced the lowest plant height. However, increased plant height due to increased concentration of GA_3 was observed at 45, 60 and 75 DAT. The tallest plant (74.4 cm) was recorded in 150 ppm GA_3 (G_3) treatments while control (G_0) produced the lowest plant height (64.6 cm). Gibberellins are key regulator of shoot growth in plants, it can promotes the activity of xyloglucan endotransglycosylase (XET) which cause loosening of cell wall and increase cell permeability (Saptari and Dawi 2013). Similar result was found in brinjal by Meena and Dhaka (2003).

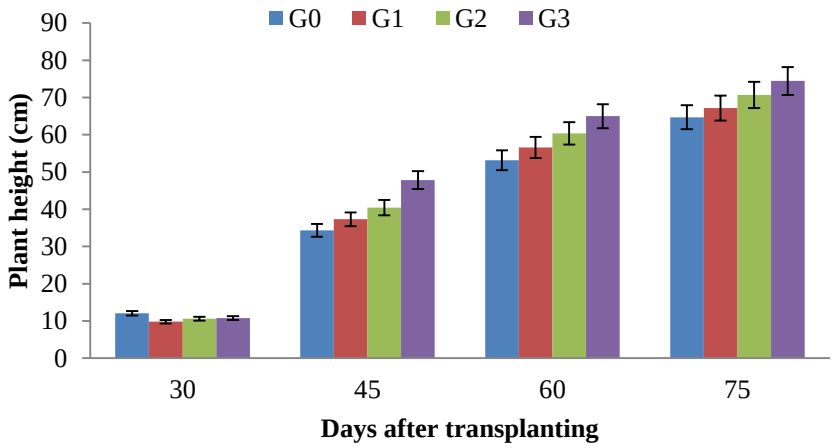

Figure 3. Effect of GA_3 on the plant height of brinjal

4.1.3 Interaction effect of variety and GA_3 on plant height (cm) of brinjal

Plant height did not vary significantly due to different treatment combinations of brinjal variety and GA_3 concentration except 30, 45 and 60 DAT (Appendix II and Table 1). At 75 DAT the highest plant height (81.7 cm) was observed from the treatment combination of V_2G_3 which was statistically similar to V_2G_1 (74.5 cm) and V_2G_2 (76.4 cm). The lowest plant height (57.3 cm) at 75 DAT was observed from V_1G_0 which was statistically similar to V_1G_1 (59.3 cm) V_1G_2 (65.1 cm) and V_3G_0 (65.1 cm).

Table 1. Interaction effect of variety and GA_3 on the plant height of brinjal

Treatments	Plant height (cm)			
	30 DAT	**45 DAT**	**60 DAT**	**75 DAT**
V_1G_0	11.4	32.0	49.8	57.3 e
V_1G_1	9.6	38.4	53.2	59.3 de
V_1G_2	11.6	40.1	57.8	65.1 cde
V_1G_3	12.0	43.2	60.5	68.3 bc
V_2G_0	12.8	43.2	58.4	71.5 bc
V_2G_1	10.3	44.4	65.0	74.5 ab
V_2G_2	11.6	49.5	71.0	76.4 ab
V_2G_3	11.8	55.2	75.6	81.7 a
V_3G_0	12.0	27.6	51.1	65.1 cde
V_3G_1	9.4	29.0	51.4	67.5 bcd
V_3G_2	8.4	31.6	52.0	70.5 bc
V_3G_3	8.4	44.9	58.8	73.2 abc
LSD	Ns	Ns	Ns	8.8
CV %	15.2	19.6	9.9	7.5

V_1 = 'BARI Begun-4', V_2 = 'BARI Begun-7', V_3 = 'BARI Begun-8', G_0 = No GA_3 application (Control), G_1 = 50 ppm in concentration, G_2 = 100 ppm in concentration, G_3 = 150 ppm in concentration

4.2 Number of leaves of brinjal

4. 2.1 Effect of variety on number of leaves of brinjal

Number of leaves varied significantly due to different varieties of brinjal (Appendix III and Figure 4). It was observed that 'BARI Begun-4' (V_1) produced the highest leaf number at 30, 60 and 75 DAT but at 45 DAT 'BARI Begun-7' (V_2) produced the highest number of leaves. However, 'BARI Begun-8' (V_3) produced the lowest number of leaves at 30, 45, 60 and 75 DAT. The maximum number of leaves (84.5) was recorded in 'BARI Begun-4' (V_1) while the minimum number of leaves (64.2) was recorded in 'BARI Begun-8' (V_3) at 75 DAT.

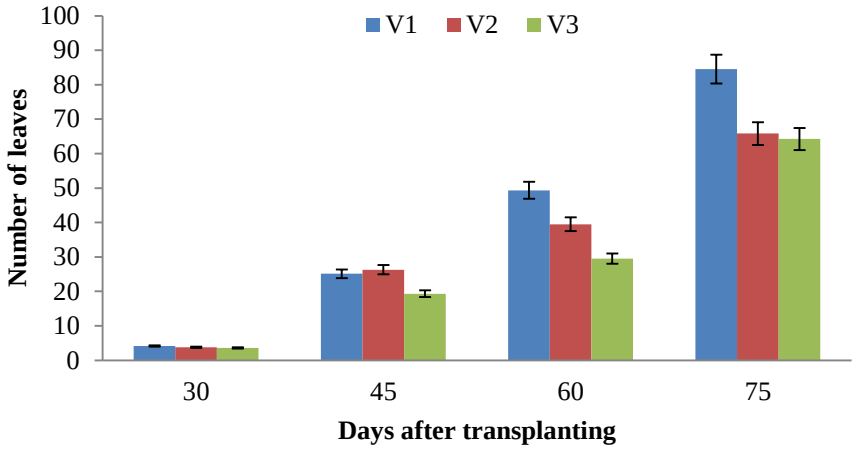

Figure 4. Effect of variety on the number of leaves of brinjal

4.2.2 Effect of GA_3 on number of leaves of brinjal

Number of leaves did not vary significantly due to application of different concentrations of GA_3 treatments at 30 and 45 DAT. However it varied significantly at 60 and 75 DAT (Appendix III and Figure 5). Increased plant height due to increased concentration of GA_3 was observed at 45, 60 and 75 DAT. The maximum number of leaves (87.7) was recorded in 150 ppm GA_3 (G_3) treatments while control (G_0) produced the minimum number of leaves (56.6).

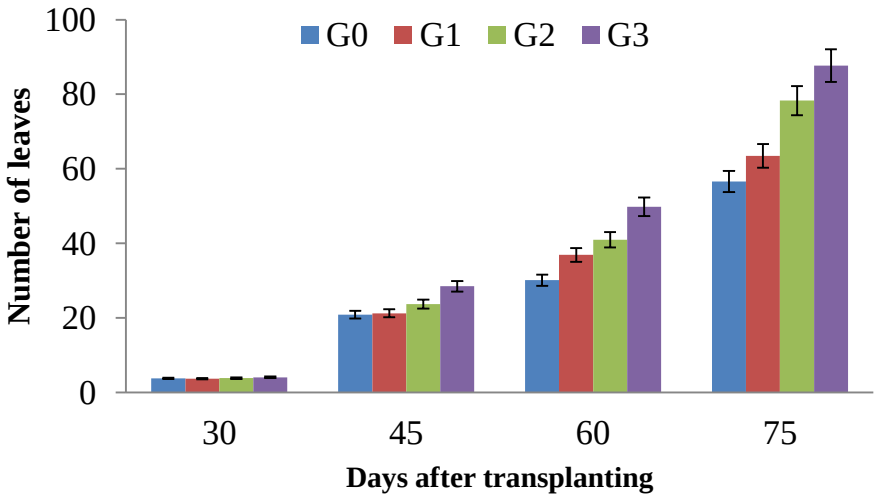

Figure 5. Effect of GA_3 on the number of leaves of brinjal

4.2.3 Interaction effect of variety and GA_3 on number of leaves of brinjal

Number of leaves did not vary significantly due to different treatment combinations of variety and GA_3 concentrations except at 75 DAT (Appendix III and Table 2). At 75 DAT the maximum number of leaves (107.8) was recorded from the treatment combination of V_1G_3 which was statistically similar to V_1G_2 (89.9) and while the minimum number of leaves (52.0) was recorded in V_3G_0 which was statistically similar to other treatment combination except V_1G_3, V_1G_2 and V_2G_3 at 75 DAT.

Table 2. Interaction effect of variety and GA_3 on the number of leaves of brinjal

Treatments	Number of leaves			
	30 DAT	45 DAT	60 DAT	75 DAT
V_1G_0	3.4 d	21.7 abcd	34.3 dg	65.0 bcd
V_1G_1	4.2 abc	25.4 abcd	50.0 abc	75.3 bcd
V_1G_2	4.5 a	25.5 abc	53.4 ab	89.9 ab
V_1G_3	4.2 abc	27.7 abc	59.4 a	107.8 a
V_2G_0	4.2 abc	26.4 abc	34.2 defg	52.7 cd
V_2G_1	3.6 cd	21.6 abcd	36.2 cdefg	56.2 cd
V_2G_2	3.6 bcd	27.6 abc	39.6 bcdef	75.6 bcd
V_2G_3	3.5 cd	29.4 a	47.8 abcd	78.6 bc
V_3G_0	3.5 cd	14.4 d	21.8 g	52.0 d
V_3G_1	3.2 d	16.6 cd	24.4 fg	58.9 cd
V_3G_2	3.3 d	18.0 bcd	29.7 efg	69.3 bcd
V_3G_3	4.4 ab	28.2 ab	42.0 bcde	76.6 bcd
LSD	0.7	11.1	15.2	25.9
CV %	11.6	27.8	22.8	21.4

V_1 = 'BARI Begun-4', V_2 = 'BARI Begun-7', V_3 = 'BARI Begun-8', G_0 = No GA_3 application (Control), G_1 = 50 ppm in concentration, G_2 = 100 ppm in concentration, G_3 = 150 ppm in concentration

4.3 Number of branches of brinjal

4. 3.1 Effect of variety on number of branches of brinjal

Number of branches varied significantly due to various brinjal varieties (Appendix IV and Figure 6). It was observed that 'BARI Begun-4' (V_1) produced the maximum number of branches at 60 and 75 DAT but at 45 DAT

'BARI Begun-7' (V_2) produced the highest number of branches. However, 'BARI Begun-8' (V_3) produced the lowest number of branches at 45, 60 and 75 DAT. The maximum number of branches (7.5) was recorded from V_1 while the minimum number of leaves recorded from V_3 (5.7) at 75 DAT.

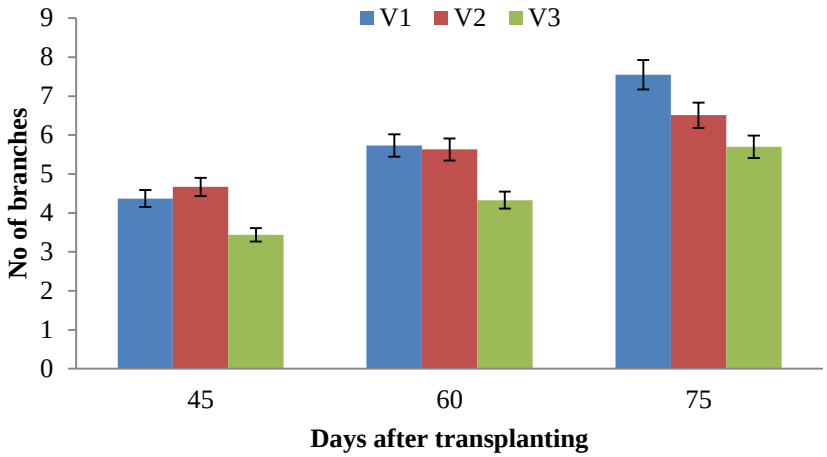

Figure 6. Effect of variety on the number of branches of brinjal

4.3.2 Effect of GA_3 on number of branches of brinjal

Number of branches did not vary significantly due to use of different concentration GA_3 treatments at 45 DAT however it varied significantly at 60 and 75 DAT (Appendix IV and Figure 7). However, it was observed that increased the number of branches due to increased concentration of GA_3 at 45, 60 and 75 DAT. The maximum number of branches (7.5) was recorded in 150 ppm GA_3 (G_3) treatments while control treatment (G_0) produced the minimum number of branches (5.6).

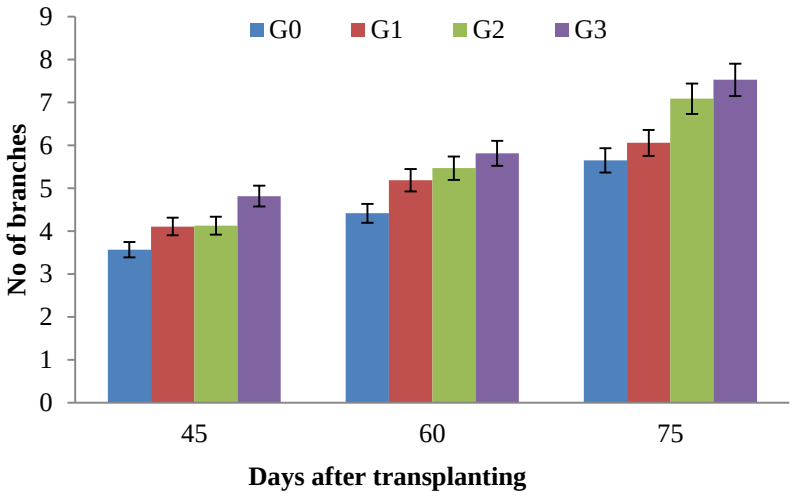

Figure 7. Effect of GA_3 on the number of branches of brinjal

4.3.3 Interaction effect of variety and GA_3 on number of branches of brinjal

Number of branches did not vary significantly due to various treatment combinations of variety and GA_3 concentrations except at 45 DAT (Appendix IV and Table 3). At 75 DAT the maximum number of branches (8.9) was recorded from the treatment combination of V_1G_3 which was statistically similar to V_1G_2 (8.1) while the minimum number of branches (5.0) was recorded in V_3G_0 which was statistically similar to V_1G_0, V_2G_0, V_3G_1 and V_3G_2 at 75 DAT.

Table 3. Interaction effect of variety and GA_3 on the number of branches of brinjal

Treatments	Number of branch		
	45 DAT	60 DAT	75 DAT
V_1G_0	3.8 ab	4.8 bcd	6.1 cd
V_1G_1	4.9 a	5.9 ab	7.0 bc
V_1G_2	4.3 ab	6.0 ab	8.1 ab
V_1G_3	4.3 ab	6.1 ab	8.9 a
V_2G_0	3.8 ab	4.4 cd	5.8 cd
V_2G_1	4.4 ab	5.6 abc	6.0 cd
V_2G_2	5.2 a	6.2 ab	7.0 bc
V_2G_3	5.2 a	6.2 a	7.1 bc
V_3G_0	2.9 b	3.9 d	5.0 d
V_3G_1	3.0 b	4.0 d	5.1 d
V_3G_2	2.8 b	4.2 d	6.1 cd
V_3G_3	4.9 a	5.0 abcd	6.5 c
LSD	1.8	1.3	1.3
CV %	26.5	15.6	12.4

V_1 = 'BARI Begun-4', V_2 = 'BARI Begun-7', V_3 = 'BARI Begun-8', G_0 = No GA_3 application (Control), G_1 = 50 ppm in concentration, G_2 = 100 ppm in concentration, G_3 = 150 ppm in concentration

4.4 Days to 1st flowering of brinjal

4. 4.1 Effect of variety on days to 1st flowering of brinjal

Days required for 1st flowering did not vary significantly due to different varieties (Appendix V and Table 4). The maximum days (76.6 days) were required for days to 1st flowering in 'BARI Begun-8' (V_3) and the minimum (75.1 days) were taken by 'BARI Begun-7' (V_2).

4.4.2 Effect of GA_3 on days to 1st flowering of brinjal

Days required for 1st flowering did not vary significantly due to various GA_3 concentration treatments (Appendix V and Table 4). The maximum days were required for 1st flowering (77.3 days) by control (G_0) plant while the minimum days (75.4 days) were required by 150 ppm GA_3 (G_3) concentration treated plant.

Table 4. Effect of variety and GA_3 on the different flowering and fruit characters of brinjal

Treatments	Days to 1st flowering	Number of flower cluster per plant	Number of flower per cluster	Days to 1st fruit set	Number of fruit per cluster	Fruit length (cm)	Fruit diameter (cm)
Variety							
V_1	75.8 a	5.6 a	3.2 a	84.8 a	4.4 a	11.9 c	3.4 a
V_2	75.1 a	4.3 b	2.0 b	84.7 a	2.0 b	19.6 b	2.4 b
V_3	76.6 a	4.1 b	1.6 b	85.0 a	1.6 b	22.1 a	2.4 b
LSD	2.0	0.6	0.6	2.6	1.2	1.3	0.1
CV %	3.1	15.2	33.3	3.6	55.7	8.7	6.1
GA_3 (Gibberellic Acid)							
G_0	77.3 a	3.9 b	1.7 b	86.7 a	1.6 b	16.1 c	2.6 b
G_1	75.4 ab	4.3 b	2.0 ab	84.2 ab	2.3 ab	17.4 bc	2.7 b
G_2	76.2 ab	5.5 a	2.8 a	85.1 ab	3.7 a	18.3 ab	2.8 b
G_3	74.5 b	5.0 a	2.5 a	83.4 b	3.0 ab	19.6 a	2.9 a
LSD	2.3	0.7	0.7	3.0	1.4	1.5	0.1
CV %	3.1	15.2	33.3	3.6	55.7	8.7	6.1

V_1 = 'BARI Begun-4', V_2 = 'BARI Begun-7', V_3 = 'BARI Begun-8', G_0 = No GA_3 application (Control), G_1 = 50 ppm in concentration, G_2 = 100 ppm in concentration, G_3 = 150 ppm in concentration.

4.4.3 Interaction effect of variety and GA_3 on days to 1st flowering of brinjal

Days required for 1st flowering did not vary significantly due to various treatment combinations of brinjal variety and GA_3 concentration (Appendix V and Figure 8). The maximum days required for 1st flowering (79.0) was observed in the treatment combination of V_1G_0 while the minimum days for 1st flowering (73.3 days) was observed in V_2G_3 treatment combination.

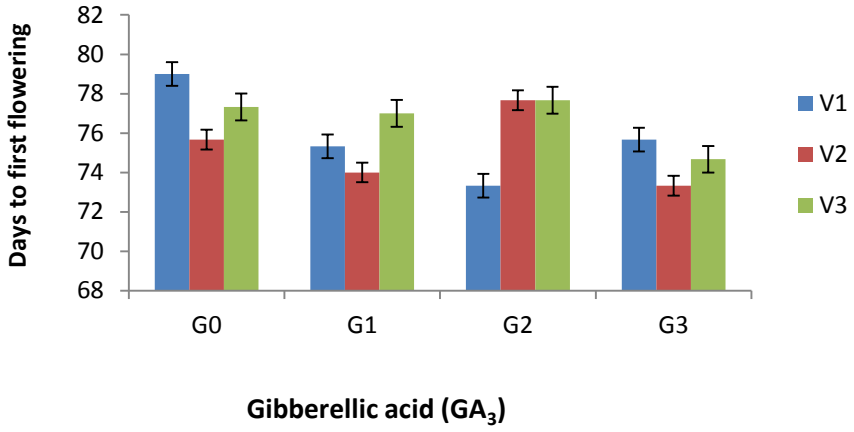

Figure 8. Interaction effect of variety and GA_3 on days to first flowering of brinjal

4.5 Number of flower clusters per plant of brinjal

4. 5.1 Effect of variety on number of flower clusters per plant of brinjal

Number of flower cluster per plant was exposed significantly with brinjal varieties (Appendix V and Table 4). The maximum number of flower cluster per plant (5.6) was recorded in 'BARI Begun-4' (V_1) whereas the minimum number of flower cluster per plant (4.1) was recorded from 'BARI Begun-8' (V_3) which was statistically similar (4.3) to 'BARI Begun-7' (V_2).

4.5.2 Effect of GA_3 on number of flower clusters per plant of brinjal

Due to application of different concentration of GA_3, significant differences were recorded on number of flower cluster per plant (Appendix V and Table 4). The maximum number of (5.5) flower cluster per plant was produced with 100 ppm GA_3 (G_2) concentration which was statistically similar (5.0) to 150 ppm GA_3 (G_3) concentration treated plant while the minimum (3.9) was obtained from the control (G_0) plant which was statistically similar to (4.3) 50 ppm GA_3 (G_1) concentration treated plant.

4.5.3 Interaction effect of variety and GA_3 on number of flower clusters per plant of brinjal

Number of flower cluster per plant did not vary significantly due to different treatment combinations of brinjal variety and GA_3 concentration (Appendix V and Figure 9). The maximum number of flower cluster per plant (6.6) observed from the treatment combination of V_1G_2 which was statistically similar to (6.2) V_1G_3 treatment combination whereas, minimum number of flower cluster per plant (3.4) was observed from V_3G_0 combination which was statistically similar to V_2G_0, V_2G_1, V_3G_1 and V_3G_3.

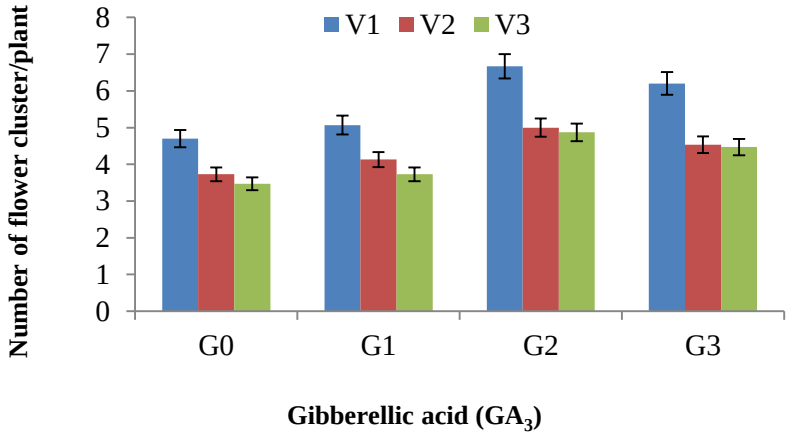

Figure 9. Interaction effect of variety and GA_3 on number of flower clusters per plant of brinjal

4.6 Number of flowers per cluster of brinjal

4. 6.1 Effect of variety on number of flowers per cluster of brinjal

Number of flower per cluster was significantly influenced with brinjal varieties (Appendix V and Table 4). The maximum number of flower per cluster (3.2) was recorded in 'BARI Begun-4' (V_1) whereas, the minimum number of flower per cluster (1.6) was recorded in 'BARI Begun-8' (V_3) which was statistically similar (2.0) to 'BARI Begun-7' (V_2).

4.6.2 Effect of GA_3 on number of flowers per cluster of brinjal

Due to application of different concentration of GA_3 significantly influenced on the number of flower per cluster (Appendix V and Table 4). Concentration of 100 ppm GA_3 (G_2) produced the maximum number of (2.8) flower per cluster which was statistically similar (2.5) to 150 ppm GA_3 (G_3) concentration and 50 ppm GA_3 (G_1) concentration treated plant while the minimum (1.7) was obtained from the control (G_0) plant.

4.6.3 Interaction effect of variety and GA_3 on number of flowers per cluster of brinjal

Number of flowers per cluster did not vary significantly due to different treatment combinations of brinjal variety and GA_3 concentration (Appendix V and Figure 10). The maximum number of flower per cluster (3.6) was observed in the treatment combination of V_1G_2 which was statistically similar to (3.2) V_1G_3, (2.7) V_1G_0, (3.13) V_1G_1, (2.6) V_2G_2, and (2.4) V_2G_3 treatment combination whereas, the minimum number of flower per cluster (1.0) was observed in V_3G_0 combination which was statistically similar to V_3G_1, V_3G_2, V_3G_3 and V_2G_0 and V_2G_1.

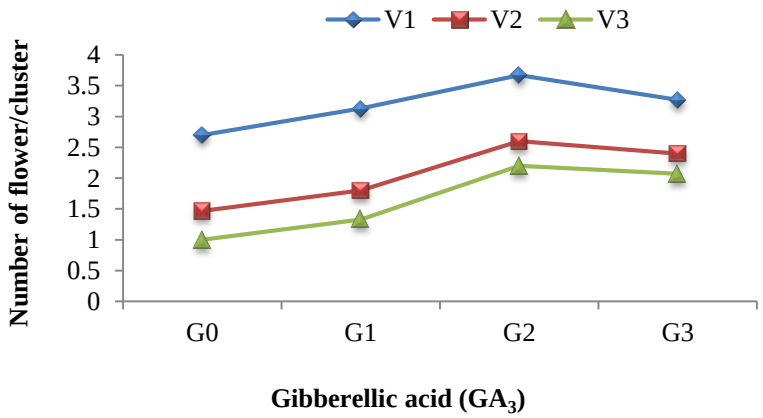

Figure 10. Interaction effect of variety and GA_3 on number of flowers per cluster of brinjal

4.7 Days to 1st fruit set of brinjal

4. 7.1 Effect of variety on days to 1st fruit set of brinjal

Days required for 1st fruit set did not vary significantly due to different varieties (Appendix VI and Table 4). The maximum days (85.0 days) were required for days to 1st fruit set in 'BARI Begun-8' (V_3) and the minimum (84.7 days) were recorded in 'BARI Begun-7' (V_2).

4.7.2 Effect of GA_3 on days to 1st fruit set of brinjal

Days required for 1st fruit set did not vary significantly due to different concentration of GA_3 treatments (Appendix VI and Table 4). The maximum days required for 1st fruit set (86.7 days) by control (G_0) plant while minimum days (83.4 days) required by 150 ppm GA_3 (G_3) concentration treated plant.

4.7.3 Interaction effect of variety and GA_3 on days to 1st fruit set of brinjal

Days required for 1st fruit set did not vary significantly due to different treatment combinations of brinjal variety and GA_3 concentration (Appendix VI and Figure 11). The maximum days required for 1st fruit set (88.0) was recorded in the treatment combination of V_1G_0 while the minimum days for 1st fruit set (82.6 days) was recorded in V_2G_2 and V_2G_3 treatment combination.

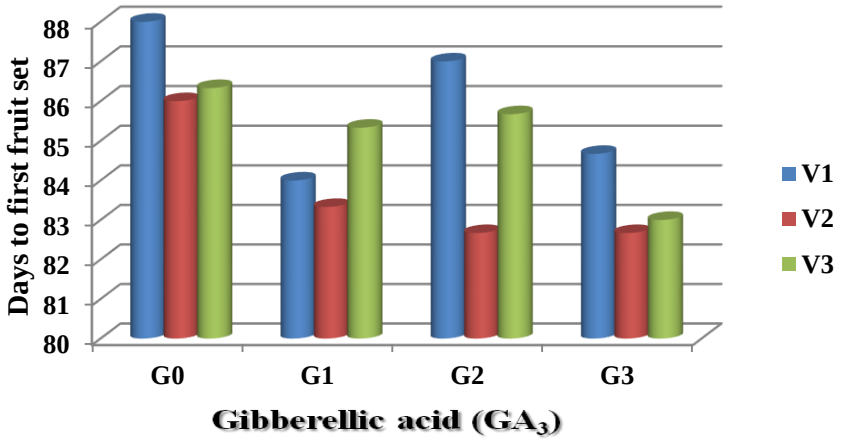

Figure 11. Interaction effect of variety and GA_3 on days to first fruit set of brinjal

4.8 Number of fruit per cluster of brinjal

4. 8.1 Effect of variety on number of fruits per cluster of brinjal

Number of fruits per cluster was significantly influenced with brinjal varieties (Appendix VI and Table 4). The maximum number of fruits per cluster (4.4) was recorded in 'BARI Begun-4' (V_1) whereas, the minimum number of fruits per cluster (1.6) was recorded in 'BARI Begun-8' (V_3) which was statistically similar (2.0) to 'BARI Begun-7' (V_2).

4.8.2 Effect of GA_3 on number of fruits per cluster of brinjal

Due to application of different concentrations of GA_3, significantly influenced on the number of fruits per cluster (Appendix VI and Table 4). Concentration of 100 ppm GA_3 (G_2) produced the maximum number of (3.7) fruits per cluster which was statistically similar (3.0) to 150 ppm GA_3 (G_3) concentration and (2.3) 50 ppm GA_3 (G_1) concentration treated plant while the minimum (1.6) was recorded in the control (G_0) plant.

4.8.3 Interaction effect of variety and GA_3 on number of fruits per cluster of brinjal

Number of fruits per cluster did not vary significantly due to various treatment combinations of brinjal variety and GA_3 concentration (Appendix VI and Figure 12). The maximum number of fruits per cluster (5.4) was recorded from the treatment combination of V_1G_2 whereas, the minimum number of fruits per cluster (0.5) was recorded in V_3G_0 combination.

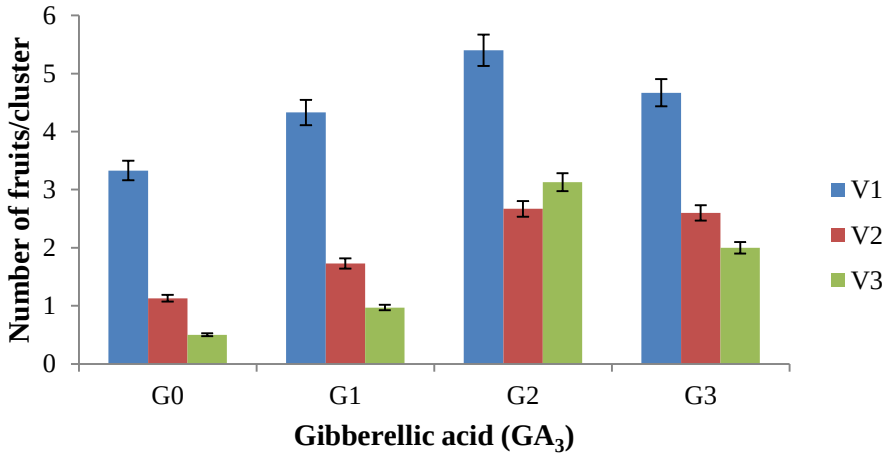

Figure 12. Interaction effect of variety and GA_3 on number of fruit per cluster of brinjal

4.9 Fruit length (cm) of brinjal

4. 9.1 Effect of variety on fruit length (cm) of brinjal

Fruit length was significantly influenced with brinjal varieties (Appendix VI and Table 4). The longest fruits (22.1 cm) were recorded in 'BARI Begun-8' (V_3) whereas the shortest fruits (11.9 cm) were recorded in 'BARI Begun-4' (V_1).

4.9.2 Effect of GA_3 on fruit length (cm) of brinjal

Fruit length varied significantly due to various GA_3 concentration treatments (Appendix VI and Table 4). It was observed that 150 ppm GA_3 (G_3) concentration produced the longest fruit (19.6 cm) which was statistically similar (18.3) to 100 ppm GA_3 (G_2) treated plant while control (G_0) produced shortest (16.1 cm) fruits length. Result show that increased concentration of GA_3 increased the fruit length. However, the report by Khan *et al*. (2006) indicated the significant role of GA_3 in tomato plant to increase fruit set that leads to larger number of fruits per plant and increased fruit size.

4.9.3 Interaction effect of variety and GA_3 on fruit length (cm) of brinjal

Fruit length did not vary significantly due to various treatment combinations of brinjal variety and GA_3 concentration (Appendix VI and Figure 13). The longest fruit length (25.2 cm) was observed from the treatment combination of V_3G_3 while the shortest fruit length (11.1 cm) was observed from V_1G_0.

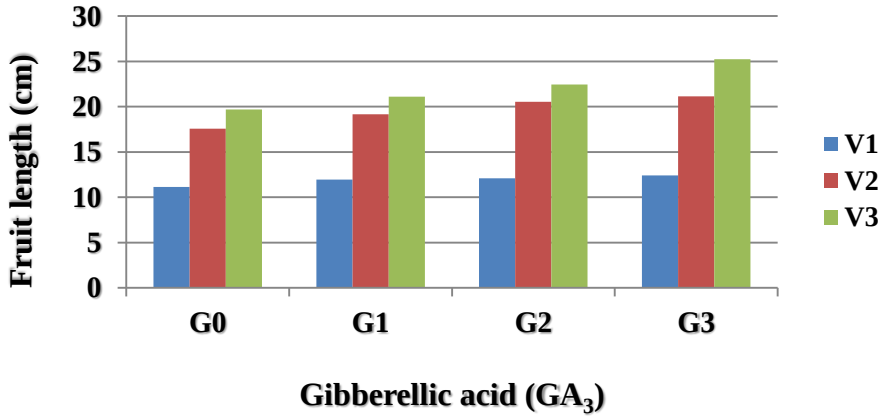

Figure 13. Interaction effect of variety and GA_3 on fruit length (cm) of brinjal

4.10 Fruit diameter (cm) of brinjal

4. 10.1 Effect of variety on fruit diameter (cm) of brinjal

Fruit diameter was significantly influenced with brinjal varieties (Appendix VI and Table 4). The widest fruits (3.4 cm) were recorded in 'BARI Begun-4' (V_1)

whereas, the narrowest fruits (2.4 cm) were recorded in 'BARI Begun-8' (V_3) which was statistically similar (2.4 cm) to 'BARI Begun-7' (V_2).

4.9.3 Effect of GA_3 on fruit diameter (cm) of brinjal

Fruit diameter varied significantly due to various GA_3 concentration treatments (Appendix VI and Table 4). It was observed that concentration of 150 ppm GA_3 (G_3) produced the widest fruit (2.9 cm) while control (G_0) produced the narrowest (2.6 cm) fruit which was statistically similar to (2.7 cm) (G_1) and (2.8 cm) (G_2) treated plant. However, the report by Khan *et al*. (2006) indicated the significant role of GA_3 in tomato plant to increase fruit set that leads to larger number of fruits per plant and increased fruit size.

4.9.4 Interaction effect of variety and GA_3 on fruit diameter (cm) of brinjal

Fruit diameter did not vary significantly due to various treatment combinations of brinjal variety and GA_3 concentration (Appendix VI and Figure 14). The widest fruit diameter (3.6 cm) was recorded from the treatment combination of V_1G_3 which was statistically similar to V_1G_1 (3.4 cm) and V_1G_2 (3.4 cm) while the narrowest fruit length (2.2 cm) was observed in V_3G_0 which was statistically similar to V_2G_0 (2.4 cm), V_2G_1 (2.4 cm), V_2G_2 (2.4 cm), V_3G_1 (2.3 cm) and V_3G_2 (2.5 cm).

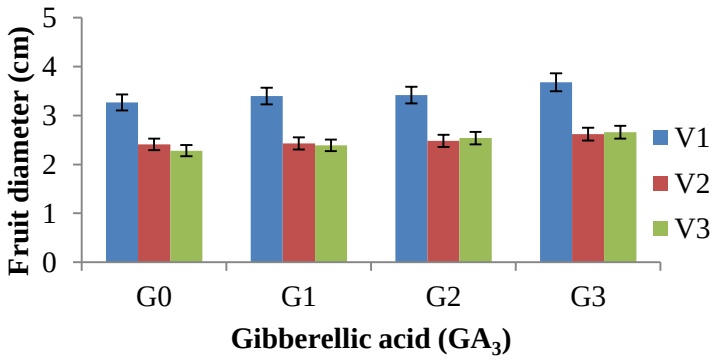

Figure 14. Interaction effect of variety and GA_3 on fruit diameter (cm) of brinjal

4.11 Average fruit weight (g) of brinjal

4. 11.1 Effect of variety on average fruit weight (g) of brinjal

Average fruit weight of brinjal per plant was influenced significantly by brinjal variety (Appendix VII and Table 5). V_2 (BARI Begun-7) variety gave the maximum average fruit weight (70.6 g) which was statistically similar (68.6 g) to V_3 (BARI Begun-8) and the minimum fruit weight (54.6 g) was recorded in from V_1 (BARI Begun-4) variety.

4.11.2 Effect of GA_3 on average fruit weight (g) of brinjal

Average fruit weight of brinjal per plant was influenced significantly by various GA_3 concentration treatments (Appendix VII and Table 5). It was observed that concentration of 100 ppm GA_3 (G_2) produced the maximum average fruit weight (69.1 g) which was statistically similar (66.8 g) to 150 ppm GA_3 (G_3) treated plant while the control (G_0) treatment produced the minimum average fruit weight (59.3 g) which was statistically similar to (63.0 g) 50 ppm GA_3 (G_1).

4.11.3 Interaction effect of variety and GA_3 on average fruit weight (g) of brinjal

Fruit diameter did not vary significantly due to various treatment combinations of brinjal variety and GA_3 concentration (Appendix VII and Table 5). The maximum average fruit weight (74.7 g) was recorded from the treatment combination of V_3G_2 which was statistically similar to V_2G_2 (74.1 g), V_2G_3 (72.0 g) and V_2G_1 (70.0 g) and the minimum average fruit weight (49.5 g) was observed from V_1G_0 which was statistically similar to V_1G_1 (52.9 g) and V_1G_3 (57.4 g).

4.12 Number of fruits per plant of brinjal

4. 12.1 Effect of variety on number of fruits per plant of brinjal

Number of fruit per plant was significantly influenced with brinjal varieties (Appendix VII and Table 5). The maximum number of fruit (33.0 fruits/plant) was recorded in V_1 (BARI Begun-4) whereas, the minimum number of fruit (19.7 fruits/plant) was recorded in V_3 (BARI Begun-8) which was statistically similar (20.7 fruits/plant) to V_2 (BARI Begun-7).

4.12.2 Effect of GA_3 on number of fruits per plant of brinjal

Different GA_3 concentration treatments significantly influenced on the production of number of fruit per plant (Appendix VII and Table 5). Concentration of 100 ppm GA_3 (G_3) treated plants produced the maximum number of fruit (27.6 fruits/plant) which was statistically similar (26.0 fruits/plant) to 150 ppm GA_3 (G_3) concentration treated plant while the minimum number of fruit (20.2 fruits/plant) was obtained from the control (G_0) treatment. Result showed that increased concentration of GA_3 increased the number of fruits per plant but in higher concentration (150 ppm GA_3) the number of fruits per plant was reduced. Application of GA_3 increases cell growth and elongation and leads to bigger plants with longer shoots, leaves and maximum canopy in many plants. The higher concentration leads higher vegetative growth which may cause of lower fruit set per plants.

4.12.3 Interaction effect of variety and GA_3 on number of fruits per plant of brinjal

Number of fruits per plant did not vary significantly due to various treatment combinations of brinjal variety and GA_3 concentration (Appendix VII and Table 5). The maximum number of fruits per plant (36.4 fruits/plant) observed from the treatment combination of V_1G_2 which was statistically similar to V_1G_1 (33.6 fruits/plant) and V_1G_2 (34.3 fruits/plant) whereas the minimum number of fruits per plant (16.2 fruits/plant) was observed from V_3G_0 combination which

was statistically similar to V_2G_0, V_2G_1, V_3G_1 and V_3G_3 treatment combination.

4.13 Yield (kg) per plant of brinjal

4. 13.1 Effect of variety on yield (kg) per plant of brinjal

It was observed from the results of the present experiment that different brinjal variety significantly varied with the yield per plant (Appendix VII and Table 5). The maximum yield per plant (1.8 kg/plant) was recorded in 'BARI Begun-4' (V_1) while minimum yield per plant (1.3 kg/plant) was found from 'BARI Begun-8' (V_3) which was statistically similar to 'BARI Begun-7' (V_2).

4.13.2 Effect of GA_3 on yield (kg) per plant of brinjal

Yield per plant varied significantly due to various GA_3 concentration treatments (Appendix VII and Table 5). It was observed that Concentration of 100 ppm GA_3 (G_2) produced maximum yield per plant (1.8 kg) which was statistically similar (1.7 kg) to 150 ppm GA_3 (G_3) concentration treated plant while the minimum yield per plant (1.1 kg) recorded from control (G_0) treated plant. Results showed that yield per plant increased up to 100 ppm GA_3 but reduced in higher concentration of GA_3 (>100 ppm). Application of GA_3 increases cell growth and elongation and leads to bigger plants with longer shoots, leaves and maximum canopy in many plants with higher crop yields.

4.13.3 Interaction effect of variety and GA_3 on yield per plant (kg) of brinjal

Yield per plant did not vary significantly due to various treatment combinations of brinjal variety and GA_3 concentration (Appendix VII and Table 5). The maximum yield per plant (2.1 kg) was observed from the treatment combination of V_1G_2 which was statistically similar with V_1G_3 (1.9 kg) whereas the minimum yield per plant (1.0 kg) was observed from V_3G_0 which was statistically similar with V_1G_0, V_2G_0 and V_3G_1 treatment combination.

4.14 Yield per plot of brinjal

4. 14.1 Effect of variety on yield (kg) per plot of brinjal

It was observed that different brinjal variety significantly varied with the yield per plot (Appendix VII and Table 5). The maximum yield per plot (29.0 kg) was recorded in 'BARI Begun-4' (V_1) while the minimum yield per plot (21.9 kg) was recorded in 'BARI Begun-8' (V_3) which was statistically similar to 'BARI Begun-7' (V_2).

4.14.2 Effect of GA_3 on yield per plot of brinjal

Yield per plot varied significantly due to various GA_3 concentration treatments (Appendix VII and Table 5). It was observed that maximum yield per plot (29.7 kg) was produced by 100 ppm GA_3 (G_2) which was statistically similar (27.2 kg) to 150 ppm GA_3 (G_3) concentration treated plant while the minimum yield per plot (18.6 kg) recorded in control (G_0) plant.

4.14.3 Interaction effect of variety and GA_3 on yield per plot of brinjal

Yield per plot did not vary significantly due to various treatment combinations of brinjal variety and GA_3 concentration (Appendix VII and Table 5). The maximum yield per plot (34.1 kg) was recorded in the treatment combination of V_1G_2 which was statistically similar with V_1G_3 (31.6 kg) whereas, the minimum yield per plot (16.5 kg) was observed from V_3G_0 which was statistically similar to V_1G_0, V_2G_0 and V_3G_1 treatment combination.

4.15 Yield (t/ha) of brinjal

4. 15.1 Effect of variety on yield (t/ha) of brinjal

It was observed that different brinjal variety significantly varied with the yield of brinjal (Appendix VII and Figure 15). The maximum yield (50.4 t/ha) was recorded in 'BARI Begun-4' (V_1) while the minimum yield per plot (38.0 t/ha) was recorded in 'BARI Begun-8' (V_3) which was statistically similar to 'BARI Begun-7' (V_2).

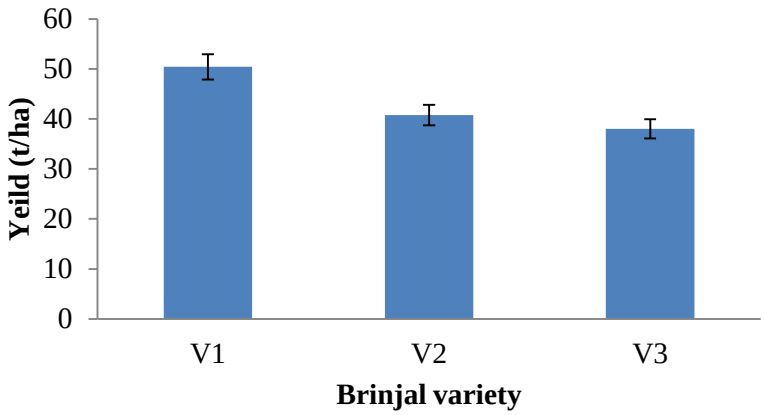

Figure 15. Effect of variety on the yield of brinjal

4.15.2 Effect of GA_3 on yield (t/ha) of brinjal

Yield of brinjal varied significantly due to various GA_3 concentration treatments (Appendix VII and Figure 16). It was observed that 100 ppm GA_3 (G_2) produced maximum yield (51.6 t/ha) which was statistically similar (47.2 t/ha) to 150 ppm GA_3 (G_3) concentration treated plant while the minimum yield (32.4 t/ha) recorded in control (G_0) treated plant. Result indicated that increased concentration of GA_3 increases yield of brinjal up to 100 ppm GA_3 and reduced in higher concentration (150 ppm). Similar result was found in brinjal by Meena and Dhaka (2003), who found the highest yield at 100 ppm gibberellic. They said that higher concentrations of GA_3 were found uneconomic. Application of GA_3 increases cell growth and elongation and leads to bigger plants with longer shoots, leaves and maximum canopy in many plants with higher crop yields.

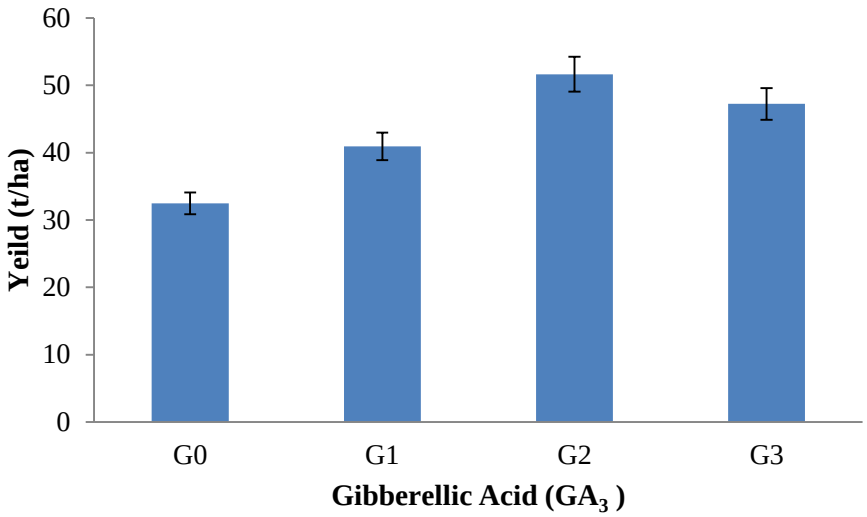

Figure 16. Effect of GA_3 on the yield of brinjal

4.15.3 Interaction effect of variety and GA_3 on yield (t/ha) of brinjal

Yield of brinjal did not vary significantly due to various treatment combinations of brinjal variety and GA_3 concentration (Appendix VII and Table 5). The maximum yield (59.2 t/ha) was recorded from the treatment combination of V_1G_2 while the minimum yield per plot (30.6 t/ha) was recorded in V_2G_0.

Table 5. Effect of variety and GA_3 on different yield parameters of brinjal

Treatments	Average fruit weight (g)	Number of fruit/plant	Yield/plant (kg)	Yield/plot	Yield (t/ha)
Variety					
V_1	54.6 b	33.0 a	1.8 a	29.0 a	50.4 a
V_2	70.6 a	20.7 b	1.4 b	23.4 b	40.7 b
V_3	68.6 a	19.7 b	1.3 b	21.9 b	38.0 b
LSD	4.0	2.4	0.1	2.7	4.7
CV %	7.3	11.8	13.0	13.0	13.0
GA_3 (Gibberellic Acid)					
G_0	59.3 c	20.2 c	1.1 c	18.6 c	32.4 c
G_1	63.0 bc	24.1 b	1.4 b	23.5 b	40.9 b
G_2	69.1 a	27.6 a	1.8 a	29.7 a	51.6 a
G_3	66.8 ab	26.0 ab	1.7 a	27.2 a	47.2 a
LSD	4.6	2.8	0.1	3.1	5.5
CV %	7.3	11.8	13.0	13.0	13.0
Interaction					
V_1G_0	49.4 e	27.7 b	1.3 efgh	21.9 efgh	38.0 i
V_1G_1	52.9 de	33.6 a	1.7 bc	28.5 bc	49.5 c
V_1G_2	58.6 cd	36.4 a	2.1 a	34.1 a	59.2 a
V_1G_3	57.4 cde	34.3 a	1.9 ab	31.6 ab	54. 8 b
V_2G_0	66.2 abc	16.7 d	1.1 gh	17.6 gh	30.6 k
V_2G_1	70.0 ab	20.1 cd	1.4 defg	22.4 defg	38.9 h
V_2G_2	74.1 a	23.4 bc	1.7 bcd	27.8 bcd	48.2 d
V_2G_3	72.0 a	22.7 c	1.6 cde	26.0 cde	45.2 f
V_3G_0	62.4 bc	16.2 d	1.0 h	16.5 h	28.6 l
V_3G_1	66.2 abc	18.6 cd	1.2 fgh	19.7 fgh	34.3 j
V_3G_2	74.7 a	22.9 bc	1.7 bcde	27.3 bcde	47.4 e
V_3G_3	71.0 ab	21.0 cd	1.5 cdef	23.9 cdef	41.6 g
LSD	8.0	4.9	0.3	5.4	9.5
CV %	7.3	11.8	13.0	13.0	13.0

V_1 = 'BARI Begun-4', V_2 = 'BARI Begun-7', V_3 = 'BARI Begun-8', G_0 = No GA_3 application (Control), G_1 = 50 ppm in concentration, G_2 = 100 ppm in concentration, G_3 = 150 ppm in concentration.

4.16 Economic analysis

Input costs for land preparation, seed cost, fertilizer & manure cost and man power required for all the operations from transplanting of seedling to harvesting of tomato were recorded for unit plot and converted into cost per hectare. Prices of tomato were considered in market rate basis of Karwan Bazar, Dhaka. 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:

4.16.1 Gross return

In the combination of nitrogen and GA_3 showed different gross return under the trial. The highest gross return (Tk. 966860/ha) was obtained from V_1G_2 (BARI Begun-4 x 100 ppm GA_3) and the second highest gross return (Tk. 948020/ha) was obtained from V_1G_3 (BARI Begun-4 x 150 ppm GA_3). The lowest gross return (Tk, 515520/ha) was obtained from V_3G_0 (Table 6).

4.16.2 Net return

In case of net return different treatment combination showed different values of net return (Table 6). The highest net return (Tk, 801609/ha) was obtained from V_1G_2 and the second highest net return (Tk, 681726/ha) was obtained from V_1G_3. The lowest net return (Tk, 253124/ha) was obtained from V_3G_0 (Table 6).

4.16.3 Benefit cost ratio (BCR)

The combination of nitrogen and GA_3 for benefit cost ratio was different in all treatment combination (Table 6). The highest benefit cost ratio (3.8) was obtained from V_1G_2 and the second highest benefit cost ratio (3.3) was estimated V_1G_3. The lowest benefit cost ratio (1.5) was obtained from V_3G_0. From economic point of view, it is apparent from the above results that V_1G_2 was more profitable than rest of the treatment combination.

Table 6. Interaction effect of variety and GA_3 on total net returns contributing characters and yield of brinjal

Treatments	Cost of production	Yield of brinjal (t/ha)	Gross return (Tk./ha)	Net return (Tk./ha)	Benefit cost ratio
V_1G_0	262178	38.0	684900	422722	1.6
V_1G_1	264226	49.5	756774	502548	2.3
V_1G_2	265251	59.2	966860	801609	3.8
V_1G_3	266294	54.8	948020	681726	3.3
V_2G_0	262343	30.0	541080	278737	2.0
V_2G_1	264367	38.9	580380	436013	2.6
V_2G_2	265323	48.2	723357	638034	3.2
V_2G_3	266372	45.2	653960	547588	3.0
V_3G_0	262396	28.6	515520	253124	1.5
V_3G_1	264352	34.3	617940	353588	2.3
V_3G_2	265401	47.4	853920	588519	3.2
V_3G_3	266425	41.6	749700	483275	2.8

V_1 = 'BARI Begun-4', V_2 = 'BARI Begun-7', V_3 = 'BARI Begun-8', G_0 = No GA_3 application (Control), G_1 = 50 ppm in concentration, G_2 = 100 ppm in concentration, G_3 = 150 ppm in concentration.

Rate of brinjal (25 Tk/kg) in peak period at Karwan Bazar, Dhaka

CHAPTER V

SUMMARY AND CONCLUSION

In order to produce brinjal with GA_3 application for Bangladeshi farmers, a research was conducted to investigate the growth and yield of brinjal varieties under different GA_3 doses at Horticultural farm, Sher-e-Bangla Agricultural University, Dhaka during the period from October 2013 to February 2014. Two factor experiment included 3 brinjal varieties viz. V_1 (BARI Begun-4), V_2 (BARI Begun-7), V_3 (BARI Begun-8) and 4 gibberellic acid (GA_3) concentrations viz. G_0 (Control), G_1 (50 ppm GA_3), G_2 (100 ppm GA_3) and G_3 (150 ppm GA_3) was outlined in Randomized Complete Block Design (RCBD) with three replications.

Results showed that variety had significant effect on growth parameters. The rapid increase of plant height was observed from 30 days to 75 days of growth stages which was the tallest (76.0 cm) in the 'BARI Begun-7' (V_2) and the shortest (62.5 cm) in 'BARI Begun-8' (V_3) at harvesting stage. Conversely, 150 ppm GA_3 (G_3) treatments and control (G_0) were recorded as the tallest (74.4 cm) and the shortest (64.6 cm) plant respectively at harvesting stage in terms of GA_3 treatments. In combination of brinjal variety and GA_3 treatments, V_2G_1 generated the tallest (74.5 cm) plant whereas V_1G_0 produced the shortest (57.3 cm) at harvesting stage. It also observed that the maximum number of leaves (84.5) was recorded in 'BARI Begun-4' (V_1) while the minimum number of leaves was recorded in (64.2) at 75 DAT. Conversely, the maximum leaves number (87.7) was recorded in 150 ppm GA_3 (G_3) treatments while the control (G_0) produced the minimum number leaves (56.6). In combination of brinjal variety and GA_3 treatments, the maximum leaves number (107.8) was recorded in the treatment combination of V_1G_3 and the minimum leaves number (52.0) recorded in V_3G_0 treatment. The maximum number of branches (7.5) was recorded in 'BARI Begun-4' (V_1) while the minimum number of leaves recorded in (5.7) at 75 DAT. Conversely, the maximum number of branches (7.5) was recorded in 150 ppm GA_3 (G_3) treatments while the control

(G_0) produced the minimum number branches (5.6). In combination of brinjal variety and GA_3 treatments, the maximum branches number (8.9) was recorded in the treatment combination of V_1G_3 while the minimum branches number (5.0) recorded in V_3G_0 treatment at 75 DAT. Days required for 1st flowering did not vary significantly due to different varieties, different GA_3 concentration treatments and combinations of brinjal variety and GA_3 concentration. The maximum days (76.6 days) were required for days to 1st flowering in 'BARI Begun-8' (V_3) and the minimum (75.1 days) were recorded in 'BARI Begun-7' (V_2). The maximum days required for 1st flowering (77.3 days) by control (G_0) treated plant while the minimum days (75.4 days) required by 150 ppm GA_3 (G_3) concentration treated plant. The maximum days required for 1st flowering (79.0) was recorded in the treatment combination of V_1G_0 while the minimum days for 1st flowering (73.3 days) was recorded in V_2G_3 treatment combination (Table 4). The maximum number of flower cluster per plant (5.6) was recorded in 'BARI Begun-4' V_1) whereas, the minimum number of flower cluster per plant (4.1) was recorded in 'BARI Begun-8' (V_3) which was statistically similar (4.3) to 'BARI Begun-7' (V_2). Conversely, 100 ppm GA_3 (G_2) concentration produced maximum number of (5.5) flower cluster per plant while the minimum (3.9) was recorded in control (G_0). In combination of brinjal variety and GA_3 treatments, the maximum number of flower cluster per plant (6.6) observed in the treatment combination of V_1G_2 whereas the minimum number of flower cluster per plant (3.4) was recorded in V_3G_0 combination. The maximum number of flower per cluster (3.2) was recorded in 'BARI Begun-4' (V_1) whereas, the minimum number of flower per cluster (1.6) was recorded in 'BARI Begun-8' (V_3) treatment. Conversely, maximum number of (2.8) flower per cluster 100 ppm GA_3 (G_2) concentration produced the maximum number of (2.8) flower per cluster while the minimum (1.7) was recorded in the control (G_0) treated plant. In combination of brinjal variety and GA_3 treatments, the maximum number of flower per cluster (3.6) recorded in the treatment combination of V_1G_2 whereas, the minimum number of flower per cluster (1.0) was recorded in V_3G_0 combination. Days required for 1st fruit

set did not vary significantly due to different varieties, different GA_3 concentration treatments and combinations of brinjal variety and GA_3 concentration. The maximum days (85.0 days) were required for days to 1st fruit set in 'BARI Begun-8' (V_3) and the minimum (84.7 days) were recorded in 'BARI Begun-7' (V_2). Conversely, the maximum days required for 1st fruit set (86.7 days) by control (G_0) treated plant while the minimum days (83.4 days) required by 150 ppm GA_3 (G_3) concentration treated plant. In combination of brinjal variety and GA_3 treatments, The maximum days required for 1st fruit set (88.0) was recorded in the treatment combination of V_1G_0 while the minimum days for 1st fruit set (82.6 days) was recorded in V_2G_3 treatment combination. The maximum number of fruits per cluster (4.4) was recorded in 'BARI Begun-4' (V_1) whereas, the minimum number of fruits per cluster (1.6) was recorded in 'BARI Begun-8' (V_3). Conversely, 100 ppm GA_3 (G_2) concentration produced the maximum number of (3.7) fruits per cluster while the minimum (1.6) was recorded in the control (G_0) treated plant. In combination of brinjal variety and GA_3 treatments, the maximum number of fruits per cluster (5.4) was recorded in the treatment combination of V_1G_2 whereas the minimum number of fruits per cluster (0.5) was recorded in V_3G_0 combination. The longest fruits (22.1 cm) were recorded in 'BARI Begun-8' (V_3) whereas, the shortest fruits (11.9 cm) were recorded in 'BARI Begun-4' (V_1). Conversely, 150 ppm GA_3 (G_3) concentration produced the longest fruit (19.6 cm) while control (G_0) produced the shortest (16.1 cm) fruits length. In combination of brinjal variety and GA_3 treatments, the longest fruit length (25.2 cm) was recorded in the treatment combination of V_3G_3 while the shortest fruit length (11.1 cm) was recorded in V_1G_0. The widest fruits (3.4 cm) were recorded in 'BARI Begun-4' (V_1) whereas the narrowest fruits (2.4 cm) were recorded in 'BARI Begun-8' (V_3) which was statistically similar (2.4 cm) to 'BARI Begun-7' (V_2). Conversely, 150 ppm GA_3 (G_3) concentration produced the widest fruit (2.9 cm) while control (G_0) produced the narrowest (2.6 cm) fruits. In combination of brinjal variety and GA_3 treatments, the widest fruit diameter (3.6 cm) was recorded in the treatment combination of

V_1G_3 while the narrowest fruit length (2.2 cm) was recorded in V_3G_0. V_2 (BARI Begun-7) variety gave the maximum average fruit weight (70.6 g) and the minimum fruit weight (54.6 g) was recorded in V_1 ('BARI Begun-4') variety. Conversely, 100 ppm GA_3 (G_2) concentration produced the maximum average fruit weight (69.1 g) while control (G_0) produced the minimum average fruit weight (59.3 g). In combination of brinjal variety and GA_3 treatments, the maximum average fruit weight (74.7 g) was recorded in the treatment combination of V_3G_2 while the minimum average fruit weight (49.5 g) was recorded in V_1G_0. The maximum number of fruit (33.0 fruits/plant) was recorded in V_1 (BARI Begun-4) whereas the minimum number of fruit (19.7 fruits/plant) was recorded in V_3 (BARI Begun-8). Conversely, 100 ppm GA_3 (G_3) concentration treated plants produced the maximum number of fruit (27.6 fruits/plant) while the minimum number of fruit (20.2 fruits/plant) was recorded in the control (G_0) treatment. In combination of brinjal variety and GA_3 treatments, the maximum number of fruits per plant (36.4 fruits/plant) recorded in the treatment combination of V_1G_2 whereas the minimum number of fruits per plant (16.2 fruits/plant) was recorded in V_3G_0 combination. Results showed that variety had significant effect on yield parameters. The maximum yield per plant (1.8 kg /plant) was recorded in 'BARI Begun-4' (V_1) while the minimum yield per plant (1.3 kg/plant) was recorded in 'BARI Begun-8' (V_3). Conversely Concentration of 100 ppm GA_3 (G_2) produced the maximum yield per plant (1.8 kg) while the minimum yield per plant (1.1 kg) recorded in control (G_0) treated plant. The maximum yield per plant (2.1 kg) was recorded in the treatment combination of V_1G_2 whereas the minimum yield per plant (1.0 kg) was recorded in V_3G_0. The maximum yield per plot (29.0 kg) was recorded in 'BARI Begun-4' (V_1) while the minimum yield per plot (21.9 kg) was recorded in 'BARI Begun-8' (V_3). Conversely, 100 ppm GA_3 (G_2) produced the maximum yield per plot (29.7 kg) while the minimum yield per plot (18.6 kg) recorded in control (G_0) plant. In combination of brinjal variety and GA_3 treatments, the maximum yield per plot (34.1 kg) was recorded in the treatment combination of V_1G_2 whereas, the minimum yield per plot (16.5 kg)

was recorded in V_3G_0. The maximum yield (50.4 t/ha) was recorded in 'BARI Begun-4' (V_1) while the minimum yield per plot (38.0 t/ha) was recorded in 'BARI Begun-8' (V_3). Conversely, the maximum yield (51.6 t/ha) was recorded in 100 ppm GA_3 (G_2) while the minimum yield (32.4 t/ha) recorded from control (G_0) plant. In combination of brinjal variety and GA_3 treatments, the maximum yield (59.2 t/ha) was recorded in the treatment combination of V_1G_2 while the minimum yield per plot (30.6 t/ha) was recorded in V_2G_0.

From the recorded data of present experiment it may be concluded that 'BARI Begun-4' is the best than other varieties. Concentration of 100 ppm GA_3 gave the maximum brinjal yield. When 'BARI Begun-4' treated with 100 ppm GA_3 it gave the maximum yield.

The highest gross return (Tk. 966860/ha), net return (Tk, 801609/ha), benefit cost ratio (3.8), was recorded in the combination of 'BARI Begun-4' and 100 ppm GA_3 whereas the lowest gross return (Tk, 515520/ha), net return (Tk, 253124/ha) and benefit cost ratio (1.9) was recorded in the combination of 'BARI Begun-8' and no ppm GA_3.

The overall results obtained from the study facilitated to draw the following conclusions:

- Variety played an important role on the growth and yield of brinjal. In respect of all the yield attributes and yield, Variety showed better performance at the higher level (50.4 t/ha).
- The plants produced the maximum growth and yield of brinjal due application of 100 ppm GA_3.
- It may be drawn the conclusion from above fact V_1 (BARI Begun-4) and 100 ppm GA_3 is suitable combination for the brinjal production.

Such experiment with other brinjal varieties and different concentrations of GA_3 could be tested further in different brinjal cultivated areas of Bangladesh to justify the present findings.

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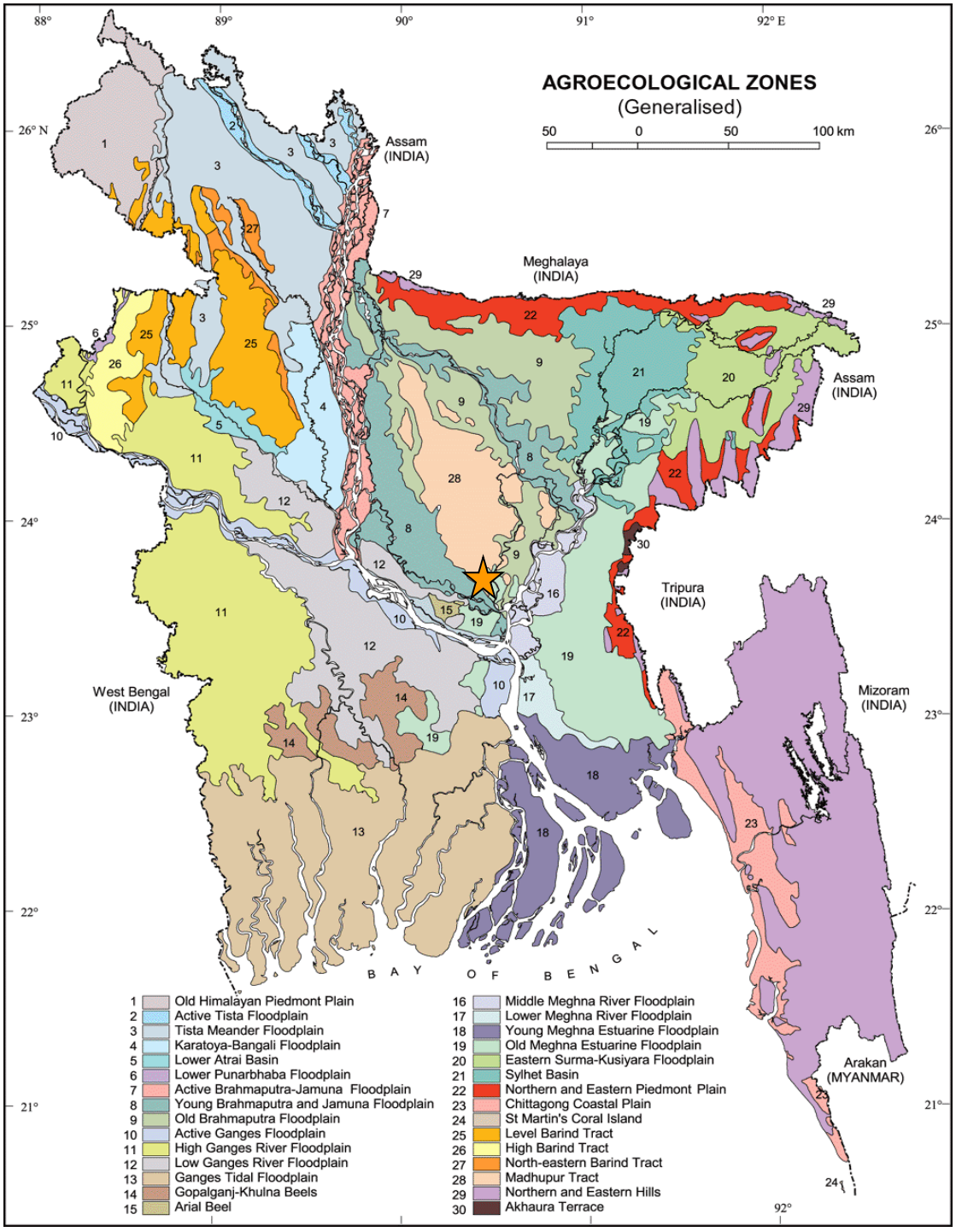
APPENDICES

Appendix I. Map showing the experimental sites under study



★ **The experimental site under study**

Appendix II. Analysis of variance of the data on plant height of brinjal at different DAT

Sources of variation	Plant height (cm)			
	30 DAT	45 DAT	60 DAT	75 DAT
Replication	0.848	0.210	96.603	48.296
Variety	14.298*	680.333*	706.523*	548.596*
Gibberellic Acid	8.268*	302.467*	232.964*	162.717*
Variety X Gibberellic acid	3.373ns	21.369ns	21.024ns	3.494*
Error	2.727	61.406	34.197	27.424ns
CV %	15.28	19.61	9.95	7.56

Appendix III. Analysis of variance of the data on number of leaves of brinjal at different DAT

Sources of variation	Number of leaves (cm)			
	30 DAT	45 DAT	60 DAT	75 DAT
Replication	0.054	32.381	3.601	159.698
Variety	0.848*	166.458*	1178.134*	1529.821*
Gibberellic Acid	0.244ns	111.176ns	607.770*	1786.128*
Variety X Gibberellic acid	0.806*	26.887ns	43.472ns	66.051ns
Error	0.199	43.142	81.173	235.235
CV %	11.61	27.86	22.84	21.44

Appendix IV. Analysis of variance of the data on number of branches of brinjal at different DAT

Sources of variation	Number of branches		
	45 DAT	60 DAT	75 DAT
Replication	2.186	1.351	0.288
Variety	4.892*	7.320*	10.177*
Gibberellic Acid	2.381ns	3.183*	6.917*
Variety X Gibberellic acid	1.224ns	0.376ns	0.297ns
Error	1.216	0.669	0.670
CV %	26.51	15.66	12.43

Appendix V. Analysis of variance of the data related to flowering of brinjal

Sources of variation	Days to 1st flowering	Number of flower cluster/ plant	Number of flower/ cluster
Replication	2.028	1.352	1.479
Variety	6.778ns	8.169*	7.632*
Gibberellic Acid	12.519ns	4.442*	2.185*
Variety X Gibberellic acid	10.407ns	0.137ns	0.059ns
Error	5.725	0.514	0.588
CV %	3.15	15.21	33.31

Appendix VI. Analysis of variance of the data related to fruits of brinjal

Sources of variation	Days to 1st fruit set	Number of fruit / cluster	Fruit length (cm)	Fruit diameter (cm)
Replication	34.778	2.248	3.823	0.004
Variety	0.361ns	27.308*	340.757*	3.720*
Gibberellic Acid	18.444ns	7.309*	19.327*	0.182*
Variety X Gibberellic acid	8.139ns	0.317ns	2.942ns	0.010ns
Error	9.778	2.278	2.427	0.030
CV %	3.68	55.79	8.71	6.17

Appendix VII. Analysis of variance of the data related to yield of brinjal

Sources of variation	Average fruit weight (gm)	Number of fruit / plant	Yield / plant (kg)	Yield / plot	Yield (t/ha)
Replication	0.118	7.842	0.048	12.300	0.118
Variety	908.744*	655.902*	0.659*	169.136*	908.744*
Gibberellic Acid	166.809*	90.705*	0.811*	207.589*	166.809*
Variety X Gibberellic acid	4.103ns	1.975ns	0.007ns	1.868ns	4.103ns
Error	22.517	8.455	0.041	10.548	22.517
CV %	7.34	11.86	13.05	13.09	13.09

Appendix VIII. Production cost of brinjal per hectare of land

A. Input cost

Treatment	Labour cost	Ploughing cost	Seed cost	Insecticide/Pesticide	Irrigation	Manure and fertilizers						Sticking	Sub total (A)
						Cowdung	Urea	TSP	MP	Gypsum	GA_3		
V_1G_0	22000	18000	7000	9000	12000	40000	8000	13000	8000	2000	00	5000	144000
V_1G_1	22000	18000	7000	9000	12000	40000	8000	13000	8000	2000	6000	5000	150000
V_1G_2	22000	18000	7000	9000	12000	40000	8000	13000	8000	2000	8000	5000	152000
V_1G_3	22000	18000	7000	9000	12000	40000	8000	13000	8000	2000	10000	5000	156000
V_2G_0	22000	18000	7000	9000	12000	40000	8000	13000	8000	2000	00	5000	144000
V_2G_1	22000	18000	7000	9000	12000	40000	8000	13000	8000	2000	6000	5000	150000
V_2G_2	22000	18000	7000	9000	12000	40000	8000	13000	8000	2000	8000	5000	152000
V_2G_3	22000	18000	7000	9000	12000	40000	8000	13000	8000	2000	10000	5000	156000
V_3G_0	22000	18000	7000	9000	12000	40000	8000	13000	8000	2000	00	5000	144000
V_3G_1	22000	18000	7000	9000	12000	40000	8000	13000	8000	2000	6000	5000	150000
V_3G_2	22000	18000	7000	9000	12000	40000	8000	13000	8000	2000	8000	5000	152000
V_3G_3	22000	18000	7000	9000	12000	40000	8000	13000	8000	2000	10000	5000	156000

Appendix VIII. Production cost of brinjal per hectare of land

B. Overhead cost

Treatment	Cost of lease of land for 6 month (13% of value of land Tk. 8,oo,ooo/year	Miscellaneous cost (Tk. Of the input cost)	Interest on running capital for 6 months (tk. 13% of cost/year)	Subtotal (Tk.) (B)	Total cost of production (Tk./ha) Total cost (A)+ overhead cost(B)
V_1G_0	52000	6850	14428	108178	262178
V_1G_1	52000	6950	14456	108226	264226
V_1G_2	52000	7000	14471	108251	265251
V_1G_3	52000	7250	14496	108294	266294
V_2G_0	52000	7350	14525	108343	262343
V_2G_1	52000	7400	14539	108367	264367
V_2G_2	52000	7350	14513	108323	265323
V_2G_3	52000	7450	14542	108372	266372
V_3G_0	52000	7500	14556	108396	262396
V_3G_1	52000	7450	14530	108352	264352
V_3G_2	52000	7550	14559	108401	265401
V_3G_3	52000	7700	14573	108425	266425