EFFECT OF SEEDLING AGE AND PRUNING ON GROWTH AND YIELD OF BRINJAL

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CERTIFICATE

This is to certify that the thesis entitled "**Effect of Seedling Age and Pruning on Growth and Yield of Brinjal**" submitted to the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** in **HORTICULTURE**, embodies the result of a piece of ***bona fide*** research work carried out by **Tanzina Binte Rahman Tinni**, Reg. No. **05-01788** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

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DEDICATED
TO
MY BELOVED MOTHER AND
FATHER

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ABSTRACT

The experiment was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur during the period from October 2010 to March 2011 to study the effect of seedling age and pruning on growth and yield of brinjal. The experiment consisted of two factors. Factor A: Different ages of seedlings; A_1: Bud stage pot seedling; A_2: Bud stage seed bed seedling; A_3: 35 days pot seedling; A_4: 35 days seed bed seedling; and Factor B: Different types of pruning; P_0: No pruning (Control); P_1: 3 stem retention and P_2: 4 stem retention. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. 'BARI Begun-10' was used in this experiment. In case of seedling age, A_3 produced the maximum number of fruits per plant (40.38), weight of individual fruit (82.81 g) and the highest yield (51.30 t/ha). In case of pruning, P_2 produced the maximum number of fruits per plant (39.67), weight of individual fruit (82.05 g) and the highest yield (50.59 t/ha). In case of combined effect A_3P_2 produced the maximum number of fruits per plant (47.40), weight of individual fruit (89.57 g) and the highest yield (55.86 t/ha). It may

therefore be concluded that the 35 days pot seedling with 4 stem retention was suitable combination for better growth and yield of brinjal.

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ABBREVIATIONS	ELABORATIONS
AEZ	Agro-Ecological Zone
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics

DAT	Days After Transplanting
DMRT	Duncan’s Multiple Range Test
FAO	Food and Agricultural Organization
HRC	Horticulture Research Centre
ppm	Parts per million
RCBD	Randomized Complete Block Design
SRDI	Soil Resources and Development Institute
TSP	Triple Super Phosphate
UNDP	United Nations Development Program

CHAPTER I

INTRODUCTION

Brinjal (*Solanum melongena* L.) has the early European name “eggplant” locally known as “Begun” is a self pollinated annual crop belongs to the family Solanaceae (Thompson, 1951). It is a major vegetable crop throughout the tropic and subtropics (Bose and Som, 1986). It is thought to be originated in Indian sub-continent because of maximum genetic diversity and closely related species of *Solanum* are grown in this region (Zeven and Zhukovesky, 1975). The eggplant is of much importance in the warm areas of Far East, being grown extensively in Bangladesh, India, Pakistan, Nepal, China, Japan and Philippines. It is also popular in France, Italy, USA, the Mediterranean and Balkan areas (Bose and Som, 1986).

Brinjal is grown commonly in almost all parts of the country. It is a main vegetable to the plains and is available more or less throughout the year. Brinjal is equally preferred by both rich and poor people (Anon., 1994). Brinjal is extensively cultivated in Bangladesh and is grown in homestead and as a field crop in both winter and rainy seasons though bulk of its production is obtained during winter season. The vegetable production in summer is scanty and brinjal plays an important role to meet up the shortage of vegetable in this lean period. Brinjal is the second most important vegetable crop next to potato in Bangladesh in respect of acreage and production (BBS, 2010). It is grown round the year both as Rabi and Kharif crops (Rashid, 1983).The total area of brinjal cultivation is 60,100 hectare where 22,500 ha is grown in Kharif season (summer) and 37,500 ha in Rabi season (winter) with a total annual production of 338,000 metric tons (BBS, 2010).

Due to its quality, diversified use, acceptable market price and year round availability it has become the widely consumed vegetable in Bangladesh. Country to the common belief, it is quite high in nutritive value and can be compared with tomato (Choudhury, 1979). The nutritive quality of brinjal varies with the shape, size and

color of the fruits (Bose and Som, 1986). Brinjal, aside from their rich texture, contain a multitude of vitamins and phytonutrients.

Yield expression of a genotype is mainly governed by environment and other management factors. Yield differences may also be occurred due to variation in cultural practices. Seedling age and pruning are two important cultural practices which may be the limiting factors of yield. The age of seedlings to be transplanted is very important for proper establishment in the field and production of good quality fruits as well as high yield. Tender aged or over aged seedlings are not suitable for better yield. Medium aged seedlings results in greater leaf area, high yield and number of fruits per plant and greater average fruit weight (Hassan, 1967).

Proper pruning practices may lead to the production of relatively large sized fruit with better quality, increase yield, early harvest, easy harvesting of fruits and conveniences in intercultural operation without damage to the fruits or plants. But in Bangladesh, majority of the growers do not get good quality fruit and high yield because of their ignorance about proper pruning practices. In that case, pruning is necessary because the branch bend down to the ground due to heavy load of fruits. Pruning could reduce production costs, increase yields and improve the quality of fruits (Davis and Estes, 1993). Appropriate pruning method gives the best quality and early fruit in tomato (Lopez and Chan, 1974). Tomato plant can be severely pruned without affecting the yield (Patil *et al*., 1973). Here tomato is a member of the same family as the brinjal belongs to. Pruning associated with proper age of seedling is an important factor for successful brinjal production. By the proper management of these cultural practices it may be possible to increase the yield of brinjal.

Considering the above facts, the present research work was carried out to achieve the following objectives-

1. To determine the optimum age of brinjal seedlings for transplanting in the main field in order to achieve higher yield.
2. To find out suitable pruning operation on the growth and yield of brinjal.
3. To find out the best combination of optimum seedling age and suitable pruning operation for successful brinjal production.

CHAPTER II
REVIEW OF LITERATURE

In Bangladesh and in many countries of the world brinjal is an important vegetable crop. The crop has less attention by the researchers on various aspects of its growth and management practices. Based on this a very few research work related to growth, yield and development of brinjal have been carried out in our country. However,

researches are going on in home and abroad to maximize the yield of brinjal. Seedling age and pruning are two important cultural practices which may be the limiting factors of yield of brinjal although research works related to seedling age and pruning on brinjal are limited in Bangladesh. However, some of the important and informative works and research findings related to the seedling age and pruning so far been done at home and abroad on this crop have been reviewed in this chapter under the following headings-

2.1 Literatures on seedling age

Histamoni and Urabe (1973) reported that high soil temperature (15^0C) and the use of young tomato seedlings supported vigorous vegetative growth, resulting in longer and thicker stems, more leaves and larger leaves. The proportion of large fruits increased with the use of young seedlings and additional nitrogen. Size of fruit showed an interaction between soil temperature and moisture. From the findings, it was possible to produce high yield of good quality fruit by controlling the nitrogen supply, plant density, high intensity, night temperature, soil temperature, soil moisture and seedling quality.

Tongova and Zhelev (1975) reported that both early sowing and early planting of tomato gave increased yield. The highest early and total yields were produced by plants sown on 20 September and transplanted at the 4-5 leaf stage.

Adelana (1976) reported that the earliest planting of tomato seedlings resulted in greater leaf area, higher yield and number of fruits per plant and greater average fruit weight than later planting. Souma *et al*. (1976) while investigating into the effect of the length of the seedling age on the growth, yield and quality of tomato reported that the seedling transplanted 40 days after sowing grow best and that abnormal fruits

were produced by the plants transplanted 60 and 70 day after sowing. Dayan *et al*. (1978) have indicated that delayed planting reduced overall yield.

On the other hand, while investigating into the effect of different methods and time of sowing on yield and quality of tomato found that the number of fruits per plant and mean yield per plant decreased with delay in sowing date. Sowing date and transplant age have tremendous effect on growth and yield of tomato (Ravikumar and Shanmugavelu, 1983).

Adelana (1983) carried out an experiment to determine the right age to transplant tomato seedlings. Seedlings were transplanted at 3, 4, 5 and 6 weeks after sowing in the nursery. He found that the younger transplants grew faster and therefore produced greater dry matter than the older ones. Also, flowering and fruiting were earlier in the younger transplants. Fruit yield was highest in the 3-week old transplants but this was not significantly higher than those of 4-week old. It was therefore recommended that tomato seedlings should be transplanted when they are between 3 and 4 weeks old.

In Bangladesh, Rahman and Quasem (1986) carried out an experiment to observe proper age of seedling on yield of tomato. The age of seedling did not show any significant difference for all yield and yield contributing characters studied except days to first flower, days to 50% flower and days to first fruit set where earliness was observed with the increased age of seedling. Yield increase of 8 tons per hectare was obtained from 40 days old seedling (64.53 t/ha) over 20 and 30 days of seedling.

In Thailand, Palamakumbura (1987) carried out an experiment to observe the effect of seedling age and spacing on growth and yield of tomato. Response of the tomato variety CL-143-0-10-3-0-1-10 to different seedling ages of 15, 20, 25 and 30 days as well as spacing of 50 × 100, 40 × 100, 30 × 100, 20 × 100 cm was studied during

October 1st, 1986 to February 28th, 1987 at TOP/AVRDC experimental site, Kamphaeng Saen Campus of Kasetsart University, Thailand. He found that 20-day-old seedlings recorded the lowest mortality in the field after transplanting, compared to other seedling ages. The highest number of fruits/plant and the highest fruit weight were recorded with seedlings transplanted at 40 × 100 cm spacing. It is evident that the 25-day-old seedlings planted at 20 × 100 cm produced highest yield.

Chowdhury *et al*. (1991) was conducted an experiment to evaluate the influence of age of seedlings (30, 40, 50 and 60 days) on growth and yield of brinjal. Age of seedlings significantly influenced the number of days to flower, plant height, foliage spread, fruit size, number of fruits per plant and yield. Although the yield was increased with increasing age of seedlings there was no statistical difference among 40, 50 and 60 days old seedlings but they out yielded the crop from 30 days old ones.

In trails during spring and autumn under greenhouse, tomato seedlings at the age of 2 to 6 weeks were planted out and irrigated using drip or sub surface irrigation. In spring, the older transplants produced more shoot and root up to 2 weeks after transplanting than young transplants. At 3 and 4 weeks after transplanting, there were no differences between 4, 5 and 6 weeks old transplants under either irrigation system. Total yield and early yield were similar for all transplant ages. In the autumn, shoot growth in the older transplants was initially faster than in the younger transplants but this effect diminished after 1 week. However, this difference diminished with time and was insignificant 4 weeks later. It was concluded that using the traditional older transplants gave no yield advantages and that use of younger transplants would reduce seedling production costs (Leskovar *et al*., 1991).

Vavrina and Orzolek (1993) conducted the research to determine the optimum age at which to transplant tomatoes. It was concluded that transplants ranging from 2 to 13 weeks old could produce similar yields, depending on many factors involved in commercial production.

Rahman *et al*. (1994) reported that in experiments of tomato cv. Manik, seedling age at transplanting had a significant effect on the number of days until flowering commenced the number of days until harvest, number of fruits/plant and yield. Plants grown from younger seedlings flowered and were ready to harvest earlier than those grown from older seedlings. The numbers of fruit/plant and average fruit weight were greatest when seedlings were 40 day old at transplanting.

Chui *et al*. (1997) conducted a greenhouse and field experiment with three tomato cultivars to study the influence of seedling age (4, 6, 8 or 10 weeks) on growth and early yield of fresh market tomatoes. Seedlings more than 6 weeks old showed slower growth and recovery after transplanting (RAT) and took longer time to flower in all 3 cultivars. Although older seedlings (> 8 weeks) had restricted roots, they produced higher early yields than younger seedlings. Three tomato cultivars were grown using the plug system or traditionally from seedlings sown in the field. They were then planted when 2 to 8 weeks old. There were no differences in performance of seedlings from the 2 different nursery systems when seedlings were less than 4 weeks old at planting. After 4 weeks, the growth rate of the field sown seedlings was greater than those raised as plugs.

Tanaka *et al*. (1998) carried out an experiment to observe the relationship of the first fruit, the age of seedling where scions had been taken, and the node position of initial bearing to devise ways that would not delay harvesting time of first fruit thus,

reducing deterioration of fruit quality of eggplant cultivated by direct planting in plug seedlings. When the first flower was removed, the plant grew very well during early stage. This shows that the first bearing influences early growth. There was a significant inverse correlation between seedling age where scions were taken and the node position of the first fruit. Plants grafted with scions taken from seedling of advanced age bore first fruit in low node position and maintained favorable growth at early stage. Having first fruit in the lower node position causes an earlier occurrence of first harvest, lengthens the bearing branches and more increases the number of bearing parts, all of which contributes to high total yield.

Sanjoy Saha (1999) studied the impact of seedling age (15 or 30 days old) and planting time (early: 16 November or late: 16 December) on the fruit yield performance of tomato (*Lycopersicon lycopersicum*) cultivars BT 18, BT 12, BT 10, BT 2 and MIXENT in upland rice (cv. Annada)- based cropping system. All cultivars performed well when planted early (with 15-day-old seedlings) and showed a declining trend in fruit yield and other yield- attributing characters when planted late with 30 days old seedlings. Among the tomato cultivars, remarkably good fruit yields of 60.7 and 47.0 t/ha were recorded from BT 18 during 1994-95 and 1995-96, respectively, when planted early with 15 days old seedlings. BT 12 gave fruit yields of 59.7 and 41.9 t/ha during 1994-95 and 1995-96, respectively. The economics of different tomato cultivars also showed the same trend. The gross return, net return and net return per rupee were highest in BT 18, followed by BT 12, respective of seedling age and planting time.

Lee and Kim (1999) observed the effects of seedling age (45, 60 or 75 days) and transplanting depth (rootball, or up to cotyledon or first true leaf). Tomatoes plant

height and stem diameter were not influenced by seedling age or planting depth. The cluster-emerged node number was not affected by planting depth. The second cluster-emerged node number was lower in 45-day-old seedlings compared with older seedlings. Average fruit weight was lowest in first cluster regardless of seedling age. The number of marketable fruits was not influenced by planting depth, but was highest in 60-day-old seedlings. The highest marketable yields (1699-1849 g/plant) were obtained from 60-day-old seedlings.

Weon *et al*. (1999) reported that plant height and stem diameter were not influenced by seedling age or planting depth of tomato. The cluster-emerged node number was not affected by planting depth. The second cluster emerged node number was lower in 45 day old seedlings compared with older seedlings. Average fruit weight was lowest in first cluster regardless of seedling age. The number of marketable fruit was not influenced by planting depth, but was highest in 60 days old seedlings. The highest marketable yield (1849 g/plant) was obtained from 60 days old seedlings.

Zhao and Li (2000) noted that old seedlings of tomato (60-days-old) had the worst quality, but produced the highest early yield and lowest total yield. Young seedlings (30 days old) produced the highest total yield, but a lower early yield. The best quality seedlings were 45 days old seedlings.

Benedictos *et al*. (2000) reported that young (5 weeks old) transplants of tomato had highest fruit setting rate (81.69%), followed by medium-aged (7 weeks old) transplants (76.94%) and old (9 week old) transplants (76.04%).

Okano *et al*. (2000) reported the effects of seedling age at planting on the quality of nursery plants, on plant from after planting and on growth rate and fruit yield. The younger the seedling at planting, the faster the plant grew after planting. When

seedlings were raised for >35 days, growth was considerably retarded. Dry weight of roots and stems at harvest were higher when tomatoes were planted at a younger age. However, leaf dry weight, total leaf area and fruit yield were highest in the 25 and 35 days old seedling plots. Total leaf area per plant was positively correlated with fruit yield.

Okano *et al*. (2000) observed the effect of seedling age at planting on plant form and fruit productivity in single-truss tomato (*Lycopersicon esculentum* Mill.) grown hydroponically. Light interception and photosynthetic activity of the leaves were also examined in plants with different plant forms. Growth after planting was retarded in proportion to the duration of rising of seedlings. 25-day to 35-day (4 to 7 leaf stages) plug seedlings was considered to be most suitable for single-truss cultivation of tomato. Fruit yield was positively correlated with total leaf area. Frequent emergence of lateral shoots could not be inhibited by the use of over mature seedlings. Interception of solar radiation which was highest for the uppermost leaf decreased for the leaves toward the lower part of the plant. Radiation interception by individual leaves varied depending on the plant form, which influenced the rate of field photosynthesis. Only upper three leaves contributed to photosynthesis in a shorter plant, while many more leaves in a taller plant.

Choi *et al*. (2002) reported that the effects of seedling containers and seedling ages on the growth and yield of tomato plants were examined to establish the criteria for appropriate seedling production methods in the summer season. The quality of seedlings was better when seedlings were grown in polyethylene pots than in 72-cell plug trays. Seedling quality was better with increasing the growth duration in black polyethylene pots, where as growth durations did not affect seedling quality in plug

trays. Fruits matured earlier with pot-grown seedlings for a long duration than with plug tray-grown seedlings for a short duration. The yields of tomato during the first two months were significantly higher in pot-nursed seedlings than the plug tray-nursed seedlings. Also, the total yield of tomato during the four month period was highest in pot-nursed seedlings. In pot-grown seedlings, there were no yield differences between 35 and 45 days old seedlings during the first two months of harvest, while the yields of 25 days old seedlings were much lower than the older seedlings (35 and 45 days old). Seedling ages had no effect on the cumulative yield for 3 months after the first harvest. With plug tray-grown transplants, the cumulative yield for the initial 3 months was highest in plants grown for 35 days in the nursery, followed by 25 days and 45 days. However, there were no significant differences among seedling ages in the total yield.

Aparajita (2002) reported that the age (3, 4, 5 and 6-week-old) of the seedlings of tomato cv. Pusa Ruby and augergines cv. Pusa Purple had significant effect on the yield contributing characters and yield of tomato.

Zhao Rui and Chen (2004) conducted to determine the effect of nutritive area on the growth of tomato seedlings grown in plug trays. They recommended to transplant middle-aged seedlings by evaluating the effects of seedling age and plug tray nursery area on yield.

A field experiment was conducted by Rajbir Singh *et al*. (2005) to see the effect of transplanting time (10 and 30 December, and 20 January) on the growth and yield of tomato cultivar Rupali. Early planting (10 December) resulted in the highest vegetative growth, yield attributes, early and total fruit yield, where as the lowest

values for the parameters measured were lowest with 20 January transplanting. The highest net returns (Rs. 52,700/ha) was recorded with transplanting on 10 December.

2.2 Literatures on pruning

An experiment was carried out by Aranjo and Nissio (1974) to observe the effect of pruning on yield from two field trials with 11 tomato cultivars. They reported that side shoot removal significantly reduced the total and marketable yield and the number of first grade fruit.

Lopez and Chan (1974) carried out an experiment to investigate the effect of plant spacing and training on the yield of tomato. The spacing was 15, 30 and 45 cm in row with 1.2, 1.5 and 1.8 cm between rows. Pruning with 1 or 2 stem was started 45 day after sowing and was repeated every 8-13 days. The higher first yield was decreased with wider spacing but fruit size increased appreciably.

To find out the response of tomato plants to different pruning methods a field experiment was done by Orzco *et al*. (1975). They reported that unpruned plant with the removal of 30% flowers gave the highest yield (58.09 t ha^{-1}) followed by 54.44 t ha^{-1} in unpruned plants and 43.47 t ha^{-1} from pruned plants where the shoots were pinched after 3 months. Whereas contradictory result reported by Samundri (1964) who observed decreased yield and did not find induced earliness in tomatoes.

In Bulgaria, an experiment was carried out Belichki (1977) to study the effect of plant training on the reproductive behavior of tomato plant. From the study, he reported that both the trained plants produced similar yields of standard fruit, which increased by 5.8-12.3%, compared to removal of all but 2 or 3 lowest laterals, and returns rose by 14.6-27.8%.

Borisov *et al*. (1978) studied the effect of training tomatoes with 1 or 2 stem (s) leaving 28 or 36 trusses m^{-2} and spacing maintained at 2.8-6.0 plants m^{-2} in greenhouse condition. From this study they reported that 2 stems yield 10-15% more fruit. Again they stated that in winter cultivation the highest yield was obtained from 4.7 plants m^{-2} with one stem and 6 trusses $plant^{-1}$ or from 2.8 plants m^{-2} with 2 stems and 10 trusses $plant^{-1}$.

Kusumo (1978) obtained larger and smooth skin fruit in cvs. 'Money maker' and 'Geraldton' when the plants were restricted to single stem. It was found that fruit size increased when fruits were thinned to 4 fruit/truss.

Pruning is important to get higher yield of tomato stated by Adrinace and Brison (1979). They found that where tomatoes are to be staked it is necessary to prune the plants 1, 2 or 3 stems with closer spacing. Ramirez *et al*. (1979) showed that 10% flower removal resulted in a higher yield (68 t ha^{-1}) than any other methods of pruning. They obtained best quality fruit from pruned plants of 2 or 3 stems.

Rajendra and Patil (1979) obtained higher yield from unpruned tomato plants than pruned plants. Maximum fruit weight (89.19 g) was obtained in case of single stem pruned plant while fruit weight was lowest (63.07 g) in unpruned plants. Other characters, like plant height, days to flowering and first fruit picking did not differ significantly among the treatments.

Atherton and Rudich (1986) stated that one or two side-shoots under the first truss on the main stem were found profitable in some growing areas. An experiment was conducted by Sharfuddin and Ahmed (1986) under the field conditions of Bangladesh Agricultural Research Institute, Joydebpur during winter, 1985-86. They noted that plants under unpruned treatment produced maximum number (36) of fruits $plant^{-1}$.

The highest yield of 120.50 t ha^{-1} was obtained from unpruned plants followed by one time pruning (100.43 t ha^{-1}), two times pruning (98.33 t ha^{-1}) and single stem pruning (73.41 t ha^{-1}), respectively. Overall, the highest yield of 123.36 t ha^{-1} was obtained from plants pruned to 3 stems and grown at a plant density of 27,777 ha^{-1}.

In an experiment, Baki (1987) found that pruning showed a significant effect on plant height. Unpruned plants exhibited higher plant height and highest number of inflorescence. Higher number of fruits was also obtained from unpruned plants. But maximum yield of tomato (96.08 t ha^{-1}) was obtained from unpruned plants with two stems at the closest spacing (75 × 50 cm). The pruned plant produced fruits relatively earlier than other treatments.

In Brazil, Campos *et al*. (1987) carried out an experiment to observe the effect of stem pruning and plant population on tomato productivity. They found that stem pruning increased the early yield and fruit weight but decreased both yield and fruit number $plant^{-1}$. The highest yield of marketable fruits was obtained in the control (54.8 t ha^{-1}) followed by the variant pruned above the 7^{th} truss (53.07 t ha^{-1}). Marketable yields rose from 46.8 t ha^{-1} with 20,000 plants ha^{-1} to 54.49 t ha^{-1} at the highest density.

Working with the tomato var. Manik, Rahman *et al*. (1988) reported that unpruned plants gave the highest yield (120.5 t ha^{-1}) and the lowest yield (39.0 t ha^{-1}) was obtained from the single stem pruning. Other characters like plant height, first flower opening and first harvesting time were not influenced by the pruning operation. Number of flower clusters, number of flowers and number of fruits $plant^{-1}$ were maximum in unpruned plant, whereas fruit length, fruit diameter and individual fruit weight were the highest from single stem pruning followed by two times pruning (21 and 35 days after transplanting).

Tomato grown in hydrophonic culture in a basic greenhouse, Hernandez *et al*. (1992) found that fruit diameter and fruit length were greatest in plants for pruning one stem and the number of fruits was higher. Yield was highest in unpruned plants followed by plants pruned 2 stems and one stem (3.826 and 3.093 kg m^{-2}, respectively).

Dhar *et al*. (1993) carried out an experiment of pruning and number of plants $hill^{-1}$ on tomato. It was found that highest yield (96.25 t ha^{-1}) was produced in the double branched plants followed by that in unpruned plants (66.21 t ha^{-1}) and single branched (61.29 t ha^{-1}) plants. In case of number of plants $hill^{-1}$, three plants $hill^{-1}$ produced highest yield (75.51 t ha^{-1}) followed by that from two plants (62.58 t ha^{-1}). The interaction effect was found significant for fruit size, weight and yield of tomato.

Davis and Estes (1993) found that early season yields were highest using early pruning (lateral shoots were 5-10 cm long) or delayed pruning (when lateral shoots were 30-60 cm long) opposed to no pruning and in row spacing of 46 cm. Total season yields $hectare^{-1}$ of pruning plants increased as in row spacing decreased. For unpruned plants, however, total season yields were high at all spacing. Total season yields were lower from delayed pruning plants than from unpruned plants. Unpruned plants produced low yields of fruits >72 mm diameter but their total yield was greater than those of pruning plants. Net return $hectare^{-1}$ was highest when i) plants spaced closely in row spacing were pruned early or ii) plants were spaced 46-76 cm apart and either pruned early or not pruned.

Poksoy *et al*. (1993) conducted an experiment to examine the effects of different pruning on the yield and quality of eggplant cultivars grown in green house conditions. Plants of the F_1 aubergine cultivars Dusky, Vittoria, Valentina, Indra, Sicilia, Palmira and Imperial were pruned to leave either 2 or 3 main shoots above

330-35 cm height, with lateral shoots pruned to leave a fruit and 3 leaves or left not pruned. Both pruning methods (i.e. to 2 or 3 shoots) significantly increased main-shoot length and 1st class fruit yield. Total yield was not affected by pruning method. The highest total and 1st class fruit yields were obtained with the cultivars Sicilia and Imperial.

In Bangladesh condition, a field experiment was carried out by Rahman *et al*. (1994) to assess the effect of pruning on yield of tomato (*Lycopersicon esculentum* Mill) cv. Manik. They observed that the highest yield (120.50 t ha^{-1}) was found from unpruned plants and the lowest yield (69 t ha^{-1}) from the single stem pruning plants.

A field trial was conducted by Cruces and Valdes (1995) with fruit thinning treatment consisted of leaving all 6, 4 or 3 fruits $truss^{-1}$. Average individual fruit and seed weight was significantly increased compared to controls when 4 or 3 fruits were left $truss^{-1}$.

Hossain *et al*. (1996) conducted an experiment on mulching and pruning on the growth and yield of tomato and they found that combined effect was insignificant. However mulching with black polythene and two times pruning (21 and 35 days after transplanting) in combination gave the highest yield (76.32 t ha^{-1} from cv. Ratan). Individual fruit weight was maximum (62.64 g) with three times pruning (21, 35 and 49 DAT) followed by two times pruning (61.51 g), one time pruning (59.02 g) and without pruning (47.21 g) respectively.

Uddin *et al*. (1997) conducted an experiment in the field of Kasetsart University, Kamaphaeng Saen Campus, Thailand from October 1995 to February 1996 to determine the effect of stem pruning (one stem, two stem, three stem and no pruning) and plant spacing (40 & 50 cm) on the yield was evaluated on indeterminate type F1

hybrid tomato variety FMTT22. Two stem pruning yielded the highest (56.20 t/ha) closer spacing (40 cm) gave higher yield (55.34 t/ha). Two stem pruning along with 40 cm plant spacing showed superior interaction.

In a trial with spring tomatoes, Cuifen and Yanping (1997) found that leaving up to 4 fruits had no significant effects on fruit bud development and gave higher yields than leaving 2 or 3 fruits.

A field trial was conducted by Srinivasan *et al*. (1999) in Tamil Nadu, India, during the kharif seasons of 1997 and 1998 to study the effect of spacing, training and pruning method (pinching or no pinching of the side branches) on the growth and yield of hybrid tomato ARTH-4. They found that pruned plants were significantly taller than non-pruned plants.

Navarrete and Jeannequin (2000) conducted an experiment to determine the effect of de-shooting frequency on vegetative growth and fruit yield, in order to help growers to determining the optimal frequency. Four de-shooting frequencies were compared on two cultivars; every 7, 9, 10, 14 and 21 days. De-shooting frequency affected vegetative growth and yield; when de-shooting was performed seldom (every 21 days), the stem diameter was decreased; the number of fruit m^{-2} was also reduced, leading to significantly lower yield. When the auxiliary buds were eliminated frequently (7 days), even those located near the apex, it reduced vegetative growth, but not yields.

Arin and Ankara (2001) conducted an experiment to determine the effect of low-tunnel, mulch and pruning treatments on yield and earliness tomato cv. Fuji F_1 tomato (*Lycopersicum esculentum* Mill.) in unheated glasshouse. Plant height, stem diameter, days to first harvest, early yield (g/plant), total yield (g/plant) and fruit weight (g/fruit)

were determined during the growing period. Low-tunnel and mulching had a positive effect on plant growth development. The highest early yield was obtained from the plants pruned from the 4th truss and mulched with any mulch under low-tunnel. Total yield was highest in plants pruned from 8th truss and mulched with wheat straw.

An experiment was carried out by Pessarakli and Dris (2003) to observe the effects of pruning and spacing on the yield and quality of eggplants. Various suggestions on pruning and spacing of eggplants and the most suitable pruning as well as the optimum spacing to increase the yield and quality of eggplant given by different investigators are discussed in this manuscript. In general, proper pruning and optimum spacing substantially increase eggplant yield and improve its fruit quality.

In the greenhouse production the effect of various side shoots pruning on productivity of eggplant was investigated by Amroszczyk *et al*. (2003). They found that pruning has a positive effect on irradiation on PAR range in the plant profile. The significant increase of the eggplant total yield was obtained with the introduction of a greater height of the second shoot. Higher accumulation of dry mass and chlorophyll 'a' and 'b' in the leaves on upper levels of the plants was noted. This tendency was not confirmed for assimilative starch. It was not found a significant effect of plant pruning on the content of dry mass, total sugars and L-ascorbic acid in fruits.

Luo-LaiXin *et al*. (2005) conducted top pruning, a new inoculating method of bacterial canker of tomato, developed based on the traditional methods including leaf shearing, root soaking and needle penetrating. These results indicate that top pruning, as a convenient and efficient inoculation method is applicable for further evaluation as against the effects of chemical control of this disease.

In Poland, Ambroszczyk *et al*. (2007) carried out an experiment under green house condition to determine the method of eggplant (aubergine) pruning, optimizing the proportions between vegetative and generative plant development. The following pruning systems were applied: pruning to one shoot with leaving on every node 2 fruit sets and 1, 2 or 3 leaves, and pruning to two shoots with leaving on every node 1 fruit set and 1, 2 or 3 leaves. Among the treatments the most beneficial light conditions were observed in treatments pruned to one shoot with two fruit sets per node. Pruning strongly affected the effectiveness of fruit setting, especially in treatments pruned to two shoots. Plants pruned to two shoots with one fruit set and three leaves per node set fruits the most evenly on subsequent nodes. Intensive plant pruning did not reduce the eggplant yield in the present experiment. Also earliness of production was not affected by the systems of pruning. Mean early yield from first four harvests was 4.06 kg m^{-2} (total) and 4.04 kg m^{-2} (marketable) without statistical differences among treatments. Also total (10.44 kg m^{-2}) and marketable (9.41 kg m^{-2}) yield was not affected by the pruning system. Plants pruned more intensively (one shoot, two fruit sets per node) produced more I class fruits. Less intensive pruning resulted in the increase of the number of unmarketable fruits. Pruning affected fruit qualities, assessed on the base of dry matter, total sugar, vitamin C, and chosen element contents.

In Poland, Ambroszczyk *et al*. (2008) carried out an experiment to find the relations between pruning methods and chosen parameters of vegetative eggplant development in greenhouse conditions. Independence between different pruning methods and vegetative plant development particularly leaves characteristics as well as pigments and photosynthesis products content in leaves was stated. Eggplant of Tania F_1 hybrid was used in the early spring-summer production in a heated greenhouse. The

following pruning systems were applied: pruning to one shoot with leaving on every node 2 fruit sets and 1, 2 or 3 leaves, and pruning to two shoots with leaving on every node 1 fruit set and 1, 2 or 3 leaves. With the introduction of a greater number of leaves and fruit sets on eggplant shoots irradiation in plant profile was reduced. The value of leaf area index (LAI) depended on the way of pruning.

Going through the above reviews, it is concluded that the age of seedling and pruning is important considering growth and yield. The literature reveals that the effect of seedling age and pruning has not been studied well for the production of brinjal under Bangladesh condition.

CHAPTER III
MATERIALS AND METHODS

The experiment was conducted at the experimental field of Olericulture Division, HRC, BARI, Joydebpur, Gazipur during the winter season of 2010-11 and the period from October 2010 to March 2011 to study the effect of seedling age and pruning on growth and yield of brinjal.

3.1 Experimental site

The location of the experimental site is $23^0 74^/$N latitude and $90^0 35^/$E longitude and at an elevation of 8.2 m from sea level (Anon., 1989). The following map shows the

specific location of the experimental site (Plate 1). The picture shows the experimental site under study (Plate 2).

3.2 Characteristics of soil

The soil of the experimental area belongs to the Modhupur Tract (UNDP, 1988) under AEZ No. 28. It had shallow red brown terrace soil. The selected plot was medium high land and the soil series was Tejgaon (FAO, 1988). The characteristics of the soil under the experimental plot were analyzed in the Soil Testing Laboratory, SRDI Farmgate, Dhaka and details of the recorded soil characteristics were presented in Appendix I.

3.3 Climatic condition of the experimental site

The climate of experimental site was under the subtropical climate, characterized by three distinct seasons, winter season from November to February and the pre-monsoon or hot season from March to April and the monsoon period from May to October (Edris *et al*., 1979). Details of the meteorological data during the period of the experiment was collected from the Bangladesh Meteorological Department, Agargoan, Dhaka and presented in Appendix II.

3.4 Planting materials

The variety of brinjal used for the present study was ‘BARI Begun-10’. The seeds of this variety were collected from the Olericulture Division, Horticultural Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. Before sowing, the seeds were tested for germination in the laboratory and the percentage of germination was found to be over 90%.

3.5 Germination test

Germination test was performed before seed sowing in the field. Three layers of filter papers were placed on Petri dishes. Each Petridis contained 100 seeds. Germination percentage was calculated by using the following formula

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds}} \times 100$$

3.6 Treatment of the experiment

The experiment consisted of two factors. Details were presented below:

Factor A: Different ages of seedlings

i. A_1: Bud stage pot seedling
ii. A_2: Bud stage seed bed seedling
iii. A_3: 35 days pot seedling
iv. A_4: 35 days seed bed seedling

* Bud stage = 1^{st} visible flower bud

Factor B: Different types of pruning

i. P_0: No pruning (Control)
ii. P_1: 3 stem retention
iii. P_2: 4 stem retention

There were 12 (4 × 3) treatments combination such as A_1P_0, A_1P_1, A_1P_2, A_2P_0, A_2P_1, A_2P_2, A_3P_0, A_3P_1, A_3P_2, A_4P_0, A_4P_1 and A_4P_2.

3.7 Design and layout of the experiment

The experiment was laid out in a Randomized Complete Block Design (RCBD). Each treatment was replicated for three times. The size of each plot was 7.0 m × 0.7 m. The distance between two adjacent replications (blocks) was 1.0 m and plot to plot

distance was 0.5 m and plant to plant distance was 0.7 m. In each plot there was one row having 10 plants. The intra block and plot spaces were used as irrigation and drainage channels. A layout of the experiment has been shown in Fig.1.

3.8 Raising of seedlings

Brinjal seedlings were raised in seedbeds of 3 m × 1 m size for seedbed seedlings and seeds were sown in pot of 10 cm × 10 cm for pot seedlings. The soil was well prepared and converted into loose friable and dried for seedbed and also pot. All weeds and stubbles were removed and well rotten cowdung was mixed with the soil. In each seed bed and pot seeds were sown on 01 October 2010. After sowing, seeds were covered with light soil. Heptachlor 40 WP was applied @ 4 kg ha^{-1}, around each seedbed and pot as precautionary measure against ants and worm. The emergence of the seedlings took place with 5 to 6 days after sowing. Weeding, Mulching and Irrigation were done from time to time as and when needed.

3.9 Land preparation

The plot selected for conducting the experiment was opened in the last week of October 2010 with a power tiller, and left exposed to the sun for a week. After one week the land was harrowed, ploughed and cross-ploughed several times followed by laddering to obtain until good tilt. Weeds and stubbles were removed, and finally obtained a desirable tilt of soil for transplanting brinjal seedlings. The experimental plot was partitioned into unit plots in accordance with the design mentioned in Fig.1. Cowdung, vermicompost and chemical fertilizers as indicated below were mixed with the soil of each unit plot.

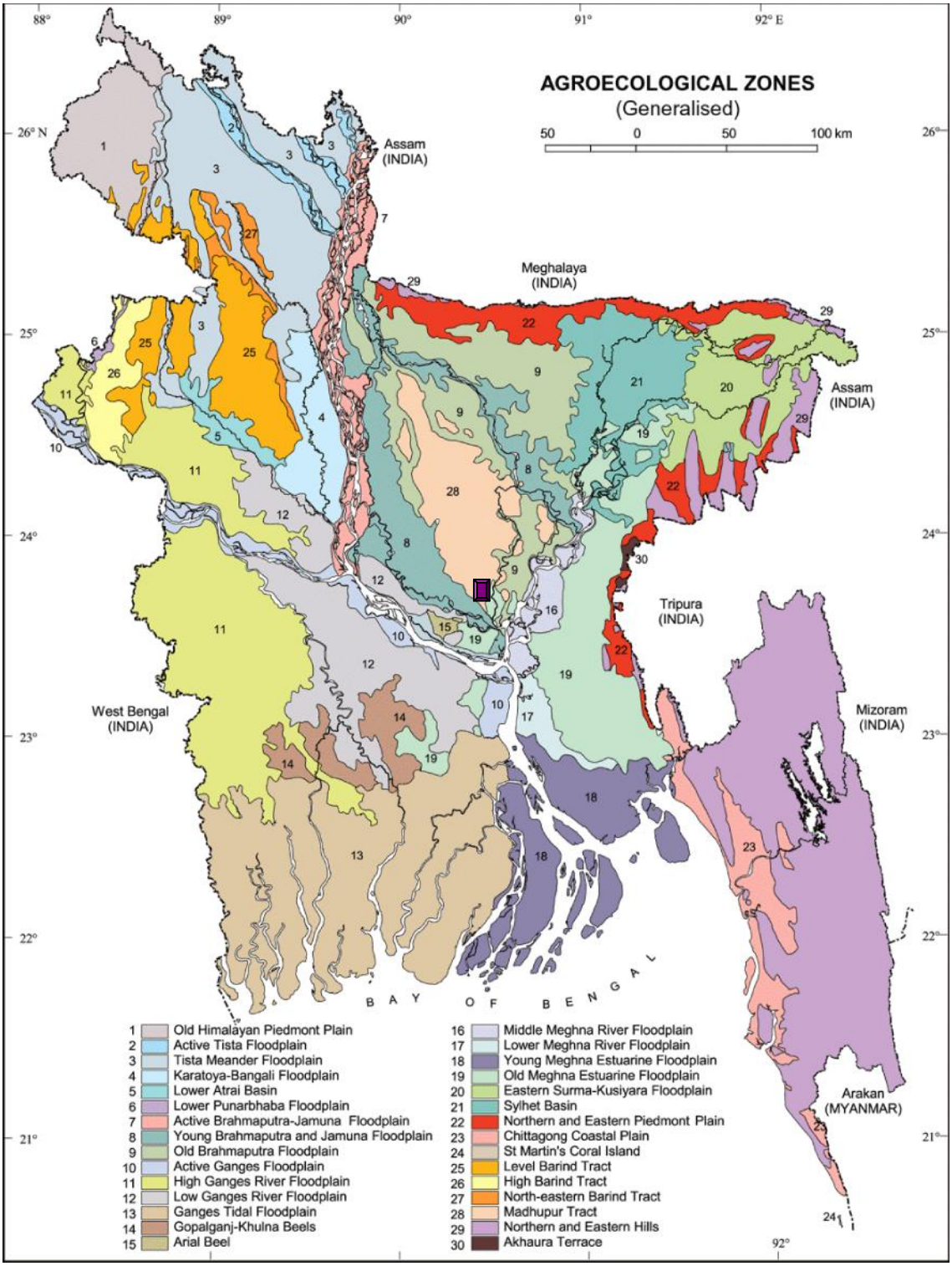
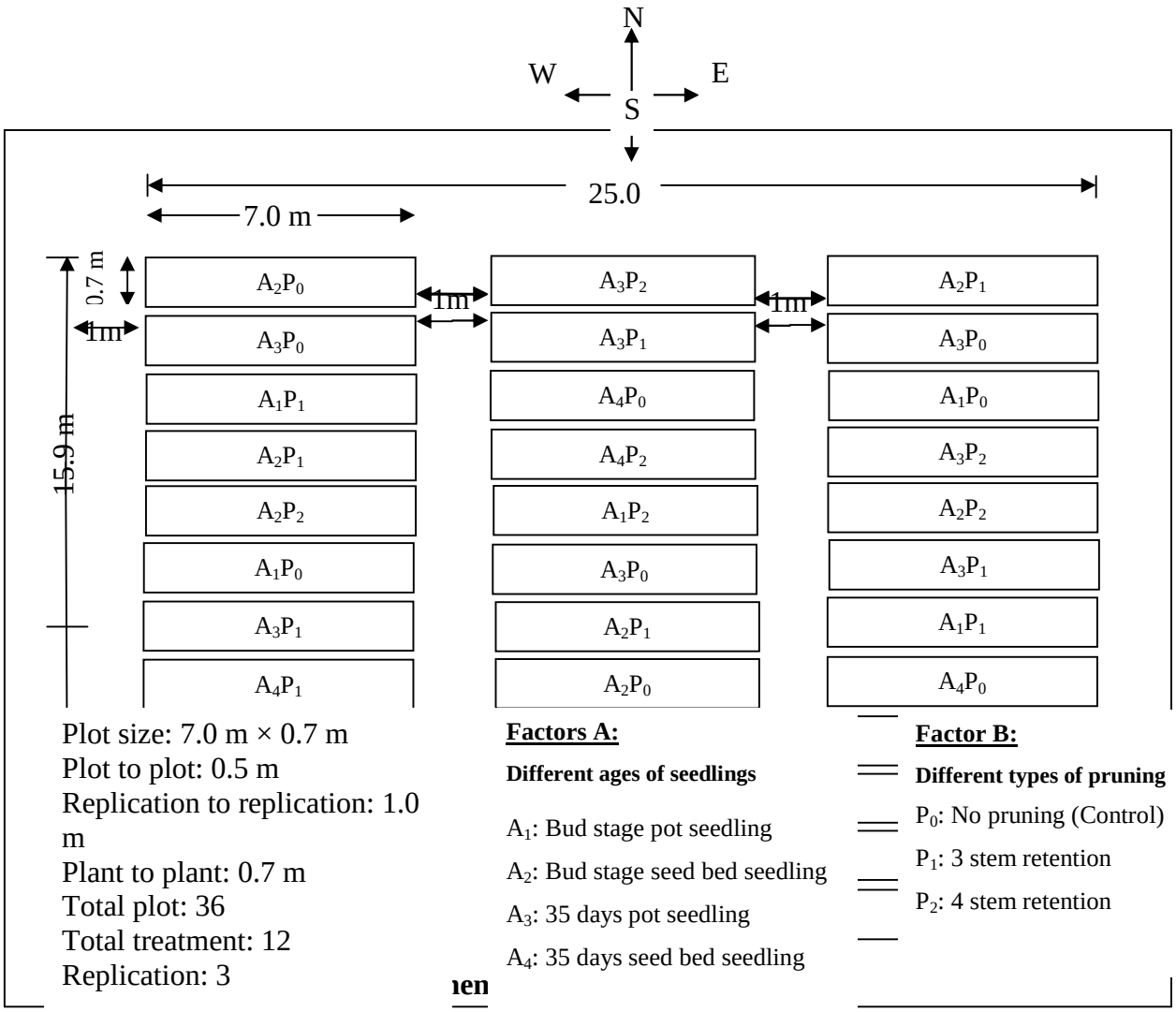

AGROECOLOGICAL ZONES
(Generalised)
50 0 50 100 km
88° 89° 90° 91° 92° E
26° N
25°
24°
23°
22°
21°
Assam (INDIA)
Meghalaya (INDIA)
Assam (INDIA)
Tripura (INDIA)
West Bengal (INDIA)
Mizoram (INDIA)
Arakan (MYANMAR)
BAY OF BENGAL
1 Old Himalayan Piedmont Plain
2 Active Tista Floodplain
3 Tista Meander Floodplain
4 Karatoya-Bangali Floodplain
5 Lower Atrai Basin
6 Lower Punarbhaba Floodplain
7 Active Brahmaputra-Jamuna Floodplain
8 Young Brahmaputra and Jamuna Floodplain
9 Old Brahmaputra Floodplain
10 Active Ganges Floodplain
11 High Ganges River Floodplain
12 Low Ganges River Floodplain
13 Ganges Tidal Floodplain
14 Gopalganj-Khulna Beels
15 Arial Beel
16 Middle Meghna River Floodplain
17 Lower Meghna River Floodplain
18 Young Meghna Estuarine Floodplain
19 Old Meghna Estuarine Floodplain
20 Eastern Surma-Kusiyara Floodplain
21 Sylhet Basin
22 Northern and Eastern Piedmont Plain
23 Chittagong Coastal Plain
24 St Martin's Coral Island
25 Level Barind Tract
26 High Barind Tract
27 North-eastern Barind Tract
28 Madhupur Tract
29 Northern and Eastern Hills
30 Akhaura Terrace

Plate 2. The picture showing the experimental sites under study



nd fertilizers

as urea, TSP and MP were applied, respectively. The entire amounts of TSP and MP were applied during the final land preparation. Urea was applied in three equal installments at 15, 30 and 45 days after seedling transplanting. Well-rotten cowdung 10 t/ha also applied during final land preparation. The following amount of manures and fertilizers were used which shown as tabular form recommended by BARI (2005).

Table 1. Fertilizer and manure applied for the experimental field

Manures and Fertilizers	Dose/ha	Application (%)			
		Basal	15 DAT	30 DAT	45 DAT

Cowdung	10 tons	100	--	--	--
Nitrogen	250 kg	--	33.33	33.33	33.33
P_2O_5 (as TSP)	200 kg	100	--	--	--
K_2O (as MP)	175 kg	100	--	--	--

3.11 Transplanting of seedlings

Healthy and uniform brinjal seedlings as per experimental treatment were uprooted separately from the seed bed and were transplanted in the experimental plots in the afternoon of 02 November, 2010 maintaining different as per treatment between the rows and plants. This allowed an accommodation of 10 plants in each plot with a spacing of plant to plant was 0.7 m. The seedbed was watered before uprooting the seedlings from the seedbed so as to minimize damage to the roots. The seedlings were watered after transplanting and continued for several days for their early establishment. Seedlings were also planted around the border area of the experimental plots for gap filling.

3.12 Intercultural operation

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

3.12.1 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. Excess plants were transplanted in border area at the same date of plants. Those seedlings were re-transplanted with a high mass of soil with roots to minimize transplanting stock.

3.12.2 Staking

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

3.12.3 Pruning

Within a few days of staking, as the plants grew up, the plants were pruned as per the treatments after 25 days of transplanting. In case of three (3) stem retention, all the side shoots were removed keeping only three stems while in the case of four (4) stem retention, only four stems were kept. The plants that were to go without pruning (control) were left to grow without any interference. Pruning was done with the help of secateurs.

3.12.4 Irrigation

Irrigation was given as when as necessary by observing the soil moisture condition. Irrigation was given throughout the growing period. The first irrigation was given 40 days after planting followed by irrigation 20 days after the first irrigation. Each fertilizing was followed by irrigation. Each plant was irrigated by a watering cane. Mulching was also done after each irrigation at appropriate time for breaking the soil crust.

3.12.5 Weeding

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

3.12.6 Top dressing

Urea was used as top-dressed in 3 equal installments at 15, 30 and 45 DAT. The fertilizers were applied on both sides of plant rows and mixed well with the soil. Earthing up operation was done immediately after top-dressing with nitrogen fertilizer.

3.13 Plant protection

3.13.1 Insect Pest

As preventive measure against the insect pests like cut worms, shoot and fruit borer, leaf hopper, jassids, thrips and others. Malathion 57 EC was applied at the rate of 2 ml L^{-1}. To control shoot and fruit borer, Tracer was applied as per suggestion of the company. The insecticide application was made fortnightly for a week after transplanting to a week before first harvesting. Furadan 10 G was also applied during final land preparation as soil insecticide.

3.13.2 Disease

Precautionary measures against disease infection especially phomopsis fruit rot of brinjal was taken by spraying Bavistin fortnightly at the rate of 2g L^{-1}.

3.14 Harvesting

Brinjal fruits were harvested when they attained full maturity indicating deep violet in color and hard in consistency. Harvesting was started on the 25 January, 2011 and was continued until March 01, 2011 as economic production.

3.15 Data collection

Five plants were randomly selected from each unit plot for the collection of plant data. The following data were recorded.

3.15.1 Plant height

The height of the selected sample plants were measured with a meter scale from the ground level to the tip of the longest stem and the mean height were expressed in cm.

3.15.2 Number of branches per plant

The number of branches of selected sample plants was counted at the time of heavy flowering stage and the average number of branches per plant was calculated.

3.15.3 Number of leaves per plant

The number of leaves of selected sample plants was counted at the time of harvesting and the average number of leaves per plant was calculated.

3.15.4 Days from transplanting to 1st visible flower bud

Days from transplanting to 1st visible flower bud was counted from the date of transplanting to the 1st visible flower bud.

3.15.5 Number of flowers per plant

At peak flowering time, this was counted from the sample plants and the average number of flowers produced per plant was calculated.

3.15.6 Number of fruits per plant

The number of fruits per plant was counted from the sample plants and the average number of fruits per plant was calculated.

3.15.7 Length of fruit

The length of fruit was measured with a scale from the neck of the fruit to the bottom of 5 randomly selected marketable fruits from each plot and there average was calculated and expressed in cm.

3.15.8 Diameter of fruit

Diameter of fruit was measured at the middle portion of 5 randomly selected marketable fruit from each plot with a slide calipers and their average was calculated and expressed in cm.

3.15.9 Dry matter content in plant

After harvesting, randomly selected 5 plants were sliced into very thin pieces from which 100 g of plant sample (stem, leaf and root) were taken and put into envelop and placed in oven maintained at 60^0C for 72 hours. The sample was then transferred into desiccators and allowed to cool down at room temperature. The final weight of the sample was taken. The dry matter contents of plant were computed by calculation from the weight recorded by the following formula

$$\% \text{ Dry matter content of plant} = \frac{\text{Dry weight of plant}}{\text{Fresh weight of plant}} \times 100$$

3.15.10 Dry matter content in fruit

After harvesting, randomly selected 5 fruits were sliced into very thin pieces from which 100 g of fruit sample were taken and put into envelop and placed in oven maintained at 60^0C for 72 hours. The sample was then transferred into desiccators and allowed to cool down at room temperature. The final weight of the sample was taken. The dry matter contents of fruit were computed by calculation from the weight recorded by the following formula

Dry weight of fruit

$$\% \text{ Dry matter content of fruit} = \frac{}{\text{Fresh weight of fruit}} \times 100$$

3.15.11 Weight of individual fruit

Among the total number of fruits harvests during the period from first to final harvest the fruits, except the first and final harvest, was considered for determining the individual fruit weight by the following formula

$$\text{Weight of individual fruit} = \frac{\text{Total weight of fruit}}{\text{Total number of fruits}}$$

3.15.12 Yield per plot

A per scale balance was used to take the weight of fruits per plot. It was measured by total the field yield of each unit plot separately during the period from fruit to final harvest and was recorded in kilogram (kg).

3.15.13 Yield per hectare

Yield per hectare of brinjal fruits was calculated by converting the weight of plot yield into hectare and was expressed in ton. It was measured by the following formula

$$\text{Fruit yield per hectare (ton)} = \frac{\text{Fruit yield per plot (kg)}}{\text{Area of plot in square meter} \times 1000}$$

3.16 Statistical analysis

The data recorded for different characters were statistically analyzed. The mean values of all the recorded characters were evaluated and analysis of variance was performed by the ‘F’ (variance ratio) test. The significance of the difference among the treatment of means was estimated by Duncan’s Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984).

CHAPTER IV
RESULTS AND DISCUSSION

The experiment was conducted to study the effect of seedling age and pruning on growth and yield of brinjal. The analyses of variance (ANOVA) of the data are presented in Appendix III-VII. The results have been presented by using table and graphs and discussed with possible interpretations under the following headings:

4.1 Plant height

Plant height of brinjal varied significantly due to different seedling ages at 30, 40, 50, 60 and 70 DAT under the present trial (Appendix III). At 30 DAT, the longest plant (18.21 cm) was recorded from A_3 (35 days pot seedling) which was statistically identical (17.22 cm) with A_4 (35 days seed bed seedling) and followed (16.39 cm) by A_1 (Bud stage pot seedling), while the shortest plant (14.65 cm) from A_2 (Bud stage seed bed seedling) (Fig.2). At 40 DAT, the longest plant (36.97 cm) was recorded from A_3 which was statistically identical (36.07 cm) with A_4 and followed (35.30 cm) by A_1 and the shortest plant (31.82 cm) from A_2. At 50 DAT, the longest plant (60.32 cm) was recorded from A_3 which was statistically similar (59.18 cm) with A_4 and followed (57.97 cm) by A_1, while the shortest plant (49.56 cm) from A_2. At 60 DAT, the longest plant (78.08 cm) was recorded from A_3 which was statistically identical (76.59 cm) with A_4 and followed (75.31 cm) by A_1, while the shortest plant (68.73 cm) from A_2. At 70 DAT, the longest plant (85.48 cm) was recorded from A_3 which was followed (82.70 cm and 81.45 cm) by A_4 and A_1, respectively, while the shortest plant (77.79 cm) from A_2 treatment.

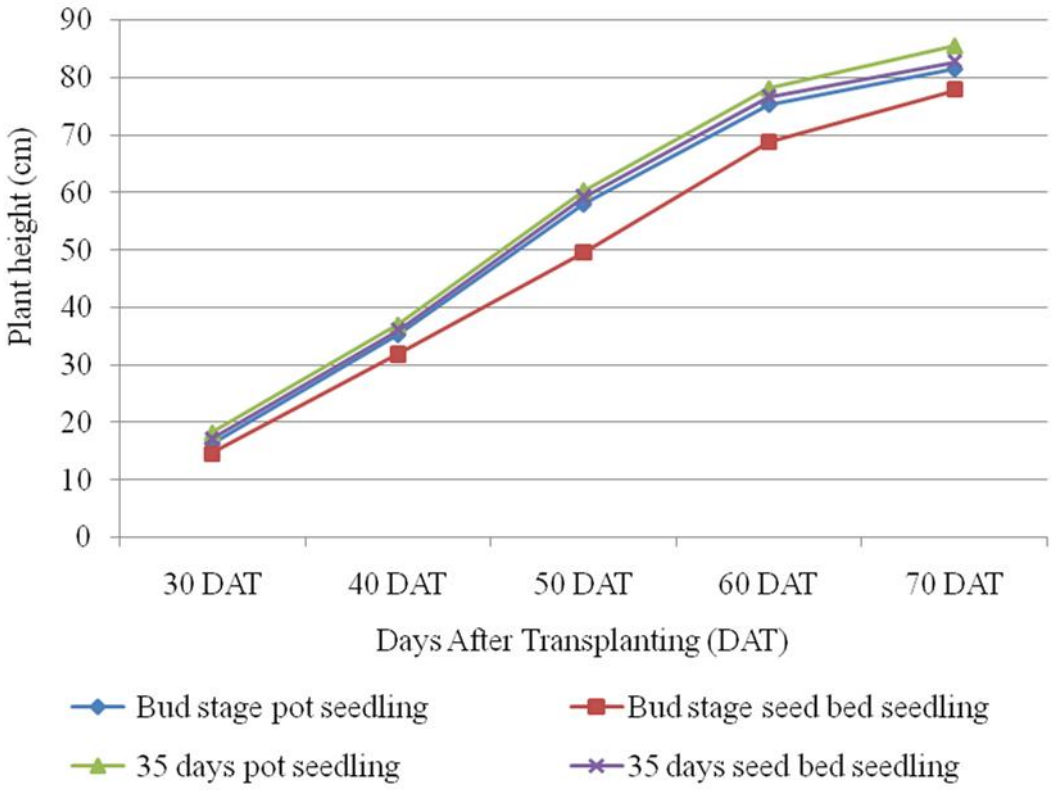


Fig.2. Effect of ages of seedlings on plant height of brinjal

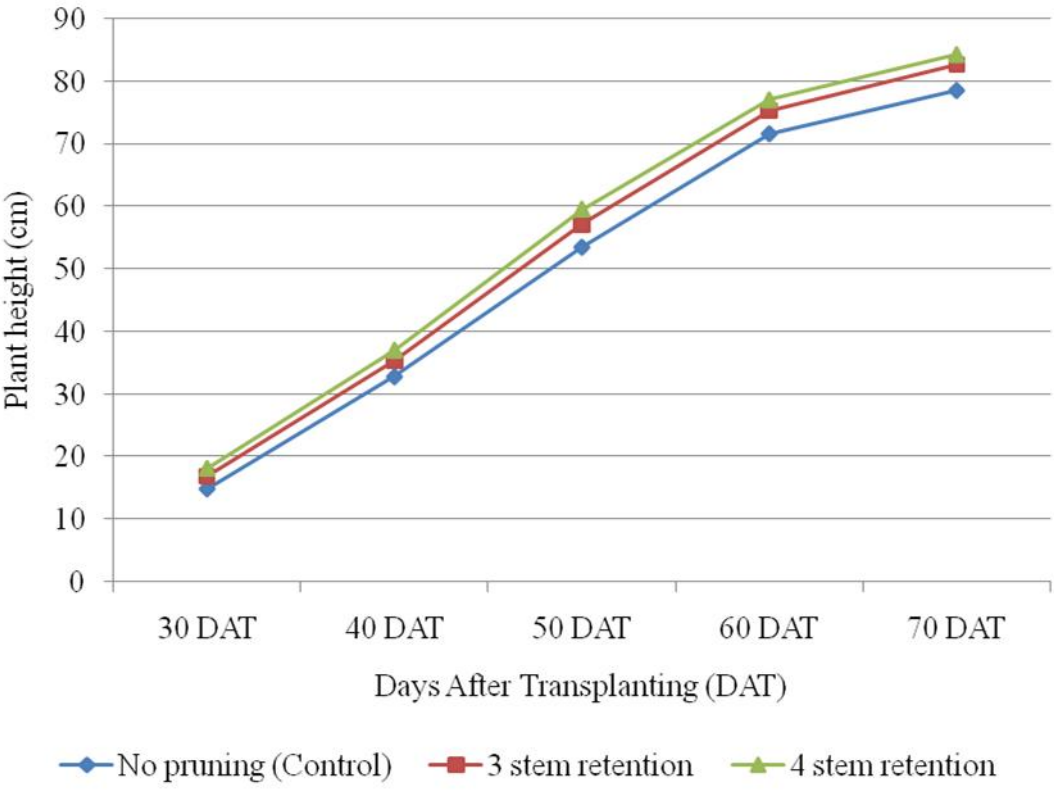


Fig.3. Effect of types of pruning on plant height of brinjal

Plant height of brinjal showed statistically significant variation for different types of pruning at 30, 40, 50, 60 and 70 DAT (Appendix III). At 30 DAT, the longest plant (18.14 cm) was recorded from P_2 (4 stem retention) which was followed (16.89 cm) by P_1 (3 stem retention) and the shortest plant (14.82 cm) was found from P_0 (No pruning). The similar trend of different types of pruning on plant height of brinjal was recorded for 40, 50, 60 and 70 DAT and the longest plant (37.06 cm, 59.64 cm, 77.14 cm and 84.38 cm) was found from P_2, respectively, while the shortest plant (32.74 cm, 53.45 cm, 71.59 cm and 78.50 cm) was recorded from P_0 for 40, 50, 60 and 70 DAT, respectively (Fig.3). Baki (1987) found that pruning showed a significant effect on plant height of tomato. Srinivasan *et al*. (1999) found that pruned plants were significantly taller than non-pruned plants of Hyybrid tomato ARTH-4. Ambroszczyk *et al*. (2007) also reported similar results earlier of eggplant.

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation for plant height at 30, 40, 50, 60 and 70 DAT (Appendix III). At 30 DAT, the longest plant (20.40 cm) was recorded from A_3P_2 (35 days pot seedling + 4 stem retention) and the shortest plant (13.48 cm) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning). At 40, 50, 60 and 70 DAT the similar trend of interaction effect between ages of seedlings and types of pruning showed on the plant height of brinjal (Table 2). At 70 DAT, the longest plant (89.86 cm) was recorded from A_3P_2 (35 days pot seedling + 4 stem retention) and the shortest plant (75.95 cm) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning).

Table 2. Interaction effect of ages of seedlings and types of pruning on plant height of brinjal

Treatment combination	Plant height (cm)				
	30 DAT	40 DAT	50 DAT	60 DAT	70 DAT
A_1P_0	14.42 cde	32.89 de	54.35 e	71.67 ef	78.13 de
A_1P_1	16.47 bcd	35.32 bcd	58.51 cd	75.92 cde	81.69 cd
A_1P_2	18.29 ab	37.70 ab	61.04 bc	78.34 bc	84.53 bc
A_2P_0	13.48 e	29.66 f	47.48 g	67.92 fg	75.95 e
A_2P_1	16.25 bcd	34.23 cde	51.66 f	71.78 ef	81.24 cd
A_2P_2	14.21 de	31.57 ef	49.53 fg	66.50 g	76.19 e
A_3P_0	16.23 bcd	34.71 cd	56.64 de	74.19 cde	81.13 cd
A_3P_1	18.02 ab	36.13 bc	59.47 cd	77.19 bc	85.46 abc
A_3P_2	20.40 a	40.06 a	64.86 a	82.87 a	89.86 a
A_4P_0	15.15 cde	33.71 cde	55.33 e	72.56 de	78.80de
A_4P_1	16.83 bc	35.60 bcd	59.05 cd	76.34 cd	82.35 bcd
A_4P_2	19.67 a	38.91 a	63.15 ab	80.86 ab	86.95 ab
$LSD_{(0.05)}$	2.202	2.512	2.659	3.987	4.419
Significance level	0.05	0.05	0.01	0.01	0.05
CV(%)	7.83	9.23	5.77	8.15	11.19

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

A_1: Bud stage pot seedling

A_2: Bud stage seed bed seedling

A_3: 35 days pot seedling

A_4: 35 days seed bed seedling

P_0: No pruning (control)

P_1: 3 stem retention

P_2: 4 stem retention

4.2 Number of leaves per plant

Due to different level of seedling ages number of leaves per plant of brinjal varied significantly at 30, 40, 50, 60 and 70 DAT (Appendix IV). At 30 DAT, the maximum number of leaves per plant (5.47) was recorded from A_3 (35 days pot seedling) which was statistically identical (5.33) with A_4 (35 days seed bed seedling) and followed (5.17) by A_1 (Bud stage pot seedling), while the minimum number of leaves per plant (4.38) was recorded from A_2 (Bud stage seed bed seedling). At 40 DAT, the maximum number of leaves per plant (14.39) was recorded from A_3 which was followed (13.28 and 12.98) by A_4 and A_1, respectively and they were statistically identical, while the minimum number (12.32) from A_2 (Fig.4). Similar trend of results was recorded for 50, 60 and 70 DAT and the maximum number of leaves per plant (21.27, 34.93 and 43.02) was recorded from A_3, respectively, whereas the minimum number of leaves per plant (18.03, 25.96 and 31.71) from A_2, respectively.

Number of leaves per plant of brinjal showed significant differences for different types of pruning at 30, 40, 50, 60 and 70 DAT (Appendix IV). At 30 DAT, the maximum number of leaves per plant (5.53) was recorded from P_2 (4 stem retention) which was statistically identical (5.47) with P_1 (3 stem retention) and the minimum number (4.26) from P_0 (No pruning). At 40 DAT, the maximum number of leaves per plant (14.51) was recorded from P_2 which was followed (13.20) by P_1 and the minimum number of leaves (12.02) was recorded from P_0 (Fig.5). Similar trend of results was recorded for 50, 60 and 70 DAT and the maximum number of leaves per plant (20.91, 34.58 and 42.13) was recorded from P_2, respectively, while the minimum number of leaves per plant (17.89, 27.73 and 35.15) from P_0 for 50, 60 and 70 DAT, respectively.

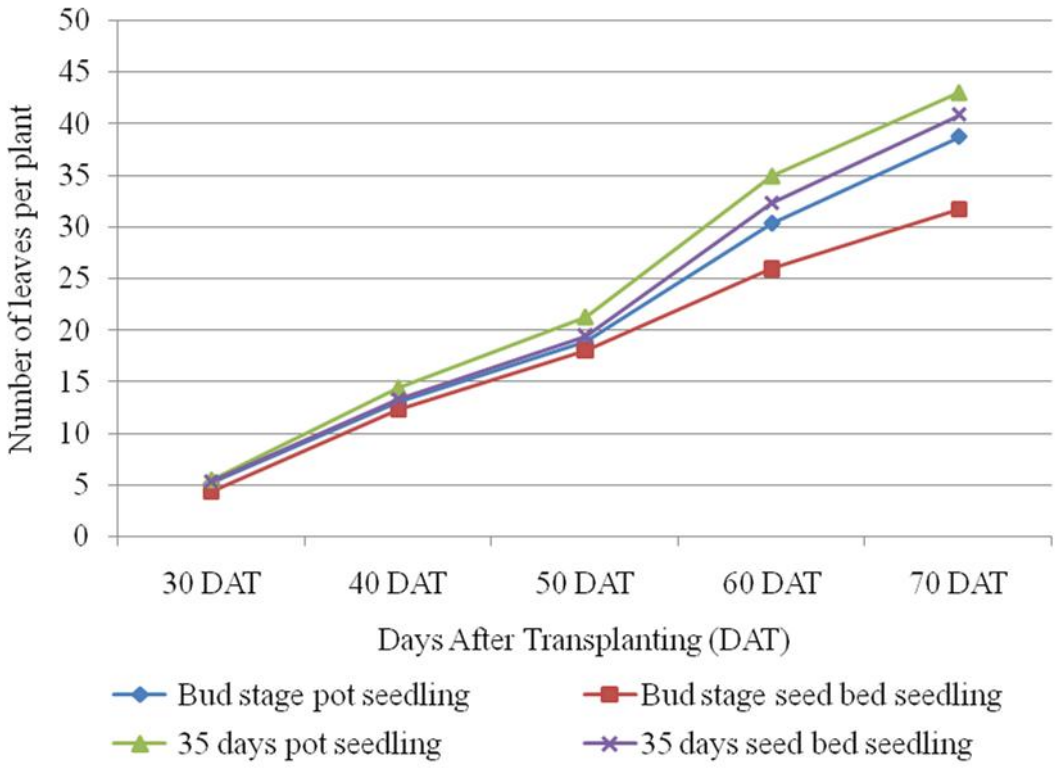


Fig.4. Effect of ages of seedlings on number of leaves per plant of brinjal

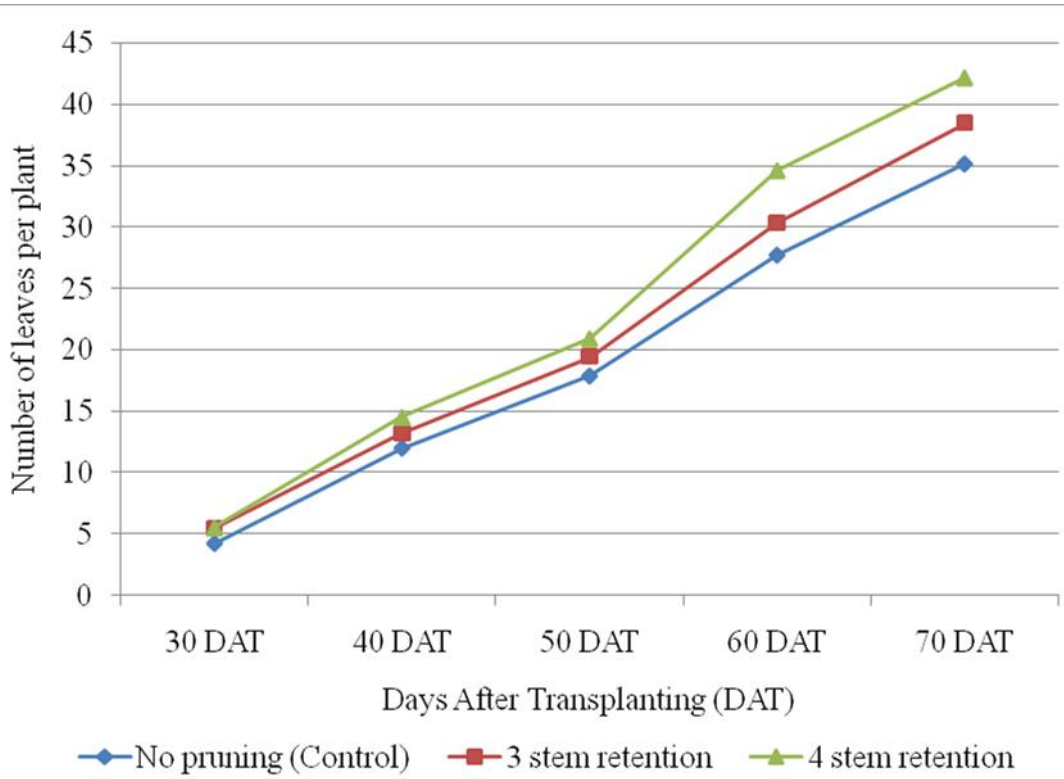


Fig.5. Effect of types of pruning on number of leaves per plant of brinjal

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation on number of leaves per plant at 30, 40, 50, 60 and 70 DAT (Appendix IV). At 30 DAT, the maximum number of leaves per plant (6.00) was recorded from A_3P_2 (35 days pot seedling + 4 stem retaining) and the minimum number of leaves per plant (3.60) from A_2P_0 (Bud stage seed bed seedling + No pruning). The similar trend of the interaction effect was recorded for the seedling age and types of pruning on the number of leaves per plant and maximum number of leaves per plant (48.20) was recorded from A_3P_2 (35 days pot seedling + 4 stem retaining) and minimum number of leaves per plant (29.87) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning) at 70 DAT (Table 3).

Table 3. Interaction effect of ages of seedlings and types of pruning on number of leaves per plant of brinjal

Treatment combination	Number of leaves per plant				
	30 DAT	40 DAT	50 DAT	60 DAT	70 DAT
A_1P_0	4.30 f	11.80 f	17.33 fg	26.80 g	34.60 ef
A_1P_1	5.50 c	13.00 de	18.93 de	29.87 ef	39.33 cd
A_1P_2	5.70 bc	14.13 bc	20.43 bc	34.33 c	42.20 b
A_2P_0	3.60 g	11.27 f	16.97 g	23.13 h	29.87 g
A_2P_1	4.97 d	12.33 def	18.70 def	28.07 fg	33.00 f
A_2P_2	4.57 ef	13.37 cd	18.43 def	26.67 g	32.27 fg
A_3P_0	4.63 e	13.03 de	19.50 cd	31.87 cde	39.27 cd
A_3P_1	5.77 abc	14.20 bc	21.00 b	32.87 cd	41.60 bc
A_3P_2	6.00 a	15.93 a	23.30 a	40.07 a	48.20 a
A_4P_0	4.50 ef	11.97 ef	17.77 efg	29.13 fg	36.87 de
A_4P_1	5.63 bc	13.27 cd	19.03 cde	30.47 def	39.73 bc
A_4P_2	5.87 ab	14.60 b	21.47 b	37.27 b	45.87 a
$LSD_{(0.05)}$	0.273	1.000	1.339	2.384	2.640
Significance level	0.05	0.05	0.05	0.01	0.01
CV(%)	7.20	9.46	6.07	10.56	12.04

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

A_1: Bud stage pot seedling

A_2: Bud stage seed bed seedling

A_3: 35 days pot seedling

A_4: 35 days seed bed seedling

P_0: No pruning (control)

P_1: 3 stem retention

P_2: 4 stem retention

4.3 Number of branches per plant

At 30, 40, 50, 60 and 70 DAT number of branches per plant of brinjal varied significantly due to different level of seedling ages (Appendix V). At 30 DAT, the maximum number of branches per plant (5.64) was recorded from A_3 (35 days pot seedling) which was statistically identical (5.42) with A_4 (35 days seed bed seedling) and followed (5.02) by A_1 (Bud stage pot seedling), while the minimum number of branches per plant (4.86) was recorded from A_2 (Bud stage seed bed seedling). At 40 DAT, the maximum number of branches per plant (12.60) was recorded from A_3 which was statistically identical (12.36 and 11.82) by A_4 and A_1, respectively, while the minimum number (9.62) was recorded from A_2 (Fig.6). Similar trend of results was recorded for 50, 60 and 70 DAT and the maximum number of branches per plant (18.44, 23.87 and 31.51) was recorded from A_3, respectively, whereas the lowest number of branches per plant (13.51, 18.24 and 21.40) was recorded from A_2 for 50, 60 and 70 DAT, respectively.

Number of branches per plant of brinjal showed statistically significant variation for different types of pruning at 30, 40, 50, 60 and 70 DAT (Appendix V). At 30 DAT, the maximum number of branches per plant (5.67) was recorded from P_0 (no pruning) which was statistically identical (5.53) with P_2 (4 stem retention) and the minimum number of branches per plant (4.52) was recorded from P_1 (3 stem pruning). At 40 DAT, the maximum number of branches per plant (12.77) was recorded from P_2 which was closely followed (11.73) by P_1 and the minimum number of branches per plant (10.30) was recorded from P_0 (Fig.7).

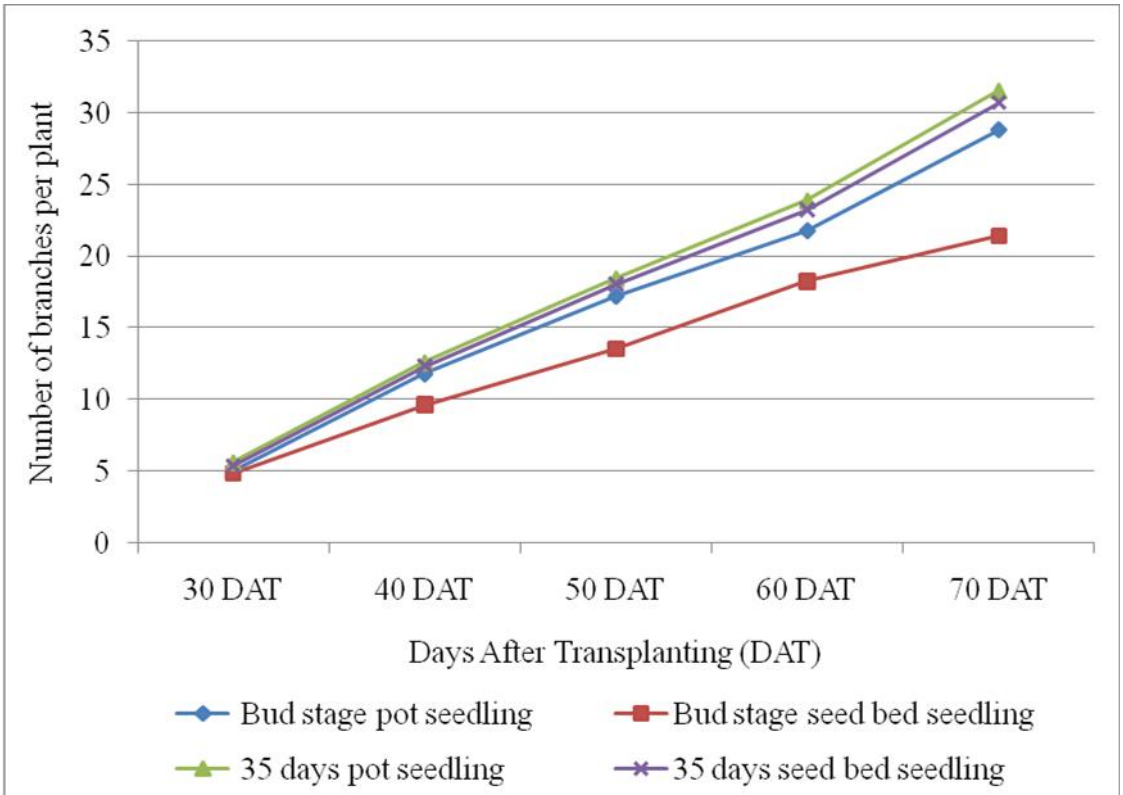


Fig.6. Effect of ages of seedlings on number of branches per plant of brinjal

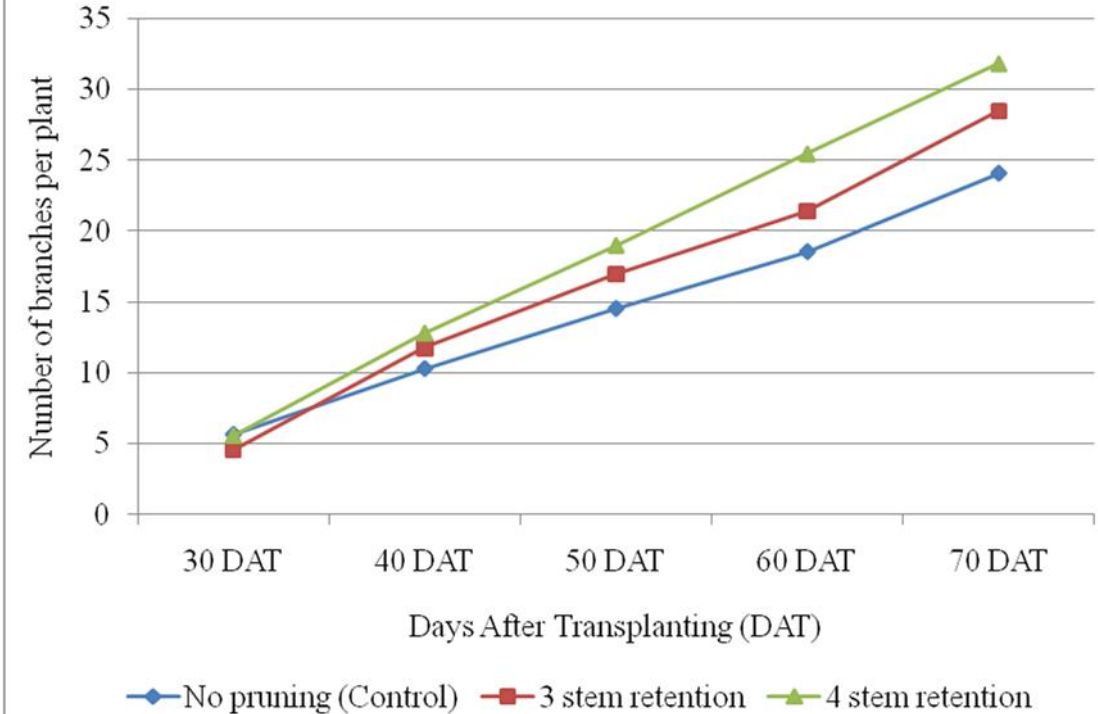


Fig.7. Effect of types of pruning on number of branches per plant of brinjal

Similar trend of results was recorded for 50, 60 and 70 DAT and the maximum number of branches per plant (18.97, 25.43 and 31.80) was recorded from P_2, respectively while the minimum number of branches (14.53, 18.53 and 24.05) was recorded from P_0 for 50, 60 and 70 DAT, respectively. Ambroszczyk *et al*. (2007) reported that the most beneficial light conditions were observed in treatments pruned to one shoot with two fruit sets per node of eggplant. Similar results also reported of eggplant by Amroszczyk *et al*. (2003).

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation on number of branches per plant at 30, 40, 50, 60 and 70 DAT (Appendix V). At 30 DAT, the maximum number of branches per plant (6.33) was recorded from A_3P_2 (35 days pot seedling + 4 stem retaining) and the minimum number of branches per plant (4.26) was recorded from A_2P_0 (Bud stage seed bed

seedling + No pruning). The similar trend of the interaction effect was recorded for the seedling age and types of pruning on the number of branches per plant. At 70 DAT, the maximum number of branches per plant (35.87) was recorded from A_3P_2 (35 days pot seedling + 4 stem retaining) and the minimum number of branches per plant (18.00) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning), (Table 4).

Table 4. Interaction effect of ages of seedlings and types of pruning on number of branches per plant of brinjal

Treatment combination	Number of branches per plant				
	30 DAT	40 DAT	50 DAT	60 DAT	70 DAT
A_1P_0	5.67 ab	10.33 de	14.80 cde	18.07 ef	24.47 f
A_1P_1	4.47 cd	12.00 bc	17.20 bcd	21.33 bc	28.93 cd
A_1P_2	5.13 bc	13.13 ab	19.67 ab	25.93 a	33.00 ab
A_2P_0	4.26 d	9.07 e	12.73 e	16.33 f	18.00 g
A_2P_1	5.07 bc	10.33 de	14.60 de	18.33 def	23.07 f
A_2P_2	5.03 bc	9.47 de	13.20 e	20.07 cde	23.13 f
A_3P_0	6.20 a	10.80 cd	15.27 cde	20.53 cd	27.80 de
A_3P_1	4.47 cd	12.67 b	18.53 b	22.93 b	30.87 bc
A_3P_2	6.13 a	14.33 a	21.53 a	28.13 a	35.87 a
A_4P_0	5.80 a	14.53 a	21.93 a	27.60 a	35.20 a
A_4P_1	4.27 d	11.93 bc	17.33 bc	22.93 b	30.93 bc
A_4P_2	6.33 a	10.60 cd	14.87 cde	19.20 cde	25.93 ef
$LSD_{(0.05)}$	0.629	1.361	2.383	2.110	2.806
Significance level	0.01	0.01	0.01	0.05	0.05
CV(%)	7.10	6.93	8.38	9.72	5.90

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

A_1: Bud stage pot seedling

A_2: Bud stage seed bed seedling

A_3: 35 days pot seedling

A_4: 35 days seed bed seedling

P_0: No pruning (control)

P_1: 3 stem retention

P_2: 4 stem retention

4.4 Days from transplanting to 1st visible flower bud

Days from transplanting to 1st visible flower bud showed statistically significant variation due to different seedling ages (Appendix VI). The maximum (41.37) days from transplanting to 1st visible flower bud was recorded from A_2 (Bud stage seed bed seedling) whereas the minimum (40.15) days from transplanting to 1st visible flower bud was recorded from A_3 (35 days pot seedling) which was statistically identical (40.45 and 40.59 day) with A_4 (35 days seed bed seedling) and A_1 (Bud stage pot seedling), respectively (Table 5).

Statistically significant variation was recorded due to the different types of pruning for days from transplanting to 1st visible flower bud (Appendix VI). The maximum (41.89) days from transplanting to 1st visible flower bud was recorded from P_0 (No pruning), while the minimum (39.89) days from transplanting to 1st visible flower bud was recorded from P_2 (4 stem retention) which was statistically similar (40.14) with P_1 as 3 stem retention (Table 5).

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation for days from transplanting to 1st visible flower bud (Appendix VI). The maximum (43.00) days from transplanting to 1st visible flower bud was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning) and the minimum (39.33) days from transplanting to 1st visible flower bud was recorded from A_3P_2 (35 days pot seedling + 4 stem retention) (Table 6).

Table 5. Effect of ages of seedlings and types of pruning on yield contributing characters of brinjal

Treatment(s)	Days from transplanting to 1st visible flower bud	Number of flowers per plant	Length of fruit (cm)	Diameter of fruits (cm)
Ages of seedlings				
A_1	40.59 b	49.87 b	18.68 c	3.39 b
A_2	41.37 a	45.49 c	15.16 d	2.73 c
A_3	40.15 b	54.56 a	22.65 a	3.72 a
A_4	40.45 b	52.91 a	20.95 b	3.63 ab
$LSD_{(0.05)}$	0.641	2.186	1.319	0.298
Significance level	0.01	0.01	0.01	0.01
Types of pruning				
P_0	41.89 a	47.23 c	17.80 b	2.81 c
P_1	40.14 b	51.03 b	19.62 a	3.52 b
P_2	39.89 b	53.85 a	20.67 a	3.78 a
$LSD_{(0.05)}$	0.555	1.894	1.142	0.258
Significance level	5.61	8.41	6.97	9.05
CV(%)	0.01	0.01	0.01	0.01

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

A_1: Bud stage pot seedling

A_2: Bud stage seed bed seedling

A_3: 35 days pot seedling

A_4: 35 days seed bed seedling

P_0: No pruning (control)

P_1: 3 stem retention

P_2: 4 stem retention

Table 6. Interaction effect of ages of seedlings and types of pruning on yield contributing characters of brinjal

Treatment combination	Days from transplanting to 1st visible flower bud	Number of flowers per plant	Length of fruit (cm)	Diameter of fruits (cm)
A_1P_0	42.00 ab	46.73 f	16.85 de	2.78 ef
A_1P_1	40.00 def	49.00 ef	19.08 cd	3.46 cd
A_1P_2	39.78 ef	53.87 bc	20.12 c	3.92 bc
A_2P_0	43.00 a	41.27 g	15.06 e	2.42 f
A_2P_1	40.78 cde	49.60 def	15.54 e	3.36 cd
A_2P_2	40.33 cdef	45.60 f	14.88 e	2.40 f
A_3P_0	41.11 bcd	51.40 cde	20.40 c	3.01 de
A_3P_1	40.00 def	53.47 bcd	22.81 ab	3.69 c
A_3P_2	39.33 f	58.80 a	24.74 a	4.47 a
A_4P_0	41.44 bc	49.53 def	18.88 cd	3.03 de
A_4P_1	39.78 ef	52.07 cde	21.03 bc	3.55 cd
A_4P_2	40.12 def	57.13 ab	22.95 ab	4.32 ab
$LSD_{(0.05)}$	1.110	3.787	2.284	0.516
Significance level	0.05	0.05	0.05	0.01
CV(%)	5.61	8.41	6.97	9.05

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

A_1: Bud stage pot seedling

A_2: Bud stage seed bed seedling

A_3: 35 days pot seedling

A_4: 35 days seed bed seedling

P_0: No pruning (control)

P_1: 3 stem retention

P_2: 4 stem retention

4.5 Number of flowers per plant

Number of flowers per plant showed statistically significant variation due to different seedling ages (Appendix VI). The highest number of flowers per plant (54.56) was recorded from A_3 (35 days pot seedling) which was statistically identical (52.91) with A_4 (35 days seed bed seedling) and followed (49.87) by A_1 (Bud stage pot seedling), while the lowest number of flowers per plant (45.49) was recorded from A_2 (Bud stage seed bed seedling) (Table 5).

Significant difference was recorded due to the different types of pruning for number of flowers per plant (Appendix VI). The maximum number of flowers per plant (53.85) was recorded from P_2 (4 stem retention) which was closely followed (51.03) by P_1 as 3 stem retention (Table 5), while the minimum number of flowers per plant (47.23) was recorded from P_0 (No pruning).

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation for number of flowers per plant (Appendix VI). The maximum number of flowers per plant (58.80) was recorded from A_3P_2 (35 days pot seedling + 4 stem retention), while the minimum number of flowers per plant (41.27) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning) (Table 6).

4.6 Number of fruits per plant

Number of fruits per plant showed statistically significant variation due to different seedling ages (Appendix VI). The highest number of fruits per plant (40.38) was recorded from A_3 (35 days pot seedling) which was statistically identical (38.44) with A_4 (35 days seed bed seedling) and followed (33.91) by A_1 (Bud stage pot seedling), while the lowest number of fruits per plant (28.29) from A_2 (Bud stage seed bed seedling) (Fig.8). Chowdhury *et al*. (1991) found that age of seedlings significantly influenced the number of fruits per plant of brinjal.

A statistically significant difference was recorded due to the different types of pruning for number of fruits per plant (Appendix VI). The maximum number of fruits per plant (39.67) was recorded from P_2 (4 stem retention) which was closely followed (36.77) by P_1 as 3 stem retention (Fig.9), while the minimum number of fruits per plant (29.33) was recorded from P_0 (No pruning). Ahmed *et al.* (1986) reported that fruit numbers of tomato had shown significant differences amongst methods of pruning.

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation for number of fruits per plant (Appendix VI). The maximum number of fruits per plant (47.40) was recorded from A_3P_2 (35 days pot seedling + 4 stem retention), while the minimum number of fruits per plant (24.40) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning) (Fig.10).

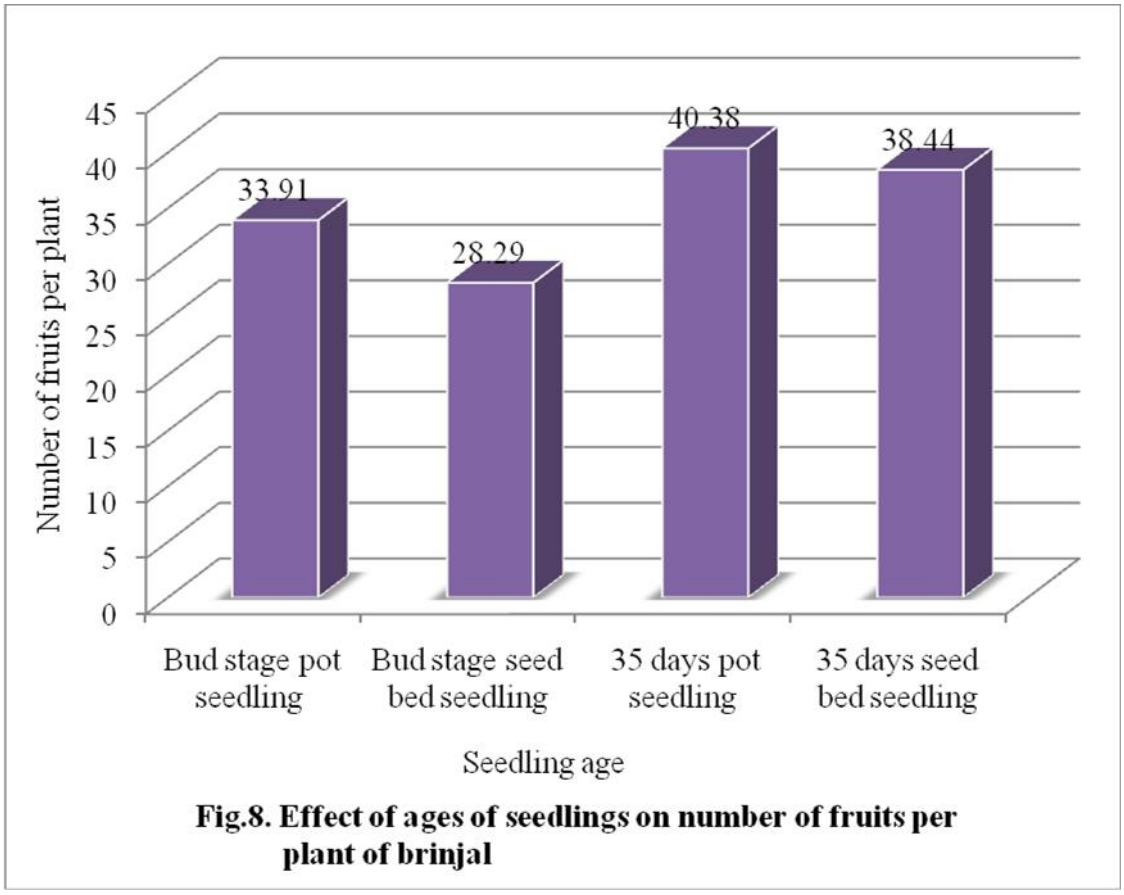


Fig.8. Effect of ages of seedlings on number of fruits per plant of brinjal

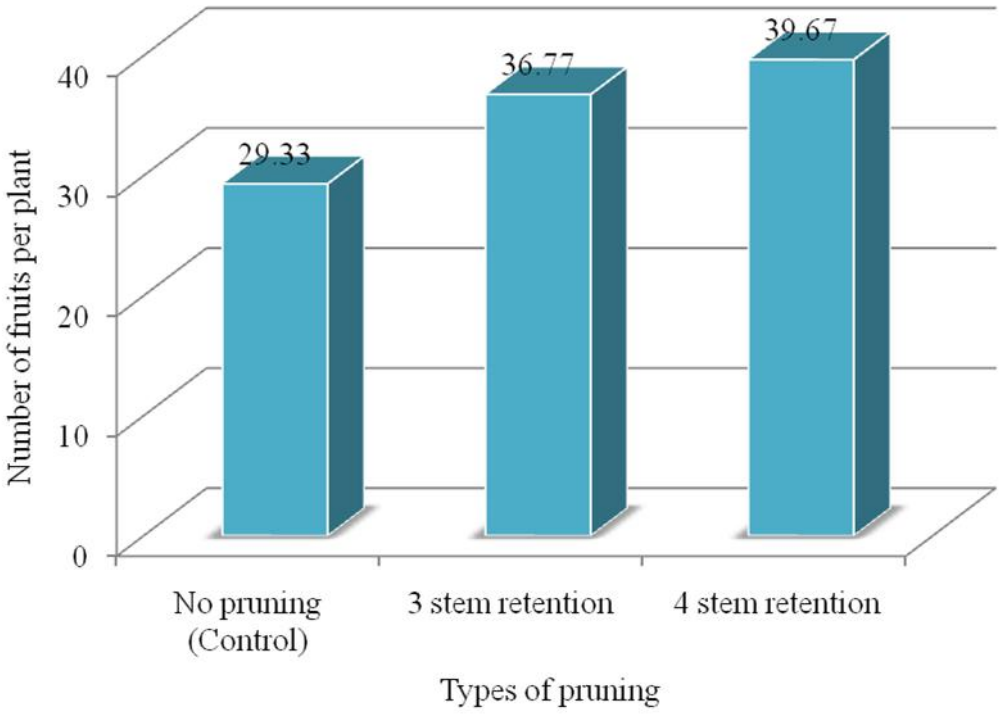


Fig.9. Effect of types of pruning on number of fruits per plant of brinjal

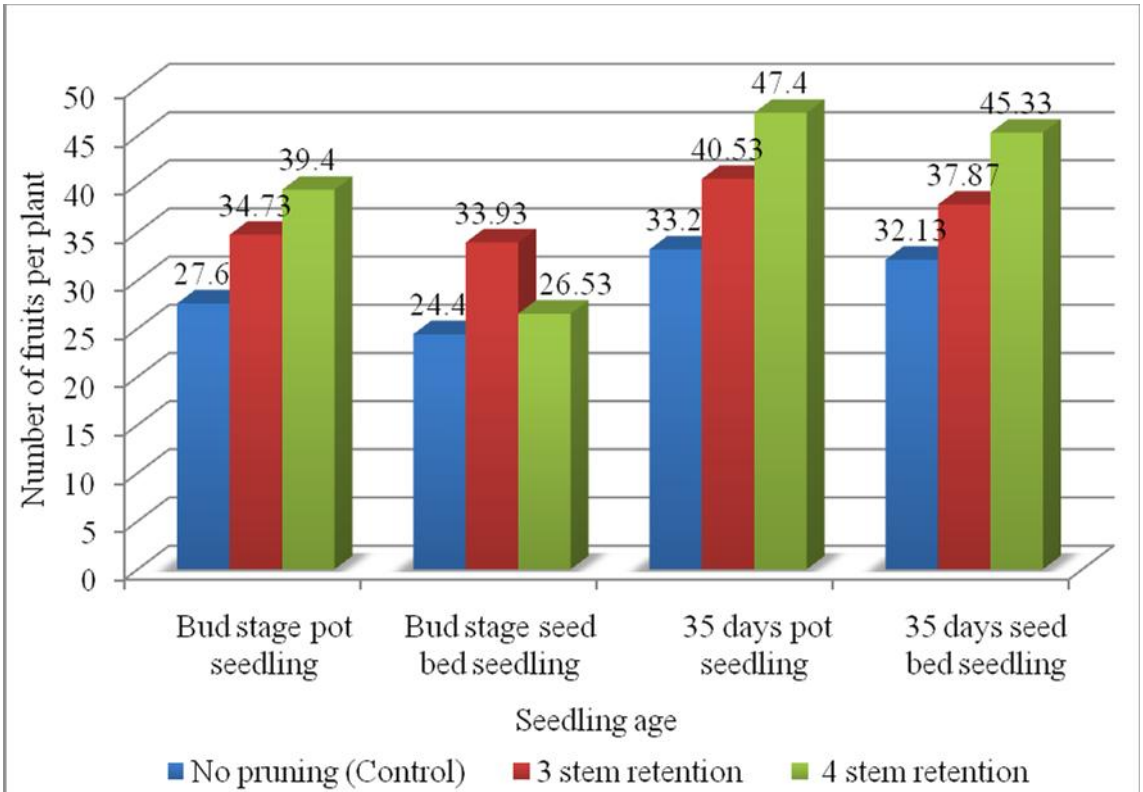


Fig.10. Interaction effect of ages of seedlings and types of pruning on number of fruits per plant of brinjal

4.7 Length of fruit

Length of fruits showed statistically significant variation due to different seedling ages (Appendix VI). The maximum length of fruits (22.65 cm) was recorded from A_3

(35 days pot seedling) which was followed (20.95 cm) by A_4 (35 days seed bed seedling), while the minimum length of fruits (15.16 cm) was recorded from A_2 (Bud stage seed bed seedling) which was followed (18.68 cm) by A_1 (Bud stage pot seedling) (Table 5).

Statistically significant variation was recorded due to the different types of pruning for length of fruit (Appendix VI). The maximum length of fruits (20.67 cm) was recorded from P_2 (4 stem retention) which was statistically similar (19.62 cm) with P_1 as 3 stem retention (Table 5) and the minimum length of fruits (17.80 cm) was recorded from P_0 (No pruning). Hernandez *et al*. (1992) found that fruit length of tomato was greatest in plants for pruning one stem and the number of fruits was higher.

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation for length of fruit (Appendix VI). The maximum length of fruits (24.74 cm) was recorded from A_3P_2 (35 days pot seedling + 4 stem retention) and the minimum length of fruit (15.06 cm) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning) (Table 6).

4.8 Diameter of fruit

Diameter of fruits varied significantly due to different seedling ages (Appendix VI). The maximum diameter of fruits (3.72 cm) was recorded from A_3 (35 days pot

seedling) which was statistically similar (3.63 cm) with A_4 (35 days seed bed seedling) and followed (3.39 cm) by A_1 (Bud stage pot seedling). On the other hand the minimum diameter of fruits (2.73 cm) was recorded from A_2 (Bud stage seed bed seedling) (Table 5). Awad *et al*. (2001) reported that maximum fruit diameter of tomato for different seedling ages. Hernandez *et al*. (1992) found that fruit diameter of tomato was greatest in plants for pruning one stem and the number of fruits was higher.

Significant variation was recorded due to the different types of pruning for diameter of fruit (Appendix VI). The maximum diameter of fruits (3.78 cm) was recorded from P_2 (4 stem retention) which was followed (3.52 cm) with P_1 as 3 stem retention (Table 5), while the minimum diameter of fruits (2.81 cm) was recorded from P_0 (No pruning).

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation for diameter of fruit (Appendix VI). The maximum diameter of fruits (4.47 cm) was recorded from A_3P_2 (35 days pot seedling + 4 stem retention) and the minimum diameter of fruits (2.42 cm) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning) (Table 6).

4.9 Dry matter content in plant

Statistically significant variation was recorded for dry matter content in plants due to different seedling ages (Appendix VII). The highest dry matter content in plants

(13.74 %) was recorded from A_3 (35 days pot seedling) which was statistically identical (13.53%) with A_4 (35 days seed bed seedling) and followed (12.97%) by A_1 (Bud stage pot seedling), whereas the lowest dry matter content in plants (11.70%) was recorded from A_2 (Bud stage seed bed seedling (Table 7).

A statistically significant variation was recorded due to the different types of pruning for dry matter content in plant (Appendix VII). The highest dry matter content in plants (13.57%) was recorded from P_2 (4 stem retention) which was statistically similar (13.24%) with P_1 as 3 stem retention (Table 7), while the lowest (12.15%) was recorded from P_0 (No pruning).

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation for dry matter content in plant (Appendix VII). The highest dry matter content in plants (14.74%) was recorded from A_3P_2 (35 days pot seedling + 4 stem retention), while the lowest dry matter content in plant (11.12%) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning) (Table 8).

Table 7. Effect of ages of seedlings and types of pruning on yield contributing characters and yield of brinjal

Treatment(s)	Dry matter content in plant (%)	Dry matter content in fruit (%)	Weight of Individual fruit (g)	Yield (kg/plot)	Yield (t/ha)

Ages of seedlings					
A_1	12.97 b	11.55 b	78.36 bc	23.35 bc	47.66 bc
A_2	11.70 c	10.77 c	75.69 c	21.99 c	44.87 c
A_3	13.74 a	12.73 a	82.81 a	25.14 a	51.30 a
A_4	13.53 ab	12.43 a	79.68 ab	24.17 ab	49.32 ab
$LSD_{(0.05)}$	0.697	0.684	3.540	1.450	2.959
Significance level	0.01	0.01	0.01	0.01	0.01
Types of pruning					
P_0	12.15 b	10.99 c	75.89 b	22.36 b	45.64 b
P_1	13.24 a	11.95 b	79.48 a	23.83 a	48.63 a
P_2	13.57 a	12.67 a	82.05 a	24.79 a	50.59 a
$LSD_{(0.05)}$	0.603	0.593	3.066	1.256	2.563
Significance level	0.01	0.01	0.01	0.01	0.01
CV(%)	5.49	5.90	8.58		6.27

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

A_1: Bud stage pot seedling

A_2: Bud stage seed bed seedling

A_3: 35 days pot seedling

A_4: 35 days seed bed seedling

P_0: No pruning (control)

P_1: 3 stem retention

P_2: 4 stem retention

Table 8. Interaction effect of ages of seedlings and types of pruning on yield contributing characters and yield of brinjal

Treatment combination	Dry matter content in plant (%)	Dry matter content in fruit (%)	Weight of Individual fruit (g)	Yield (kg/plot)	Yield (t/ha)

A_1P_0	11.86 cde	10.51 cd	78.24 cde	21.78 def	44.45 def
A_1P_1	13.30 b	11.76 bc	77.24 cde	23.28 cde	47.52 cde
A_1P_2	13.75 ab	12.38 b	79.61 bcd	24.99 abc	51.00 abc
A_2P_0	11.12 e	10.31 d	72.32 e	19.87 f	40.56 f
A_2P_1	12.64 bcd	11.63 bcd	81.40 bc	24.85 abc	50.72 abc
A_2P_2	11.34 de	10.37 d	73.36 de	21.23 ef	43.33 ef
A_3P_0	12.78 bc	11.61 bcd	79.00 bcde	23.57 cde	48.10 cde
A_3P_1	13.77 ab	12.31 b	79.86 bcd	24.47 bcd	49.93 bcd
A_3P_2	14.74 a	14.29 a	89.57 a	27.37 a	55.86 a
A_4P_0	12.62 bcd	11.48 bcd	73.98 de	22.86 cde	46.66 cde
A_4P_1	13.24 b	12.10 b	79.43 bcd	22.71 cde	46.34 cde
A_4P_2	14.68 a	13.71 a	85.64 ab	26.93 ab	54.95 ab
$LSD_{(0.05)}$	1.207	1.185	6.132	2.512	5.125
Significance level	0.05	0.01	0.01	0.01	0.01
CV(%)	5.49	5.90	8.58	6.27	6.27

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

A_1: Bud stage pot seedling
A_2: Bud stage seed bed seedling
A_3: 35 days pot seedling
A_4: 35 days seed bed seedling

P_0: No pruning (control)
P_1: 3 stem retention
P_2: 4 stem retention

4.10 Dry matter content in fruit

Dry matter content in fruits showed statistically significant variation due to different seedling ages (Appendix VII). The highest dry matter content in fruits (12.73%) was

recorded from A_3 (35 days pot seedling) which was statistically similar (12.43%) by A_4 (35 days seed bed seedling) and followed (11.55%) by A_1 (Bud stage pot seedling). On the other hand the lowest dry matter content in fruits (10.77%) was recorded from A_2 (Bud stage seed bed seedling) (Table 7). Okano *et al*. (2000) reported that dry weight of tomato fruits at harvest were higher when were planted at a younger age.

Statistically significant variation was recorded due to the different types of pruning for dry matter content in fruit (Appendix VII). The highest dry matter content in fruits (12.67%) was recorded from P_2 (4 stem retention) which was closely followed (11.95%) by P_1 as 3 stem retention (Table 7), and the lowest dry matter content in fruits (10.99%) was recorded from P_0 (No pruning).

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation for dry matter content in fruit (Appendix VII). The highest dry matter content in fruits (14.29%) was recorded from A_3P_2 (35 days pot seedling + 4 stem retention) and the lowest dry matter content in fruit (10.31%) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning) (Table 8).

4.11 Weight of individual fruit

Due to different seedling ages statistically significant variation was recorded for weight of individual fruit (Appendix VII). The highest weight of individual fruit (82.81 g) was recorded from A_3 (35 days pot seedling) which was statistically similar (79.68 g) with A_4 (35 days seed bed seedling) and closely followed (78.36 g) by A_1 (Bud stage pot seedling), whereas the lowest weight of individual fruit (75.69 g) was recorded from A_2 (Bud stage seed bed seedling) (Table 7). Rahman *et al*. (1994) reported that average fruit weight of tomato were greatest when seedlings were 40 day old at transplanting.

Statistically significant variation was recorded due to the different types of pruning for weight of individual fruit (Appendix VII). The highest weight of individual fruit (82.05 g) was recorded from P_2 (4 stem retention) which was statistically similar (79.48 g) with P_1 as 3 stem retention (Table 7). On the other hand the lowest weight of individual fruit (75.89 g) was recorded from P_0 (No pruning).

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation for weight of individual fruit (Appendix VII). The highest weight of individual fruit (89.57 g) was recorded from A_3P_2 (35 days pot seedling + 4 stem retention) and the lowest weight of individual fruit (72.32 g) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning) (Table 8).

4.12 Yield per plot

Yield per plot of brinjal showed statistically significant variation due to different seedling ages (Appendix VII). The highest yield (25.14 kg/plot) was recorded from A_3 (35 days pot seedling) which was statistically similar (24.17 kg/plot) with A_4 (35 days seed bed seedling) and followed (47.66 kg/plot) by A_1 (Bud stage pot seedling) and the lowest yield (21.99 kg/plot) was found from A_2 (Bud stage seed bed seedling) (Table 7).

Types of pruning in brinjal showed statistically significant variation in terms of yield per plot (Appendix VII). The highest yield (24.79 kg/plot) was recorded from P_2 (4 stem retention) which was statistically similar (23.83 kg/plot) with P_1 as 3 stem retention (Table 7), and the lowest yield (22.36 kg/plot) was recorded from P_0 (No pruning).

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation for yield per plot (Appendix VII). The highest yield (27.37 kg/plot) was recorded from A_3P_2 (35 days pot seedling + 4 stem retention) (Table 8, Plate 3) and the lowest yield (19.87 kg/plot) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning) (Table 8).

Plate 3. The picture showing the highest yield was found in A_3P_2 (35 days pot seedling + 4 stem retention) combination

4.13 Yield per hectare

Statistically significant variation was recorded for yield per hectare due to different seedling ages (Appendix VII). The highest yield (51.30 t/ha) was recorded from A_3 (35 days pot seedling) which was statistically similar (49.32 t/ha) with A_4 (35 days seed bed seedling) and followed (47.66 t/ha) by A_1 (Bud stage pot seedling) and the lowest yield (44.87 t/ha) was recorded from A_2 (Bud stage seed bed seedling) (Table 7). Rahman and Quasem (1986) reported that yield of tomato increase of 8 tons per hectare from 40 days old seedling (64.53 t/ha) over 20 and 30 days of seedling.

Different types of pruning showed statistically significant variation in terms of yield per hectare (Appendix VII). The highest yield (50.59 t/ha) was recorded from P_2 (4 stem retention) which was statistically similar (48.63 t/ha) with P_1 as 3 stem retention (Table 7), and the lowest yield (45.64 t/ha) was recorded from P_0 (No pruning).

Interaction effect of ages of seedlings and types of pruning showed statistically significant variation for yield per hectare (Appendix VII). The highest yield (55.86 t/ha) was recorded from A_3P_2 (35 days pot seedling + 4 stem retention) and the lowest yield (40.56 t/ha) was recorded from A_2P_0 (Bud stage seed bed seedling + No pruning) (Table 8).

CHAPTER V
SUMMARY AND CONCLUSION

SUMMARY

The experiment was conducted at the experimental field of Olericulture Division, HRC, BARI, Gazipur during the winter season of 2010-11 and the period from October 2010 to March 2011 to study the effect of seedling age and pruning on growth and yield of brinjal. The experiment consisted of two factors. Factor A: Different ages of seedlings; A_1: Bud stage pot seedling; A_2: Bud stage seed bed seedling; A_3: 35 days pot seedling; A_4: 35 days seed bed seedling and Factor B: Different types of pruning; P_0: No pruning (Control); P_1: 3 stem retention and P_2: 4 stem retention. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. 'BARI Begun-10' was used in this experiment.

Plant height, number of leaves per plant and number of branches per plant was found to increase significantly with the increase of time due to the effect of ages of seedlings. There was different progressive increase of plant at every data recording days from 30 DAT to 70 DAT at 10 days interval. At 70 DAT, the longest plant (85.48 cm) was recorded from A_3, while the shortest (77.79 cm) was recorded from A_2. At 70 DAT, the maximum number of leaves per plant (43.02) was recorded from A_3, while the minimum (31.71) was recorded from A_2. At 70 DAT, the maximum number of branches per plant (31.51) was recorded from A_3, while the minimum (21.40) was recorded from A_2.The maximum days from transplanting to 1st visible flower bud (41.37) was recorded from A_2, whereas the minimum (40.15) was

recorded from A_3. The highest number of flowers per plant (54.56) was recorded from A_3 and the lowest (45.49) was recorded from A_2. The highest number of fruits per plant (40.38) was recorded from A_3, while the lowest (28.29) was recorded from A_2. The maximum length of fruits (22.65 cm) was recorded from A_3 and the minimum (15.16 cm) was recorded from A_2. The maximum diameter of fruits (3.72 cm) was recorded from A_3 and the minimum (2.73 cm) was recorded from A_2. The highest dry matter content in plants (13.74%) was recorded from A_3, whereas the lowest (11.70%) was recorded from A_2. The highest dry matter content in fruits (12.73%) was recorded from A_3 and the lowest (10.77%) was recorded from A_2. The highest weight of individual fruit (82.81 g) was recorded from A_3 whereas the lowest (75.69 g) was recorded from A_2. The highest yield (25.14 kg/plot) was recorded from A_3 and the lowest (21.99 kg/plot) was recorded from A_2. The highest yield (51.30 t/ha) was recorded from A_3 and the lowest (44.87 t/ha) was recorded from A_2.

Types of pruning also had significant effect on plant height and number of leaves at every data recording days from 30 DAT to 70 DAT at 10 days interval. At 70 DAT, the longest plant (84.38 cm) was recorded from P_2, while the shortest (78.50 cm) was recorded from P_0. At 70 DAT, the maximum number of leaves per plant (42.13) was recorded from P_2, while the minimum (35.15) was recorded from P_0. At 70 DAT, the maximum number of branches per plant (31.80) was recorded from P_2, while the minimum (24.05) was recorded from P_0. The maximum days from transplanting to 1st visible flower bud (41.89) was recorded from P_0, while the minimum (39.89) was recorded from P_2. The maximum number of flowers per plant (53.85) was recorded from P_2 and the minimum (47.23) was recorded from P_0. The maximum number of fruits per plant (39.67) was recorded from P_2 while the minimum (29.33) was recorded from P_0. The maximum length of fruits (20.67 cm) was recorded from P_2 and

the minimum (17.80 cm) was recorded from P_0. The maximum diameter of fruits (3.78 cm) was recorded from P_2, while the minimum (2.81 cm) was recorded from P_0. The highest dry matter content in plants (13.57%) was recorded from P_2 and the lowest (12.15%) was recorded from P_0. The highest dry matter content in fruits (12.67%) was recorded from P_2 and the lowest (10.99%) was recorded from P_0. The highest weight of individual fruit (82.05 g) was recorded from P_2 and the lowest (75.89 g) was recorded from P_0. The highest yield (24.79 kg/plot) was recorded from P_2 and the lowest (22.36 kg/plot) was recorded from P_0. The highest yield (50.59 t/ha) was recorded from P_2 and the lowest (45.64 t/ha) was recorded from P_0.

The individual effect of ages of seedlings and types of pruning was reflected on their interaction effect. At 70 DAT, the longest plant (89.86 cm) was recorded from A_3P_2 and the shortest (75.95 cm) was recorded from A_2P_0. At 70 DAT, the maximum number of leaves per plant (48.20) was recorded from A_3P_2 and the minimum (29.87) was recorded from A_2P_0. At 70 DAT, the maximum number of branches per plant (35.87) was recorded from A_3P_2 and the minimum (18.00) was recorded from A_2P_0. The maximum days from transplanting to 1st visible flower bud (43.00) were recorded from A_2P_0 and the minimum (39.33) was recorded from A_3P_2. The maximum number of flowers per plant (58.80) was recorded from A_3P_2 and the minimum (41.27) was recorded from A_2P_0. The maximum number of fruits per plant (47.40) was recorded from A_3P_2 and the minimum (24.40) was recorded from A_2P_0. The maximum length of fruits (24.74 cm) was recorded from A_3P_2 and the minimum (15.06 cm) was recorded from A_2P_0. The maximum diameter of fruits (4.47 cm) was recorded from A_3P_2 and the minimum (2.42 cm) was recorded from A_2P_0. The highest dry matter content in plants (14.74%) was recorded from A_3P_2, while the lowest (11.12%) was recorded from A_2P_0. The highest dry matter content in fruits (14.29%) was recorded

from A_3P_2 and the lowest (10.31%) was recorded from A_2P_0. The highest weight of individual fruit (89.57 g) was recorded from A_3P_2 and the lowest (72.32 g) was recorded from A_2P_0. The highest yield (27.37 kg/plot) was recorded from A_3P_2 and the lowest (19.87 kg/plot) was recorded from A_2P_0. The highest yield (55.86 t/ha) was recorded from A_3P_2 and the lowest (40.56 t/ha) was recorded from A_2P_0.

CONCLUSION

In consideration of yield and yield contributing characters, the treatment 35 days pot seedling with 4 stem retention (A_3P_2) was suitable for brinjal cultivation.

RECOMMENDATION

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

1. Such study is needed in different agro-ecological zones (AEZ) of Bangladesh for regional adaptability;
2. Another ages of seedlings may be included for future study;
3. Another types of pruning may be used for further study.

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APPENDICES

Appendix I. Results of mechanical and chemical analysis of soil of the experimental plot

Mechanical analysis

Constituents	Percent
Sand	32.45
Silt	61.35
Clay	6.10
Textural class	Silty loam

Chemical analysis

Soil properties	Amount
Soil pH	6.15
Organic carbon (%)	1.32
Total nitrogen (%)	0.075
Available P (ppm)	19.5
Exchangeable K (%)	0.2

Appendix II. Monthly record of temperature, relative humidity, rainfall and sunshine of the experimental site during the period from October 2010 to March 2011

Month	*Temperature (°c)		*Relative humidity (%)	*Rain fall (mm) (total)	*Sunshine (hr)
	Maximum	Minimum			
October, 2010	20.2	16.3	77	23	6.8

November, 2010	19.4	15.3	78	00	6.2
December, 2010	22.4	13.5	74	00	6.3
January, 2011	24.5	12.4	68	00	5.7
February, 2011	27.1	16.7	67	30	6.7
March, 2011	31.4	19.6	54	11	8.2

* Monthly average,

Source: Bangladesh Meteorological Department (Climate & weather division) Agargoan, Dhaka - 1212

Appendix III. Analysis of variance of the data on plant height of brinjal as influenced by seedling age and pruning

Source of variation	Degrees of freedom	Mean square				
		Plant height (cm) at				
		30 DAT	40 DAT	50 DAT	60 DAT	70 DAT
Replication	2	0.787	0.870	0.138	0.313	2.038
Seedling age (A)	3	20.517**	45.693**	215.515**	152.908**	91.645**
Pruning (B)	2	33.826**	56.535**	116.721**	96.134**	109.736**
Interaction (A×B)	6	4.139*	6.798*	9.613**	23.458**	18.333*
Error	22	1.691	2.201	2.466	5.543	6.810

** : Significant at 0.01 level of significance; * : Significant at 0.05 level of significance

Appendix IV. Analysis of variance of the data on number of leaves per plant of brinjal as influenced by seedling age and pruning

Source of variation	Degrees of freedom	Mean square				
		Number of leaves per plant at				
		30 DAT	40 DAT	50 DAT	60 DAT	70 DAT
Replication	2	0.029	0.081	0.079	0.588	0.563
Seedling age (A)	3	2.142**	6.697**	16.808**	128.890**	215.877**
Pruning (B)	2	6.180**	18.641**	27.302**	143.601**	146.503**
Interaction (A×B)	6	0.076*	4.113*	1.373*	11.989**	11.189**
Error	22	0.026	0.349	0.625	1.982	2.430

** : Significant at 0.01 level of significance; * : Significant at 0.05 level of significance

Appendix V. Analysis of variance of the data on number of branches per plant of brinjal as influenced by seedling age and pruning

Source of variation	Degrees of freedom	Mean square				
		Number of branches per plant at				
		30 DAT	40 DAT	50 DAT	60 DAT	70 DAT
Replication	2	0.274	0.174	0.913	0.103	0.023
Seedling age (A)	3	1.177**	16.598**	45.738**	56.998**	191.154**
Pruning (B)	2	4.722**	18.411**	59.086**	144.266**	181.290**
Interaction (A×B)	6	1.132**	3.390**	9.863**	3.825*	8.551*
Error	22	0.138	0.646	1.981	1.552	2.746

** : Significant at 0.01 level of significance; * : Significant at 0.05 level of significance

Appendix VI. Analysis of variance of the data on yield contributing characters of brinjal as influenced by seedling age and pruning

Source of variation	Degrees of freedom	Mean square				
		Days from transplanting to 1st visible flower bud	Number of flowers per plant	Number of fruits per plant	Length of fruit (cm)	Diameter of fruits (cm)
Replication	2	0.200	2.314	1.268	0.934	0.002
Seedling age (A)	3	2.443**	142.812**	260.244**	94.400**	1.820**
Pruning (B)	2	14.221**	132.311**	340.884**	25.339**	3.027**
Interaction (A×B)	6	1.379*	16.107*	40.960**	6.327*	0.582**
Error	22	0.430	5.002	7.650	1.820	0.093

** : Significant at 0.01 level of significance; * : Significant at 0.05 level of significance

Appendix VII. Analysis of variance of the data on yield contributing characters and yield of brinjal as influenced by seedling age and pruning

Source of variation	Degrees of freedom	Mean square				
		Dry matter content in plant (%)	Dry matter content in fruit (%)	Weight of Individual fruit (g)	Yield (kg/plot)	Yield (t/ha)
Replication	2	0.381	0.037	3.106	0.520	2.166
Seedling age (A)	3	7.569**	7.118**	78.752**	15.994**	66.612**
Pruning (B)	2	6.654**	8.564**	114.898**	17.945**	74.740**
Interaction (A×B)	6	1.528*	1.871**	56.311**	12.888**	53.678**
Error	22	0.508	0.490	13.115	2.200	9.162

** : Significant at 0.01 level of significance; * : Significant at 0.05 level of significance