YIELD PERFORMANCE OF CUCUMBER (*Cucumis sativus*) AS INFLUENCED BY SEEDLING AGE AND TRAINING

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CERTIFICATE

*This is to certify that the thesis entitled **"YIELD PERFORMANCE OF CUCUMBER (Cucumis sativus)AS INFLUENCED BY SEEDLING AGE AND TRAINING"** submitted to the Department of Horticulture, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (M.S.)** in **HORTICULTURE**, embodies the result of a piece of bonafide research work carried out by* **Mst. Arjuara Sumi**, *Registration No.* ***18-09105*** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

Dated: December, 2020
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DEDICATED TO MY BELOVED PARENTS

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ABSTRACT

An experiment was carried out during the period of April to July 2019 at Horticulture farm of Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh to evaluate the yield performance of cucumber influenced by seedling age and training. The experiment was laid out in the Randomized Complete Block Design with three replications. Treatment as three different age of seedling i.e. S_1=15 days old seedling , S_2= 20 days old seedling, S_3= 25 days old seedling; and four levels of training i.e. T_0=Control, $T_{1=}$ Removal of all branches up to 40 cm height, T_2= Removal of all branches up to 80 cm height and T_3= Removal of all branches up to 120 cm height . 'Baromashi' (local variety) was used in this experiment. In case of seedling age, the maximum number of fruits per plant (17.18), individual fruit weight (174.33 g) and fruit yield (41.63 t/ha) was recorded from S_3 treatment, whereas the lowest was recorded from S_1 treatment. On the other hand, the maximum number of fruits per plant (15.93), individual fruit weight (160.87 g) and fruit yield (35.97 ton/ha) was recorded from T_1 treatment, while the lowest was recorded from T_0 (control) treatment. In case of combined effect S_3T_1 produced the maximum number of fruits per plant (19.45), weight of individual fruit (177.91 g) and the highest yield (47.73 ton/ha), while the lowest were recorded from S_1T_0 treatment combination respectively. The highest net income (73082 TK/ha) and benefit cost ratio (2.58) was noted from S_3T_1 treatment. It may therefore be accomplished that the 25 days old seedling and removal of all branches up to 40 cm height showed more cost-effective than rest of the combinations in cultivation of cucumber.

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LIST OF ABBREVIATED TERMS

ABBREVIATION	FULL NAME
Agril	Agricultural
AVRDC	Asian Vegetable Research and Development centre
AEZ	Agro-Ecological Zone
BBS	Bangladesh Bureau of Statistics
BARI	Bangladesh Agricultural Scientific Research Institute
cv.	Cultivar (s)
cm	Centimeter
CV %	Percent Coefficient of Variation
DAT	Days After Transplanting
DMRT	Duncan's Multiple Range Test
df	Degrees of Freedom
et al.,	And others
RCBD.	Randomized Complete Block Design
etc.	Etcetera
LSD	Least Significant Difference
MoP	Muriate of Potash
°C	Degree Celsius
TSP	Triple Super phosphate
Kg	Kilogram (s)
LSD	Least Significant Difference
m^2	Meter squares
R.H	Relative humidity
SAU	Sher-e-Bangla Agricultural University
^oC	Degree Celceous
%	Percentage

CHAPTER I

INTRODUCTION

Cucumber (*Cucumis sativus*) is a widely grown creeping vine plant that belongs to the gourd family (*Cucurbitaceae).* It belongs to the same family as zucchini, pointed gourd, sweet gourd, and other types of summer squash. Cucumber is a monoecious plant like other vine crops having separate male and female flowers in the same plant. It bears cucumiform fruits which are used as vegetables. Cucumbers, which are members of the cucurbitaceae family, contain large quantities of cucurbitacin, a bitter-tasting biochemical compound. It is mostly cultivated for its little tender fruits. It is mainly popular for salads and relishes. Cucumbers are also consumed as vegetables like other vegetables of the gourd family. The origin of cucumber is in southern Asia, but a great number of cultivars have been introduced and are grown globally. In Western Europe, after the tomato, it is the second most important vegetable crop. Cucumber is a subtropical crop that won't stand frost.

Among different crops, cucumber is a vital vegetable crop of Bangladesh. It contains a good source of nutrients for the human body. It is mostly taken as fresh. According to AVRDC (1999), it is a major source of vitamins and minerals of the human body. Cucumber fruits contain approximately 95% of water. It is rich in valuable nutrients, as well as different plant compounds and antioxidants that may help to avoid some undesirable conditions. Also, cucumbers contain little amount of calories and a good quantity of water and soluble fiber which promotes hydration and aiding in weight loss. Regular consumption of cucumber is beneficial for people who are suffering from high blood pressure, diabetes, and digestion problems. Cucumber is considered to be an excellent vegetable due to its nutrient value. Fifty two gm of peeling cucumber contains 8 calories of food energy, 0.1 g of fat, 1 mg of sodium. 1.9 g of carbohydrates, 0.3 g of fiber, 0.9 g of sugar, 0.3 g of protein, 8.8mcg of vitamin k, 1.5 mg of vitamin c, and 76.4 mg of potassium (USDA, 2019). Cucumber is commonly thought of as a savory vegetable, although it is actually a fruit. It can also be found in some cosmetics.

Usually, in our country, cucumbers are year-round crop. Evaluating with the world production of vegetables, Bangladesh's vegetable productivity is lower than that of other countries. According to (BBS, 2020), the total production of cucumber was 73220 M.ton during the year 2018-2019.

The performance of any crop depends upon several factors such as the excellence of the seed used for sowing, kind of variety, different cultural practices and environmental factors etc. In Bangladesh cucumber is mainly cultivated by direct sowing of seed. Transplantation of cucumber seedlings is not as popular among the farmers. One of the most essential variables in cucumber cultivation is cucumber seedling transfer, which has a significant impact on growth and productivity yet is sometimes disregarded by farmers. Seedling age and training are two crucial cultural activities for increasing cucumber production. The timing of seedling transplantation is critical for successful field establishment and the development of increased yields of high-quality fruits. Early transplanting of young cucumber seedlings reduces the survival rate of plants because during seedling transplanting cucumber root is easily damaged. Different age of cucumber seedlings shows a great effect on the vegetative growth of the plant. Seedling age has a significant impact on the vegetative development of the crop after transplantation, plant resistance, vegetative mass, standard transplant output, and biochemical composition in difficult conditions (Henare and Ravanloo, 2008). Comparing different ages of seedling, growth of the plant, and getting fruit earlier, transplantation of cucumber seedling may be done. Different seedling ages affect a lot not only in vegetative but also in the reproduction period of cucumber. Optimum seedling age helps in early production of cucumber. Older seedlings are more resistant to stress and yield fruits (Vavrina 1998; Orzolek 2004). Cucumber yield could be boosted by determining the optimal seedling age for better plant establishment. (Handley and Hutton, 2003). As a result, the best seedling age is required for better plant establishment and early cucumber production, as well as a greater yield that allows farmers to achieve the best market price.

Training of cucumbers means force or make the plant grow in a certain structure or shape. Training helps remove surfeit growth of plants and manage plants to get the desired shape. Training procedures are important for successful cucumber production because they boost yield, allow for early harvest, and facilitate fruit harvesting in intercultural operations without harming the plants or fruits. Pruning and training, as well as optimal spatial layouts, have been highlighted as critical management techniques for maximizing marketable yields from greenhouse crops (Premalatha *et al*., 2006). Appropriate training practices facilitate intercultural operations and help for utilizing maximum resources. Not only will the training system aid in crop management and supplying uniform sunlight to the plants, but it will also help with close planting, enhanced yield with larger fruits, and the acquisition of high-quality seeds (Lal *et al*., 2014). Training methods has direct effect on the productivity of cucumber (Hebert, 1998). So, appropriate training procedures may aid in enhancing vegetative development and production of cucumber in our country.

By evaluating the importance of age of seedling and training for early production of cucumber, the current experiment was conducted with the express goal of determining the effect of seedling age and training on yield of cucumber.

- ❖ To identify optimum seedling age for transplanting in the main field to get a higher yield of cucumber.
- ❖ To mark out the appropriate training system for a higher yield of cucumber.
- ❖ To determine the best seedling age and training combination for optimal cucumber yield and economic advantage.

CHAPTER II

REVIEW OF LITERATURE

Cucumber is a popular salad and vegetable in both Bangladesh and globally. It can be grown in the summer as well as in winter. Several experiment was conducted in different countries including Bangladesh. Optimum age of seedling play a great role to increase the productivity of cucumber. As well as training of cucumber plants improve plant growth and yield of cucumber. However, in Bangladesh, a small number of studies on various seedling ages and training have been conducted. So, under the headings-, some of the fascinating material and discoveries linked to the influence of altering seedling age and training on cucumber yield performance that have been done in our nation and abroad have been given opinion with other interrelated crops.

2.1. Effect of Seedling age

Saxena and Singh (2019) conducted a ten-treatment study in which transplants began at the age of 18 days and were spaced by three days. The cultivar used in the experiment was California Wonder. The maximum values for the common of the characters, including seedling survival after transplantation (100%), fruit yield per plant (8.09 kg), and harvest duration (85 days), were acquired using 36-day-old transplants, while the minimum values for all of these characters were obtained using 18-day-old transplants. In Uttarakhand's Dehradun region, from 33 to 36-day old seedling produced the best growth and yield of capsicum under open ventilated polyhouse conditions.

During the years 2011 and 2012, Jellani *et al*. (2016) conducted a field experiment to determine the growth and yield of bitter gourd in relation to seedling age. The seedlings that were 40 days old had the shortest days to first picking, the longest availability time, the highest yield, and the highest net profit, while all three seedling ages (40, 50, and 60 days) had a 100% survival rate. In the field, yield and yield components were not significantly different between seedlings of various ages, but all seedlings had higher early yields than the directly sown in the fields. When evaluateing to direct planted crops (US $337.5 ha), seedlings 40 days old had the highest gross margin (US $1777.7 haG1). These studies' findings imply that 40 days may be an appropriate duration.

Jellani *et al*. (2015) examined the effect of seedling age on cucumber crop yield over a two-year period in 2011 and 2012 on the experimental field of the National Agricultural Research Center (NARC), Islamabad, Pakistan. Under enclosed structures, cucumber seedlings were developed in polythene tubes (walk-in tunnels). We contrasting direct sowing in the open field to seedling transplantation at three different ages: 30, 45, and 60 days. When to contrasting direct planting, seedling transplantation produced fruits 22 days before and lasted 41 days longer. Transplanting 45 and 60 day old seedlings resulted in increased cucumber fruit production, gross return, and gross margin. The findings indicated that transplanting seedlings 45 to 60 days after germination is optimal for establishing early fruiting and cucumber production technologies.

Jankauskiene *et al*. (2013) investigated the effect of tomato transplant growth stage on the quality and yield of tomato transplants. Between 2008 and 2010, research was conducted at the Horticulture Institute, Lithuanian Research Centre for Agriculture and Forestry, in a greenhouse. Seedling of Tomato with 9-10 leaves were the most elongated, with the largest leaf area. Plants have 7-8 leaves had the highest photosynthesis pigment content in their leaves and the greatest SLA. Tomatoes implanted with over aged transplants flowered earlier than those with five to six leaves. With 7-8 leaf transplants, a soaring total yield was obtained. The smallest amount of early output was generated by transplanting 5-6 leaves. The stage of growth of tomato transplants had no effect on the average weight of tomato fruits.

Shukla *et al*. (2011) designed and carried out an experiment. During the summer 2008, at the Department Vegetable Science Department, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, at the Vegetable Research Farm. Ten procedures were performed, each lasting three days and beginning at the age of 15 days. The highest values for the majority of parameters, including seedling survival after transplantation (100%), fruits per plant (8.09), yield per plot (7.58 kg), and duration of harvest (85 days), were achieved with 36 day old seedling whereas the lowest rates for all of these characters were obtained with 18-day-old transplants. It was discovered that grafts 33 to 36 days old grew and produced the most effectively.

In two independent trials, Hasandokht *et al*. (2010) evaluated the effect of five ages of transplant and three fruit cutting processes on three fruit on in the early hours harvest of greenhouse cucumber cv. Sultan. The first experiment included four levels of transplant age [two leaves of cotyledonous (A0), one (A1), two (A2), three (A3), and four true leaves (A4)], while the second experiment incorporated three levels of fruit pruning [no pruning of fruit (P0), fruit pruning up to 30 cm (P1), and fruit pruning up to 60 cm (P2) In the first traial revealed that transplants with two cotyledonous leaves and one, two, three, or four true leaves produced 0, 4, 28, 31, and 63 fruits, respectively, during the first ten days of harvest. Four true leaf seedling produced a 15-fold boost in early harvest compared to one true leaf transplant. Four genuine leaves transplants yielded 1.8 times as much as two cotyledonous leaves transplants. The total yields of transplants with two cotyledonous leaves and one, two, three, or four true leaves were 0.716, 0.988, 1.712, 1.228, and 1.308 kg/ha, respectively. The second experiment discovered that unpruned plants produced 1.7 and 74 times more than plants pruned to 30 and 60 cm, respectively, during the first ten days of harvest. Unpruned plants formed 1.47, 1.22, and 1.16 kg/plant, while pruned plants generated 1.47, 1.22, and 1.16 kg/plant, respectively. It is suggested to use four-leaf transplants and to avoid clipping.

According to Sing *et al.,* cucurbits are first and foremost sown by seeds during their regular season of agriculture in India (2010). Seedlings of these vegetables cannot be raised in the conventional nursery system on dirt beds due to their sensitivity to even small root and shoot system injure during uprooting and transplanting. Off-season seedlings were grown in small plastic bags with a 50:50 mixture of soil and compost, despite the fact that this technology requires a large amount of constrained space and is labor consuming. Due to the fact that the crop in the main field consumes a large amount of media during shipping, causes significant root system damage, and is environmentally unfriendly, it is not accepted by Indian growers. However, at the Centre for Protected Cultivation Technology of the Indian Agricultural Research Institute in New Delhi. Seedlings of major cucurbits are raised in multi-celled plastic plug trays with each cell containing 18-20 cc and shaped like an inverted pyramid, using a 3:1:1 ratio of coco-peat, vermiculite, and perlite as soilfree media. This technique is not only effective at promoting rapid root development, but also at minimizing damage to seedling roots and shoots during transplantation. This method is cost-effective and advantageous for cucurbit farmers in India's northern plains, as it enables farmers to grow as many seedlings as necessary for off-season cultivation of cucurbits) in order to obtain a premium price for their produce

During the summer of 2008-09, Shukla *et al*. (2009) conducted an experiment at the Dr. Y. S. Parmar University of Horticulture and Forestry's Vegetable Research Farm in Nauni, Solan, Himachal Pradesh, with the objective of determining the optimal age of capsicum transplants for growth and yield. It was determined that 33-36 day old (middle aged) capsicum transplants produced the highest fruit and seed yield in Himachal Pradesh's mid-hill regions.

Jankauskiene and Brazaityte (2005) conducted a greenhouse experiment to determine the effect of seedling age on cucumber (cv. Mandy) yield (0. 15, 25, 30 days old seedling). Thirty-day-old seedlings were 4.2-fold larger than 15-day-old seedlings, with greater leaf area assimilation (by an 8-fold factor) and fresh fruit weight assimilation (by 7.4-fold). On the other hand, 25-day-old seedlings were the most suitable in terms of fresh weight. Carotenoids were found to be more abundant in seedlings 20 days or older. 15-day-old plants grew at the fastest rate (64-68 cm per week). Yields of 20- and 25-day-old seedlings were significantly higher (by 22.2-24.8 percent) than yields of 15 and 30-day-old seedlings (by 12.5-14.9 percent). Seedlings that were 30 days old produced the most early (1.95 kg/m2). The highest fruit production per plant (48.7) was observed in 25-day-old seedlings, while the lowest fruit production was observed in 15-day-old seedlings (39.1). Individual fruits weighing 60.95 g were observed on 15-day-old seedlings, while those on 20- and 25-day-old seedlings weighed the most (68.7 and 67.9 g).

Naz *et al*. (2005) investigated the effect of different transplant ages on the growth of the chilli F1 hybrid Sky Line2 between 2004 and 2005. The proportion of humans per plant and the root dry weight per plant were unaffected by transplant age. The transplantation age had an effect on the height of the plants at initial flowering and maturity, the number of days required to flowering, the number of leaves and branches per plant at middle age, the unsullied and dry weight of foliage per plant, and the fresh root weight. In fifty-day-old seedlings, plant height, branch number, leaf number per plant, fresh and dehydrated weight of foliage, and fresh weight of root per plant all increased significantly.

Bucan *et al*. (2005) conducted a three-year study in Dalmatia to determine the effect of transplant age and type on the growth and yield of seed-propagated globe artichoke cv. Talpiot. The transplants used in the trial were 81, 68, and 51 days old, and all were grown in 200 cm3 pots. In the other experiment, which examined transplant types, treatments included bare root plants and transplants grown in 200 cm3 and 300 cm3 pots. Distinct transplant ages had no effect on standard yield or head weight, except during one growing season when plants developed from 68-day-old transplants produced more than plants developed from 51-day-old transplants.

Babik (2000) conducted a study in which Broccoli cv. Cruiser F (RS) seeds were sown every ten days for transplantation at ages 20, 30, 40, and 50 days. The time of head formation has an effect on the production and average weight of broccoli's center head. Due to the high air temperatures, earliness occurred, resulting in a decrease in yield and average weight of head. The transplant age and plant-raising strategy had an effect on broccoli ripeness. The earliest, but lowest yielding, transplants were those that were 50 days old and grown on a seedbed and in large cell size trays (90 cm3). Harvest was delayed by 30 or 20 days of shorter growing periods, while yield and head weight were inflated. A 20-day growth time on a seedbed was insufficient for the development of strong transplants.

NeSmith (1993) described an experiment on summer squash 2 cultivars in which summer squash transplants aged 10 to 30 days (approximately 1.4 to 4.3 weeks) were planted in the field. There were a few differences discovered between cultivars. The seedling's age had an effect on growth and establishment in general, but had no effect on total yields. The transplantation age had no effect on early yield. The researcher also addressed the issue of eradicating young transplants from cells. A seedling that was 21 days old was recommended because it could be kept for an additional 10 days without affecting yields if it could not be planted immediately.

Vavrina and Orzolet (1993) performed a greenhouse experiment using data from a 60-year study of tomato transplant age. They discovered that production is significantly influenced by cultivar, environment, and management practices. As a result, yields for transplants aged two to thirteen weeks are comparable. The older transplants produced higher initial yields. Despite the fact that a 2-week-old transplant produces season-greater yields comparable to those of a 13-week-old transplant, extracting a young seedling from its cell can be challenging due to the root system being insufficiently extensive to grasp the container soil.

Weston (1988) evaluated the fruit productivity of Yolo Wonder L pepper (Capsicum annuum L) transplants grown in two locations (Florida and Kentucky) and five cell sizes in Kentucky. In both locations, transplants grown in large cells produced higher early yields than transplants grown in small cells, but not higher total yields. Transplants grown in speedling cells with a volume of 175 (39.5 cm3) had greater height, leaf area, and dry weight at field establishment, as well as higher early fruit yields, than those grown in minor cells. Transplants grown in Kentucky speedling trays but fertilized differently than those grown in Florida produced significantly higher early and total yields than Florida speedling transplants. Sixty-day-old seedlings produced significantly more early yields than seedlings transplanted at 30, 40, or 50 days.

McCraw and Greig (1986) conducted field trials on 11- and 8-week-old seedling of four variety.The flowers and fruit of the 11-week-old transplants were either left on the plant or strained off. To stimulate growth, 8-week-old plants were either left alone or had their growing tip detached. In the first year of the two-year study, none of the treatments increased yield. In the second year, 11-week-old transplants with pinched flowers and fruit produced the highest early yield, but yields from 8-week-old transplants with the growth tip pinched produced the largest fruit. The conclusion was that 11-week-old transplants produce more but minor fruit than 8-week-old transplants, regardless of whether pinching was used.

2.2. Effect of Training

Haque *et al.* (2019) conducted a field experiment to investigate the effects of spacing and training on sweet pepper growth and productivity. Three distinct spacings were used in the study: S1: 45× 30 cm, S2: 45 ×45 cm, and S3: 45× 60 cm, as well as three distinct training levels: P1: 2 shoots, P2: 3 shoots, and P3: 4 shoots plant-1. With increased spacing, leaf area, number of fruits plant-1, fruit breadth, and yield plant-1, yield per plot and yield per hectare decreased significantly in comparison to days to first blossom. 45-60 cm spacing resulted in the highest number of fruits per plant (15.00) and yield per plant (1.26 kg). On the other hand, the maximum yields per per plot and per hectare (11.12 kg and 20.90 ton, respectively) were determined using a 45

30 cm spacing. The number of shoots per plant had an effect on plant height at last harvest, days to first blossom, number of fruits per plant, and yield per ha. The plant with the most shoots (4.00) produced the most fruits per plant (15.00), the highest yield per plant (1.25 kg), the highest yield per plot (1.39 kg), and the highest yield per hectare (21.41 t). A 45 x 45 cm spacing between plants and four shoots per plant resulted in the highest yield per plant (1.37 kg) and yield per hectare (22.00 ton). As a result, it was determined that capsicum planted at a middle spacing (45 45 cm) with four shoots per plant grew and produced the best.

Kumar *et al*. (2018) discovered that proper nutrient proportioning and plant manipulation are critical determinants of greenhouse cucumber output. Between 2013 and 2015, a study involving four different levels of fertilizer and three different training systems was conducted in factorial arrangements to optimize nutrient dose and training system in greenhouse cucumber. Greenhouse cucumbers responded admirably to increased fertigation levels, exhibiting not only the earliest flowering and, consequently, the earliest harvest, but also incredible vegetative development. Cucumber plants grown in greenhouses that were taught to use a single stem system also performed well. Additionally, increased fertigation resulted in higher fiber content fruits and had a significant effect on yield components such as fruit length and diameter. The effect of sensory rating on acceptability of such fruits was determined by a diverse panel of assessors, demonstrating its importance for rapid field application. The yield of greenhouse cucumbers was significantly influenced by the number of fruits per plant, which was influenced by fertigation and training system interactions. After three months of crop duration, plants that received a higher level of fertigation and were taught to use a single stem system produced a higher yield per unit area, resulting in a good net return of Rs. 83724. Additionally, a greater economic benefit could be realized by utilizing the government's 65 percent and 75 percent subsidy programs, which are determined by the farmers' socioeconomic status.

Sharma and Kumari (2018) examined the effect of different spacing and training levels on hybrid cucumber growth and yield in polyhouse environments. The experiment included 18 treatment combinations involving two hybrids, Kian and Isetis, three different spacing levels (S1), 6045 cm (S2), and 6060 cm (S3), and three different training levels (T1 (removal of one shoot), T2 (removal of two shoots), and T3 (removal of three shoots) (removal of three shoots). With the highest net returns (28940.5 rupees) and benefit:cost ratio, In terms of vine length (261 cm), fruit number (26.8), fruit length (17.8 cm), fruit weight (173.53 g), harvest duration, and fruit yield per plant (3.68 kg), Hybrid Isetis outperformed Kian (2.34). S3 spacing was the best in terms of vegetative and yield contributing factors. S3 had longer fruits (17.0 cm), wider fruits (6.2 cm), heavier fruits (187.51 g), more fruits per vine (27.2), higher total soluble solids (30brix), and higher fruit yield per plant (3.97 kg), as well as a shorter time required to initiate the first female flower (14.17 days), a nodal position for the first female flower (14.17 days), and a shorter time required to harvest the first female bloom (14.17 days) (33.9). In terms of fruit length (16.7 cm), fruit breadth (6.0 cm), and fruit weight, T1 outperformed the other training regimens (179.95 g). S3T3 was the treatment combination that resulted in the highest total yield per vine (4.96 kg). The hybrid Isetis therapy with S1T3 demonstrated the highest net return and ratio of benefit cost.

In a polyhouse, Kapuriya *et al*. (2017) investigated the effect of different spacing and training methods on cucumber growth and yield. The experiment was conducted using a completely randomized three-replication factorial design (CRD). The experiment incorporated twelve treatment combinations with four level of spacing (S1), 4530 cm (S2), 4545 cm (S3), and 4560 cm (S4), as well as three different training levels (T1 (complete removal of all branches up to 45 cm stem height), T2 (up to 90 cm stem height), and T3 (up to 120 cm stem height) (up to 135 cm stem height). S4 spacing had the best vegetative and yield-contributing characteristics. S4 had the highest fruit yield per vine (40.19), fruit weight (119.69 g), and fruit number per vine (40.19). (4.74 kg). T1 had the most fruits per vine (38.17), the largest fruit weight (118.04 g), and the highest yield per m2 of all the training treatments (17.71 kg). S4T3 produced the highest overall yield per vine (4.97 kg) (45x60 cm and up to 135 cm stem height). S1T1 had the uppermost net return (41405.2 rupees per 1000 square meters) and benefit-cost ratio .

During the summers of 2014 and 2015, Rajalingam and Saraswathi (2017) conducted a trial to develop an appropriate cucumber training system in the college orchard at HC&RI, Coimbatore, in a naturally ventilated poly house. Drape system (in which the apical meristem is not destroyed and the plant is draped at an 8-foot height over the top cable wire) was one of four treatments. Allowing only two lateral shoots from the basal two nodes (@ 1 per node and the plant is draped over the top cable wire at 8 feet height), the pinch system (the apical meristem is removed at 8 feet height and a lateral shoot is trained over the cable wire at 8 feet height and back down to the floor), and the control which included. The arithmetical design was an RBD with five replications. In a pooled analysis of two seasons, the drape system had significantly higher values for number of flowers per plant, percentage of fruit set, fruit weight, fruit length, fruit diameter, number of fruits per plant, total number of harvests, fruit yield per plant (13.15 kg), fruit yield per m^2 (19.94 kg), probable yield per ha (199.4 ton), and B:C ratio. Internodal length, number of days required for first flowering, and number of days required for first harvest (41.27) were all significantly shorter than control. Although this treatment had the highest TSS (3.32%) and ascorbic acid (3.18 mg per 100 g), no significant changes were observed.

Dhilion *et al*. (2017) investigated the effect of various training methods on the vegetative growth parameters and yield of cucumber grown in protected culture. The experiment employs seven separate training strategies. Days until 50% flowering, days until first harvest, fruit weight (g), fruit number per plant, fruit yield per plant (kg), duration of harvest (days), inter-nodal length (cm), and vine length were all recorded (m). The treatment with a single stem (T1) produced the shortest days to 50% flowering (23.67), the shortest days to first harvesting (35.00 days), the highest weight of fruit (136.23 g), the shortest duration of harvest (56.00 days), the shortest vine length (2.26 m), and the shortest inter nodal length (9.34 cm), whereas the treatment with three stems and side shoot training after three leaves (T6) produced the shortest days to 50% flowering (23.67), (T5). According to the findings, plants trained to a single stem exhibited superior vegetative characteristics, whereas plants trained to three stems with side shoot training after three leaves produced more yield/m2 area.

Lal *et al*. (2014) conducted a study in Kharif 2012 using the cultivar Solan Bharpur to determine the optimal planting density and training strategy for seed production of bell pepper, Capsicum annuum L, under protected conditions. Three planting densities S 1 (45 x 15 cm), S 2 (45 x 30 cm), and S 3 (45 x 45 cm), were used, as well as four training systems (T), T 1 (single shoot), T 2 (two shoots), T 3 (three shoots), and T 4 (four shoots). The following data were collected in the field: plant height (cm), days until harvesting of ripe fruit, weight of ripe fruit weight (g), total number of ripe fruits/plant, ripe fruit yield/plant (kg), number of seeds per fruit, seed yield per plant (g), seed yield/m2 (g), and seed yield/ha (kg). Analysis of variance exposed that the combination S2T2 outperformed all other treatments in terms of total fruit yield per plant and seed yield (per plant, per m^2 and per hectare).

Between 2009–10 and 2010–11, Kumar and Chandra (2014) conducted an experiment at the polyhouse unit of the Department of Horticulture at Tirhut College of Agriculture in Dholi, Muzaffarpur, Bihar, to determine the effect of spacing and shoot number on the growth and yield of the capsicum variety Indira. Three spacing levels were used: 45 x 30 cm, 45 x 45 cm, and 45 x 60 cm, as well as three shoots per plant levels of two, three, and four. Although spacing S1 resulted in significantly greater plant height (147.21 cm) than the other spacings, spacing S3 resulted in significantly greater leaf number (105.67), total number of flower per plant (13.03), and fruit number per plant (9.65), but the highest fruit yield (71.39t/ha) was recorded under spacing S1 (45 x 30 cm). Two shoots per plant resulted in a significantly increased plant height (144.36 cm) and leaf count (116.25), but four shoots per plant resulted in a significantly increased number of flowers per plant (13.04), fruit per plant (9.30), and fruit yield (65.35t/ha). For general farmers, growing capsicum cv. Indira in a polyhouse with a narrower S1 spacing (45 x 30 cm) and training level (four shoots per plant) will be more advantageous.

Bakkerand and Van de vooren (1985) conducted a greenhouse cucumber experiment to determine appropriate plant densities and training methods. The effect of plant densities ranging from 0.7 to 3.1 plants m^2 on output and mean fruit weight was investigated. To train the plants, either the umbrella system (V-system) or cordons were used. There are data on early, late, and final production, as well as average fruit weight. There were significant variation in yield and average fruit weight between the two training systems.

CHAPTER III

MATERIALS AND MATHODS

From April to August 2019, the experiment was carried out to determine the effect of seedling age and training on cucumber yield. This chapter discusses the critical information needed to carry out the experiment**.**

3.1 The experimental location's description

3.1.1 Period of experimentation

The experiment took place between April and August 2019.

3.1.2 Experimental site

The experiment was conducted at the Horticulture farm of Sher-e-Bangla Agricultural University in Dhaka. Between April and August of this year, the experiment was conducted. The site is 8.2 meters above sea level and is located at 23°74" north latitude, 90°35" east longitude (Anon, 1989).

3.1.3 Soil characteristics

Tejgaon, Zone, Madhupur Tract is the soil type found in the experimental field (AEZ-28). Before the experiment began, a composite sample was taken by collecting soil at a depth of 0-15 cm from numerous locations throughout the field. The soil was air-dried, crushed, and filtered through a 2 mm sieve before being analyzed for a variety of physical and chemical properties at the Soil Resources Development Institute (SRDI), Khamarbari, Farmgate, Dhaka. The soil texture was silty clay with a pH range of 5.47–5.63 and a 0.83 percent organic matter content. The soil test report is included in Appendix III.

3.1.4 Climatic condition

The experimental site is in a subtropical region with a climate determined by abundant rainfall from April to September (Kharif season) and insufficient rainfall for the rest of the month (winter). The Bangladesh Meteorological Department's Climate Division collected and made available data on various parameters such as highest and lowest temperatures, humidity, rainfall, and soil temperature throughout the study period (Appendix-II).

3.2 Planting materials

As test crops, cucumber seeds from the local variety 'Baromashi' were used. LalTeer Seed Company in Siddique Bazar, Gulistan, Dhaka provided the seeds.

3.3 Treatments of the experiment

The purpose of the experiment was to determine the effect of seedling age and training on cucumber yield performance. The experiment is divided into two sections:

Factor A: Seedling age(Three types)

S_1 = 15 days old seedling

S_2 = 20 days old seedling

S_3= 25 days old seedling

Factor B: Training (Four types)

T_0= Control

T_1 = Removal of all branches up to 40 cm

T_2 = Removal of all branches up to 80 cm

T_3 = Removal of all branches up to 120 cm

There are 12 treatment combinations such as S_1T_0, S_1T_1, S_1T_2, S_1T_3, S_2T_0, S_2T_1, S_2T_2, S_2T_3, S_3T_0, S_3T_1, S_3T_2, S_3T_3

3.4 Design and layout of experiments

The experiment was replicated three times using a Randomized Complete Block Design (RCBD). Three blocks of 30.3m×8.4m each were created. The experimental plot covered a total area of 241.92m^2. Each block consisted of twelve plots. The first block was designated as the first replication (R_1), while the second and third blocks were designated as the second replication (R_2) and third replication, respectively (R_3). Each replication consisted of twelve plots. At each replication, twelve treatments were assigned randomly. Each plot was 2.4m ×1.8m in size. The space between plants is 60 ×60cm. There was a 30 cm distance from the plot's border. Two blocks and two plots were separated by 0.75 m and 0.5 m, respectively. There are a total of 36 plots. The experimental field is depicted in Fig. 1.

3.5 Growing of crops

3.5.1 Raising of seedlings

On April 23, 2019, seeds were immediately seeded in polyethylene bags with an equivalent amount of well-decomposed cowdung, sand, and soil. Watering was done on a regular basis to provide moist conditions for good seed germination. Two holes are located on the lower edge of the polythene bag for improved water drainage. Each polybag contained four seeds. The poly bags were stored in a cool environment. During the seedling-raising period, they were watered often. Complete germination of the seeds took about 4-5 days. Only one seedling was permitted to develop in each polybag after 6 days of emergence. Proper precautions were taken to protect the seedlings from insect and disease attacks.

3.5.2 Preparation of land and pits

On 18th April, 20019, the land was first opened with the assistance of a power tiller. Later, tractor plowing was used to prepare the land, followed by harrowing and alternate laddering up the slope to achieve a fine tilth. Weeds, stubbles, and crop residues were removed from the field. The field was laid out on 23rd April 2019. Finally, on 26th April 2019, individual plots were prepared using a spade in accordance with the experimental design. Drains were constructed around each plot and excavated soil was used to elevate the plots to approximately 5 cm above the soil surface.

3.5.3 Application of fertilizer

Nitrogen, phosphorous, potassium, gypsum, sulphur, zinc, and boron were obtained using the necessary amounts of urea, triple superphosphate (TSP), muriate of potash (MP), gypsum, zinc sulphate, and boric acid. Cowdung, urea, triple superphosphate, potash muriate (MP), gypsum, zinc sulphate, and boric acid were treated at rates of

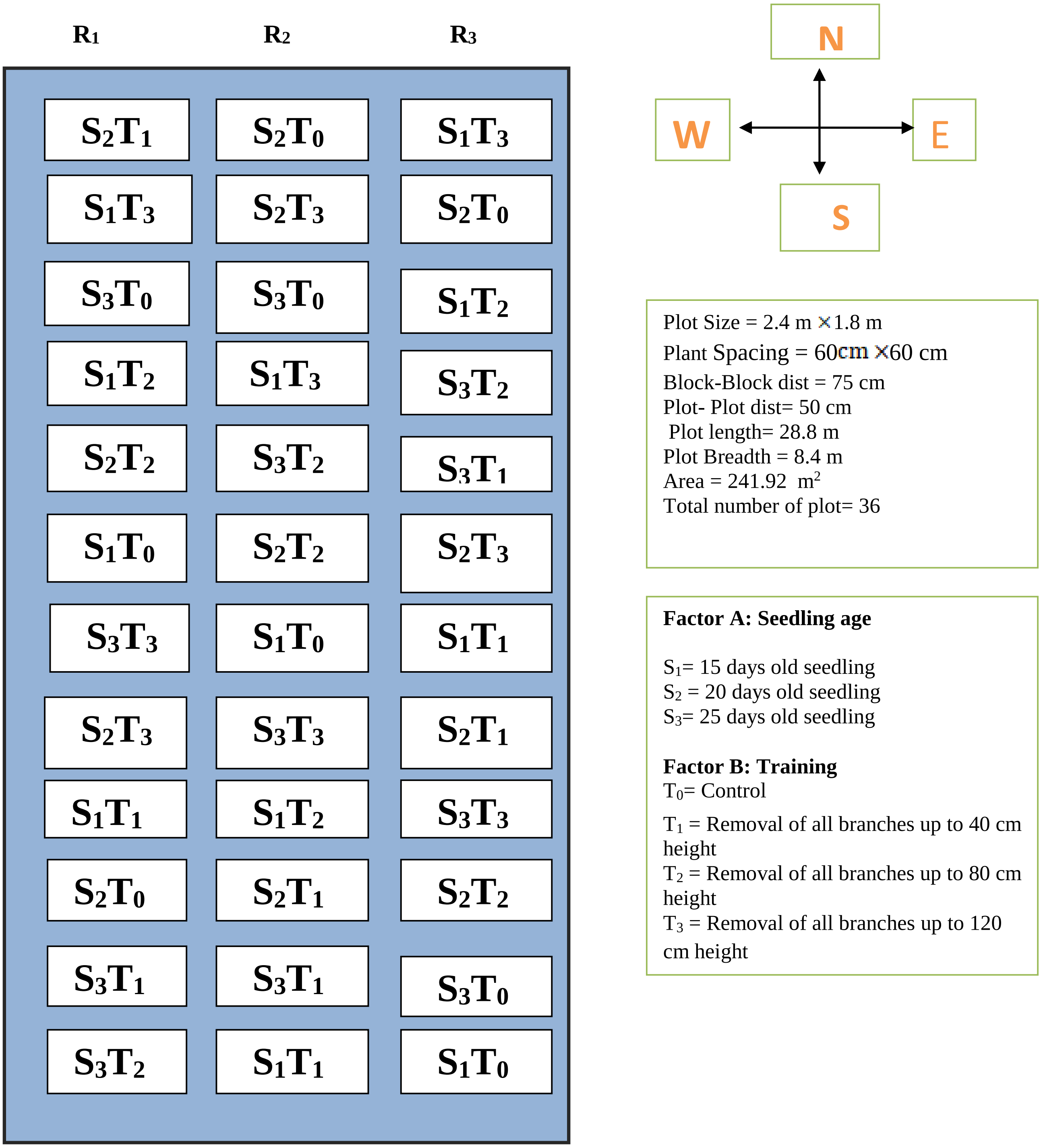


Fig. 1. The field layout of the cucumber experimental plot in the Randomized Complete Block Design.

10,000, 173, 160, 130, 10, 126, 8.0, and 9.0 kg/ha, respectively. Adhering to the Fertilizer Recommendation Guide (2012). Recommended doses of Cowdung, Urea, TSP,MoP, gypsum, zinc sulphate, and boric acid were applied in the experimental plot. During the final land preparation, a total amount of cowdung was applied.

Fertilizer	Doses plot-1
Cowdung	324g
Urea	56g
TSP	51.84
MoP	42g
Zypsum	40.82g
Zinc Sulphate	2.5g
Boric Acid	2.9g

During pit preparation, the entire amount of TSP, gypsum, zinc oxide, boric acid, and one-third of urea and MoP were applied. After seedling transplantation, Urea and MoP were administered in two equal installments.

3.5.4 Transplanting of seedling

Cucumber seedlings that were healthy and uniform were transplanted in the pits of each plot of the experimental field after 15 days of germination, 20 days of germination and 25 days of germination respectively according to the treatment. At the time of transplanting, polyethylene bag was cut and removed carefully so that the soil keep intact with the root of the seedling. Following transplantation, the seedlings were watered daily for several days to aid in their establishment.

3.6 Application of training treatment

Side branches on the main stem were removed according to treatments. When the branches were visible from the main stem and it became 2-3 cm long then that was removed. The training was done according to the treatments of the experiment. In the case of T_1 treatment removed all branches up to 40 cm of plant height. In T_2 and T_3, treatment removed all branches up to 80 and 120 cm of plant height.

3.7 Intercultural Operations

3.7.1 Weeding

Weeding was performed as needed to keep the crop weed-free.

3.7.2. Gap filling

Seedlings that had been injured or were fragile were replaced with new vigor seedlings from the experiment's stock.

3.7.3 Staking

Staking was applied to each plant once the seedlings were established. The bamboo stick was given to support the growing vine.

3.7.4 Trellis

Six bamboo poles, each 5 feet tall, were slantingly placed in each plot from the ground level. In order to create the opposite "V" shape, the poles were securely attached to one another by wire. On the iron rope, a net made of a rope was hung. Trellis was built for each plot to creep the vines of the crops.

3.7.5 Vine management

The delicate vines that are falling from the supports may be harmed by bad weather (Trellis). To ensure the plants' optimal growth and development, the vines were directed upward with the aid of a hand. As a result, the plants' expanding vines and fruit were unaffected by the poor environmental conditions.

3.7.6 Irrigation

The experiment was done in the summer season. So, irrigation was given when it was required. Sometimes adequate water came from rain then irrigation was no longer needed. irrigation was supplied through the drains of the plots. Proper drainage facilities were made surrounding the experimental plots for drainage of excess water

3.7.8 Plant protection

The cucumber is a very sensitive plant to several types of insect pests and diseases. So, Plant protection measures have been implemented. To protect the plant from insect pests such as beetles, fruit flies, and fruit borer, Melathion 57 EC and Ripcord were administered at a rate of 2 ml/l as needed. Insecticides were applied every two weeks from seedling transplantation to a week before the first harvest. Spraying was used to defend against viral diseases such as cucumber mosaic during cloudy and hot weather. Furadan 5 G was also treated at a rate of 6 g/pit during pit preparation as a soil pesticide.

3.8 Harvesting

When the green fruits were in marketable condition then they were harvested. Fruits were harvested at an immature stage, near full size and before full maturity. Skin color is also another widely used for harvesting cucumber. Harvesting of fruit continued until the fruits reached a marketable size.

3.9 Data collection

3.9.1 Plant height (cm)

At harvest, the plants' heights were measured in cm. Four plants from each treatment were measured using a meter scale from the ground to the tip of the main stem, and the average value was recorded.

3.9.2 Number of branches per plant

The number of branches on selected sample plants was counted during the harvesting process, and the average number of branches per plant was computed.

3.9.3 Days required to first flowering

We documented the number of days required for the emergence of the first female and male flowers and calculated a mean value.

3.9.4 Number of male flower plant^{-1}

Three days after the first male flower bloom appeared, the total number of female blossoms on each plant was counted. We counted the total number of male flowers on four plants from each treatment and calculated the mean value.

3.9.5 Number of female flower plant^{-1}

Following the development of the first female flower, female flowers were counted per plant in each plot, and data were gathered at three-day intervals. Female flowers from four plants in each treatment were counted in total and a mean value was determined.

3.9.6 Days required to first fruit harvest

This information was gathered at each plant's and plot's initial fruit harvest. The number of days between seedling emergence and the first harvest was calculated.

3.9. 7 Number of fruits per plant

From the first to the last harvest, fruits were counted. We tallied the total number of fruits produced by each plant and determined an average fruit yield.

3.9.8 Fruit length (cm)

Individual fruit lengths were measured during harvesting using a meter scale on five randomly picked fruits, and the average value of individual fruit lengths was recorded and reported in centimeters (cm).

3.9.9 Fruit diameter (cm)

At the time of fruit harvest, the diameter of each fruit was measured using slide calipers on individual plants, and the mean value was calculated. The diameter of the fruit was measured in centiimeters (cm).

3.9.10 Individual fruit weight (g)

Individual fruits were weighed in grams (g) and converted individually using a digital weight machine.

3.9.11 Fruit yield/plant (kg)

The fruit yield per plant was determined by multiplying the weight of each fruit by the plant's fruit production. It is measured in kilograms (kg).

3.9.12 Fruit yield/plot (kg)

All fruits harvested from a plot were collected, the weight of all collected fruits was added, and the average value in kilograms was calculated.

3.9.13 Fruit yield/ hectare(ton)

The cucumber fruit yield per hectare was determined by converting the weight of plot produce to the hectare and calculating in tons.

3 .10 Statistical analysis

Statistic 10 software was used to analyze the recorded data on various parameters. The least significant difference (LSD) test was used to examine the significance of the difference in averages between treatments at the 5% level of probability.

3.11 Economic analysis

The most cost-effective combination of seedling age and training was used to calculate the production cost. The computation included all input costs, such as cost of land lease and interest on operating capital. Simple interest was calculated at a rate of 12%. The market price of cucumber was utilized to calculate the return. Analyses were undertaken in accordance with the procedure described by Alam *et al*. (1989).

3.11.1 Analysis for the total cost of production of cucumber

The entire cost of production was determined by factoring in all material and non-material input expenses, interest on the land's fixed capital, and other charges. The report includes the entire cost of production (input and overhead costs), gross profit, net profit, and BCR (benefit-cost ratio) (Appendix X)

3.11.2 Gross income

The gross revenue was determined by the selling of fruit. The fruit was projected to cost Tk.25tk/kg at the time of harvesting, based on the current market value in Dhaka's Kawran Bazar.

3.11.3 Net return

The net return on each treatment combination was determined by subtracting the entire cost of production from the gross income. Net return equals a gross return on a hectare (Tk.) - total cost of production on a hectare (Tk.)

3.11.4 Benefit-cost ratio (BCR) :

The following formula was used to determine the benefit-cost ratio (BCR): The benefit-cost ratio (BCR) equals the gross return per hectare (Tk.) divided by the total cost of production per hectare (Tk.)

CHAPTER IV
RESULTS AND DISCUSSION

The purpose of this experiment was to evaluate how seedling age and training affect cucumber yield performance. We collected data on many growth and other parameters, yield qualities, and yield. The Appendix section contains analyses of variance (ANOVA) of the data for several parameters (IV-IX). The findings are presented graphically and in tables, and possible interpretations are given under the following headings:

4.1 Plant Height (cm)

The height of the plants was measured solely during final harvesting time. Cucumber plant height varied substantially owing to seedling ages (Table 1, Appendix IV). At harvest, the S_3 (25 days old seedling) treatment resulted in the maximum plant height (244.59 cm), while the S_1 (15 days old seedling) treatment resulted in the lowest plant height (227.97cm). According to the data, the seedling that was 25 days old grew the longest plant. In our country, cucumbers are primarily grown via direct seeding. However, if seedling transplantation is possible, it will alter cucumber development and yield, but this element is often neglected by farmers. Jankauskiene and Brazaityte (2005), Sing *et al*. (2010), and Sahar *et al.* (2005) all observed comparable results in their earlier experiments.

The maximum plant height (242.24 cm) was recorded from the T_3 (removal of all branches up to 120 cm) treatment. While the T_0 (control) treatment produced the shortest plant (226.98 cm) (Table 2). Cucumber training promotes development and increases fruiting area. A suitable training system will enable more effective management and uniform lighting of the plants. According to Kapuriya *et al.* (2017), effective training increases cucumber's vegetative development.

The combined influence of seedling age and training on plant height is significant (Table 3, Appendix IV). The maximum height of a plant (250.89 cm) was recorded from the treatment combination of S_3T_3 (25 days old seedling and removal of all branches up to 120 cm height) and the minimum (220.24 cm) in the treatment combination of S_1T_0 (15 days old seedling and control) which is statistically identical to S_2T_0 treatment combination.

4.2 Number of branches per plant

Because of the varying seedling ages, there was a significant variation in the number of cucumber branches per plant (Table 1, Appendix IV). Data was collected while cucumbers were being picked. At harvest, the S_3 (25 days old seedling) treatment had the highest number of branches per plant (13.82), while the S_1 (15 days old seedling) treatment had the lowest number of branches per plant (11.81).

Table 1. Effect of seedling age on plant height and number of branch per plant of cucumber

Treatment	Plant height At last harvest(cm)	Number of Branch per plant last At harvest
S_1	227.97 c	11.81 c
S_2	234.07 b	12.90 b
S_3	244.59 a	13.82 a
LSD(0.05)	2.0046	0.2357
CV%	1.01	2.17

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability Here,S_1= 15 days old seedling S_2= 20 days 0ld seedling S_3= 25 days old seedling

Table 2. Effect of training on plant height and number of branch per plant of cucumber

Treatment	Plant height At last harvest(cm)	Number of branch per plant At harvest
T_0	226.98 d	11.61 d
T_1	235.15 c	13.67 a
T_2	237.79 b	13.23 b
T_3	242.24 a	12.86 c
LSD(0.05)	2.3147	0.2722
CV%	1.01	2.17

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability Here, T_0= Control , T_1= Removal of all branches up to 40 cm height T_2= Removal of all branches up to 80 cm height and T_3= Removal of all branches up to 120 cm height

Due to the different levels of training, a significant effect on the number of cucumber branches per plant was observed (Table 2, Appendix IV). At harvest, the T_1 treatment (removal of all branches up to 40 cm height) resulted in the maximum number of branches per plant (13.67). While the T_0 (control) treatment had the fewest branches per plant (11.61). Training assists in minimizing branch overcrowding in a single location. It is demonstrated that T_1 (Removal of all branches up to 40 cm in height) significantly increased the number of branches among different training systems. Kapuriya *et al*. (2017) also reported similar findings in an earlier experiment.

The combined effect of seedling age and training resulted in a statistically significant variation in the number of branches per cucumber plant (Table 3, Appendix IV). The highest number of branches per plant (14.90) was observed with the S_3T_1 (25 days old seedling and branch removal up to 40 cm height) treatment combination, while the lowest number of branches per plant (10.81) was observed with the S_1T_0 (15 days old seedling and control) treatment combination.

Table 3.Combined effect of seedling age and training on plant height and number of branches per plant of cucumber

Treatment combination	Plant height(cm) At last harvest	Number of branch /plant at last harvest
S_1T_0	220.24 h	10.81 h
S_1T_1	226.72 g	12.72 de
S_1T_2	231.16 f	12.21f
S_1T_3	233.76 ef	11.51 g
S_2T_0	222.06 h	11.74 g
S_2T_1	235.94 de	13.40 c
S_2T_2	236.18 de	13.36 c
S_2T_3	242.09 bc	13.08cd
S_3T_0	238.65 cd	12.28 ef
S_3T_1	242.79 b	14.90 a
S_3T_2	246.03 b	14.13 b
S_3T_3	250.89 a	13.98 b
LSD(0.05)	4.0092	0.4714
CV%	1.01	2.17

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability Here,S_1= 15 days old seedling S_2= 20 days 0ld seedling S_3= 25 dayold seedling Where, T_0= Control , T_1= Removal of all branches up to 40 cm height T_2= Removal of all branches up to 80 cm height and T_3= Removal of all branches up to 120 cm height

4.3 Days required to 1st flowering

Days required for first flowering varied significantly with seedling age (Table 4 and Appendix V). The S_3 (25 days old seedling) treatment required the fewest (28.31) days for first flowering, while S_1 (15 days old seedling) treatment required the highest (31.79) days for first flowering. It can be concluded that later transplants reproduce more rapidly than earlier transplants. Vavrina (1998), Jellani *et al*. (2016) discovered a similar trend in their findings. Orzolek (2004) stated in an experiment that older seedlings develop reproductive phase faster than vegetative phase.

The number of days required to initiate the first flowering of cucumber was positively correlated with the application of different types of training (Table 5, Appendix V). The T_1 (removal of all branches up to 40 cm height) treatment required the fewest (28.70) days for first flowering, while T_0 (Control) treatment required the most (31.36) days for first flowering Training levels had a significant impact on it. Lal *et al*. (2014) and Kapuriya *et al.* (2017) discovered a similar trend in their findings.

Significant variation in the number of days required to reach first flowering was observed as a result of the combined effect of seedling age and training. (Appendix V, Table 6) The shortest number of days required to reach first flowering (27.05) was observed with S_3T_1 (25 days old seedling and removal of all branches up to 40 cm height), which is statistically similar to S_3T_2 (27.55), and the longest number of days required to reach first flowering (33.66) was observed with S_1T_0 (15 days old seedling and control) treatment combination (15 days old seedling and control).

4.4 Number of male flower per plant

The number of male flowers per plant was discovered to be significant in relation to cucumber seedling age (Table 4, Appendix V).The S_3 (25-day-old seedling) treatment resulted in the highest number of male flowers per plant (38.07). On the other hand, the S_1 (15 days old seedling) treatment produced the fewest male flowers per plant (28.24).

Different levels of training had a significant effect on the number of male flowers per plant (Table 5). The highest number of male flowers per plant (34.91) was observed in the T_1 (removal of all branches up to 40 cm height) treatment, while the lowest number (30.54) was observed in the T_0 (Control) treatment. It is believed that cucumber training aids in the production of more male flowers.

The combined effect of seedling age and training demonstrated statistically significant variation in terms of male flowers per cucumber plant (Table 6, Appendix V).The highest number of male flowers per plant (40.30) was observed with the S_3T_1 (25 days old seedling and removal of all branches up to 40 cm height) treatment combination, while the lowest number (26.33) was observed with the S_1T_0 (15 days old seedling and control) treatment combination.

4.5 Number of female flower per plant

The number of female flowers per plant varied statistically significantly according to the cucumber seedling age (Table 4, Appendix V).The S_3 (25 days old seedling) treatment resulted in the highest number of female flowers per plant (28.48). Contrast, the S_1 (15 days old seedling treatment) produced the fewest female flowers per plant (18.23). Lorenz and Maynard (1988) reported that four-week-old cucumber seedlings produce the most female flowers.

The recorded data on the number of female flowers per cucumber plant were significantly influenced by the level of training applied (Table 5). The highest number of female flowers per plant (25.57) was observed in the T_1 (remove all branches up to 40 cm in height) treatment, while the lowest number (20.08) was observed in the T_0 (Control) treatment. It is believed that training aids in the production of more female flowers. It was significantly influenced by training levels. This could be because The cucumber plant's reproductive growth was improved through training. Additionally, Kumar *et al*. (2017) discovered that cucumber training results in an increase in female flowers.

The number of female flowers per plant varied significantly depending on the seedling age and training of the cucumber (Table 6, Appendix V). The highest number of female flowers per plant (30.69) was observed with the treatment combination S_3T_1 (25 days old seedling and complete removal of all branches up to 40 cm height), while the lowest number of female flowers per plant (14.88) was observed with the S_1T_0 treatment combination (15 days old seedling and control)

4.6 Days required to harvest the first fruit

Seedling age had a substantial impact on the number of days it took to harvest the first cucumber fruit (Fig. 2. and Appendix VI, VIII).The S_3 (25 days old seedling) treatment required the fewest (39.36) days for harvesting green fruit, while S_1 (15 days old seedling) treatment required the most (48.19) days for harvesting green fruit.

Table 4. Effect of seedling age on days required to first flowering, number of male and female flower per plant of cucumber

Treatment	Days required to first flowering	Number of male flower/plant	Number of female flower/plant
S_1	31.79 a	28.24 c	18.23c
S_2	29.70 b	32.24 b	23.39 b
S_3	28.31 c	38.07 a	28.48 a
LSD(0.05)	0.5188	0.644	0.5932
CV%	2.05	2.41	3.00

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability Here,S_1= 15 days old seedling S_2= 20 days 0ld seedling S_3= 25 days old seedling

Table 5. Effect of training on days to first flowering, number of male and female flower per plant of cucumber

Treatment	Days required to first flowering	Number of male flower/plant	Number of female flower/plant
T_0	31.36 a	30.54 d	20.08 d
T_1	28.70 d	34.91a	25.57 a
T_2	29.46 c	33.29 b	24.38 b
T_3	30.21 b	32.85 c	23.44 c
LSD(0.05)	0.5991	0.7438	0.6849
CV%	2.05	2.41	3.00

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability Here T_0= Control , T_1= Removal of all branches up to 40 cm height T_2= Removal of all branches up to 80 cm height and T_3= Removal of all branches up to 120 cm height

Vavrina (1998), Jellani *et al.* (2016), and Sahar *et al*. (2005) all reported similar results from earlier experiments. In India, Singh *et al*. (2010) demonstrated how to cultivate seedlings for early cucurbit harvesting.

Different types of training resulted in a significant variation in the number of days required to harvest the cucumber for the first time (Fig.3. and Appendix VI, VIII). Due to the use of different training systems, the T_1 (removal of all branches up to 40 cm height) treatment required the fewest (41.42) days for harvesting green fruit (45.16) and the T_0 (control) treatment required the most (45.16) days for harvesting

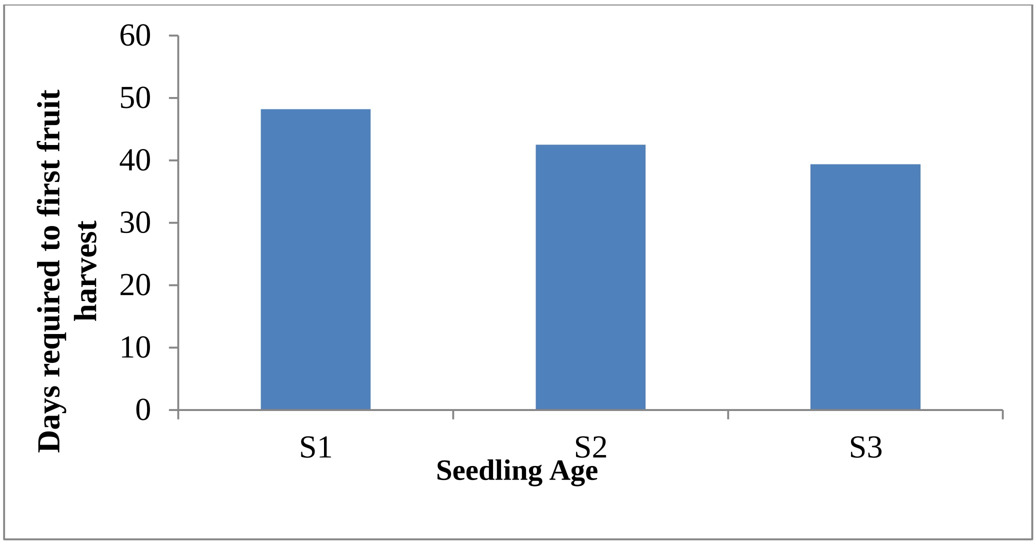


Fig. 2. Effect of different age of seedling on days required to first fruit harvest of cucumber. Where, S_1= 15 days old seedling , S_2= 20 days old seedling S_3= 25 days old seedling

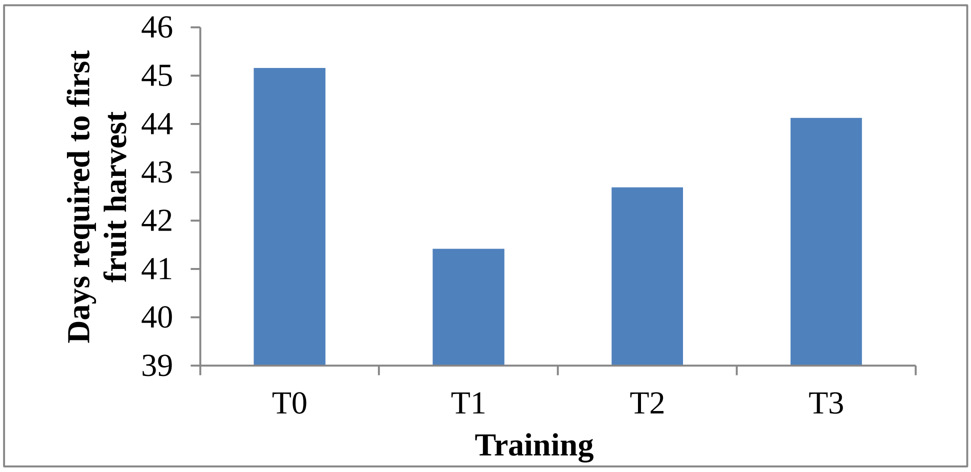


Fig. 3. Effect of different level of training on days required to first fruit harvest of cucumber. Where, T_0= Control T_1= Removal of all branches up to 40 cm height T_2= Removal of all branches up to 80 cm height and T_3= Removal of all branches up to 120 cm height

green fruit (45.16). Kapuriya *et al.* (2017) and Haque *et al.* (2019) observed a similar trend in their research. Significant variation in the number of days required to harvest the first cucumber fruit was observed when the combined effect of seedling age and training was considered (Table 6, Appendix VI). The minimum number of days required to harvest the first fruit (37.09) was observed with the S_3T_1 treatment combination (25 days old seedling and removal of all branches up to 40 cm height), and the lowest number of days required to harvest the first fruit (49.88) with the S_1T_0

treatment combination (15 days old seedling and control), which is statistically identical to the S_1T_3 treatment combination (48.96).

Table 6. Combined effect of seedling age and training on days to first flowering, number of male and female flower per plant, and days required to first fruit harvest of cucumber

Treatment combination	Days required to first flowering	Number of male flower/plant	Number of female flower/plant	Days required to first fruit harvest
S_1T_0	33.66 a	26.33 i	14.88 g	49.88 a
S_1T_1	30.47 cde	29.74 g	20.22 e	46.90 b
S_1T_2	31.35 bc	29.12 gh	20.03 e	47.02 b
S_1T_3	31.68 b	28.54 h	17.81 f	48.96 a
S_2T_0	30.80 bcd	29.42 g	19.77 e	44.02 c
S_2T_1	28.58 gh	34.70 e	25.81 c	40.28 fg
S_2T_2	29.47 efg	32.18 f	24.19 d	42.13 de
S_2T_3	29.94 def	32.50 f	23.78 d	43.59 cd
S_3T_0	29.60 efg	35.89 d	25.58 c	41.58 ef
S_3T_1	27.05 i	40.30 a	30.69 a	37.09 h
S_3T_2	27.55 hi	38.58 b	28.92 b	38.93 g
S_3T_3	29.02 fg	37.50 c	28.73 b	39.83 g
LSD(0.05)	1.0376	0.6376	1.1863	1.7535
CV%	2.05	1.14	3.00	2.39

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability Here,S_1= 15 days old seedling S_2= 20 days 0ld seedling S_3= 25 days old seedling where, T_0= Control T_1= Removal of all branches up to 40 cm height T_2= Removal of all branches up to 80 cm height and T_3= Removal of all branches up to 120 cm height

4.7Number of fruit per plant

The total number of fruits produced per plant varied statistically significantly according to the cucumber seedling age (Table 7, Appendix VI). The S_3 (25 days old seedling) treatment produced the most fruit (17.18). On the other hand, the S_1 (15 days old seedling treatment) produced the fewest fruits per plant (11.97). NeSmith (1993) reported the highest number of fruits with 28-day-old seedlings. Seedlings that are older produce maximum fruit per plant than seedlings that are younger. The current finding is consistent with those of Jellani *et al.* (2015)

The number of fruits produced per plant varied significantly according to the level of training (Table 8, Appendix VI). The T_1 (removal of all branches up to 40 cm in height) treatment produced the highest quantity of fruits per plant (15.93). T_0 (control) on the other hand, produced the fewest fruits per plant (12.88).The present finding is consistent with those of Lal *et al.* (2014).

The combined effect of seedling age and training resulted in a statistically significant difference in terms of fruit per plant (Table 9, Appendix VI).The S_3T_1 (25 days old seedling and removal of all branches up to 40 cm height) treatment combination produced the highest total number of fruit per plant (19.45), while S_1T_0 (15 days old seedling and control) treatment combination produced the lowest total number of fruit per plant (10.47).

4.8 Fruit length (cm)

The length of cucumber fruits varied statistically significant**ly** according to seedling age (Table 7, Appendix VI). The longest fruit (18.08cm) was obtained from the S_3 (25 days old seedling) treatment, while the shortest fruit (13.92cm) was obtained from the S_1 (15 days old seedling) treatment.

Fruit length variation was found to be statistically significant as a result of different levels of training (Table 8, Appendix VI).The longest fruit (17.03cm) was obtained from the T_1 treatment (removal of all branches up to 40 cm in height). The shortest fruit (15.51 cm) was obtained from the T_0 (control) treatment, which is statistically equivalent (15.93) to the T_3 treatment (removal of all branches up to 120 cm height).

Cucumber fruit length was shown to be significantly different when seedling age and training were combined (Table 9, Appendix VI). The S_3T_1 treatment combination (25 days old seedling and removal of all branches up to 40 cm height) produced the longest fruit length (18.77cm), which was statistically similar to the (17.85cm and 17.91cm) S_3T_0 and S_3T_3 treatment combinations, respectively, and the S_1T_0 treatment combination produced the shortest fruit length (12.91cm).

4.9 Fruit diameter (cm)

The S_3 (25 days old seedling) treatment produced the largest diameter of fruits (5.59 cm), while S_1 (15 days old seedling) produced the smallest diameter of fruits (3.72cm) (Table. 7).

Different levels of training had a significant effect on the diameters of fruits (Table 8). The T_1 treatment (removal of all branches up to 40 cm height) resulted in the largest diameter of fruits (5.29 cm). The smallest diameter of fruits (4.28cm) was obtained from the T_0 treatment, which is statistically similar (4.53 cm) to the T_3 treatment (removal of all branches up to 120 cm in height).

The combined effect of seedling age and training resulted in a significant variation in cucumber fruit diameter (Table 9, Appendix VI).The largest fruit diameter (6.22cm) was obtained from the S_3T_1 treatment combination (25 days old seedling and removal of all branches up to 40 cm height), while the smallest fruit diameter (3.18 cm) was obtained from the S_1T_0 treatment combination, which is statistically similar to the S_1T_1 (3.65cm) treatment combination.

4.10 Individual fruit weight (g)

Individual cucumber fruit weights varied significantly according to seedling age (Table 7, Appendix VII). S_3 produced the largest individual fruit weight (174.33 g) (25 days old seedling). Whereas the S_1 (15 days old seedling) treatment resulted in the lowest individual fruit weight (138.10 g). Grimstads and Frimanslund (2002), as well as Jellani *et al.* (2015), noted that their earlier investigation yielded similar findings.

T The weight of individual cucumber fruits varied statistically significantly depending on the variation of training (Table 8, Appendix VII).T_1 treatment resulted in the maximum individual fruit weight (160.87g), while T_0 treatment resulted in the lowest individual fruit weight (151.64g). Kapuriya *et al.* (2017) and Haque *et al.* (2019) observed a similar trend in their experiments.

In terms of individual fruit weight (g), the combined effect of seedling age and training resulted in a remarkable amount of meaningful variance (Table 9, Appendix VII). The S_3T_1 treatment combination (25 days old seedling and removal of all branches up to 40 cm in height) produced the highest individual fruit weight (177.91g), whereas the S_1T_0 treatment combination produced the lowest (132.40g).

Table 7. Effect of seedling age and on number of fruit per plant, fruit length, fruit diameter and individual fruit weight of cucumber

Treatment	Total no of fruit per plant	Length of fruit(cm)	Diameter of fruit(cm)	Individual fruit weight(g)
S_1	11.97 c	13.92 c	3.72 c	138.10 c
S_2	14.13 b	16.56b	4.74b	155.53 b
S_3	17.18a	18.08a	5.59a	174.33a
LSD(0.05)	0.3635	0.4784	0.2543	0.2543
CV%	2.97	3.49	6.40	1.42

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability Here ,S_1= 15 days old seedling S_2= 20 days 0ld seedling S_3= 25 days old seedling

Table 8. Effect of training on number of fruit per plant, fruit length fruit diameter and individual fruit weight of cucumber

Treatment	Total no of fruit per plant	Fruit length (cm)	Fruit Diameter (cm)	Individual fruit weight(g)
T_0	12.88 d	15.51 c	4.28 c	151.64 c
T_1	15.93a	17.03a	5.29a	160.87a
T_2	14.77 b	16.28 b	4.64 b	156.51 b
T_3	14.12 c	15.93 bc	4.53bc	154.93 b
LSD(0.05)	0.4197	0.5524	0.2936	2.1593
CV%	2.97	3.49	6.40	1.42

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability Here, T_0= Control T_1= Removal of all branches up to 40 cm height T_2= Removal of all branches up to 80 cm height and T_3= Removal of all branches up to 120 cm height

4.11 Yield per plant (kg)

Significant variation in cucumber yield per plant was observed as a result of seedling age (Table 10, Appendix VII). The S_3 (25 days old seedling) treatment produced the highest fruit yield per plant (2.99 kg), while the S_1 treatment produced the lowest fruit yield per plant (1.65 kg). A higher fruit yield per plant is inextricably linked to a greater number of fruits per plant. NeSmith (1993), Sahar *et al.* (2016) reported that 25 days old seedlings produced more fruit. Jellani *et al.* (2015) also discovered similar results in their previous experiment.

Table 9.Combined effect of seedling age and training on number of fruit per plant, fruit length, fruit diameter and individual fruit weight of cucumber

Treatment combination	Total no of fruit per plant	Fruit length (cm)	Fruit diameter (cm)	Individual fruit weight(g)
S_1T_0	10.47 i	12.91i	3.18e	132.40g
S_1T_1	13.10 g	14.8 fg	3.65 de	140.92 f
S_1T_2	12.22 h	14.27 gh	3.74 d	140.18 f
S_1T_3	12.08 h	13.69 hi	4.33 c	138.92 f
S_2T_0	12.36 h	15.76 ef	4.46 c	150.48 e
S_2T_1	15.26de	17.53 bc	4.56 c	163.77 c
S_2T_2	14.84 e	16.77 cd	4.61 c	155.31 d
S_2T_3	14.07 f	16.18 de	5.20 b	152.55 de
S_3T_0	15.81 cd	17.85ab	5.29 b	172.03 b
S_3T_1	19.45a	18.773a	6.22a	177.91a
S_3T_2	17.25b	17.81 b	5.66 b	174.05 b
S_3T_3	16.22 c	17.91ab	5.34b	173.33 b
LSD(0.05)	0.7269	0.9568	0.5086	3.7400
CV%	2.97	3.49	6.40	1.42

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability Here, S_1= 15 days old seedling S_2= 20 days 0ld seedling S_3= 25 days old seedling where, T_0= Control T_1=Removal of all branches up to 40 cm height T_2= Removal of all branches up to 80 cm height and T_3= Removal of all branches up to 120 cm height

Different levels of training resulted in significant differences in cucumber fruit yield per plant (Table 11, Appendix VII). The T_1 (Removal of all branches up to 40 cm height) treatment produced the highest fruit yield per plant (2.59 kg), whereas the T_0 treatment produced the lowest fruit yield per plant (1.98 kg).

A statistically significant change in cucumber fruit yield per plant was found when seedling age and training were combined (Table 12, Appendix VII). The S_3T_1 treatment combination produced the highest fruit yield per plant (3.43kg) (25 days old seedling and removal of all branches up to 40 cm height). The S_1T_0 (15-day-old seedling and control) treatment combination, on the other hand, provided the lowest fruit yield per plant (1.38 kg).

4.12 Yield per plot (kg)

The total yield per plot varied statistically significantly due to the different cucumber seedling ages (Table 10, Appendix VII). The maximum fruit yield (17.98kg) per plot was obtained with the S_3 treatment (25 days old seedling age). The S_1 (15 days old seedling) treatment resulted in the lowest fruit yield per plot (9.90kg). Orzolek (2004) also noted that vegetables grown from older seedlings yielded more.

Different levels of training had a significant effect on the total yield per cucumber plot (Table 11, Appendix VII). Per plot, the highest yield (15.54kg) was obtained with the T_1 treatment (removal of all branches up to 40 cm in height), while the lowest yield per plot (11.91kg) was obtained with the T_0 treatment (control). By implementing an appropriate training system, it is possible to improve growth and fruiting area.

The findings indicated that seedling age and training had a significant effect on the total fruit yield per cucumber plot (Table 12, Appendix VII). The combination of S_3T_1 (25 days old seedling and removal of all branches up to 40 cm height) treatment produced the highest fruit yield per plot (20.62 kg). The S_1T_0 (15 days old seedling and control) treatment combination yielded the least amount of fruit per plot (8.28kg).

4.13 Yield per hectare (ton)

Different seedling ages showed a considerable difference in cucumber fruit yield per hectare (Fig 4, Appendix VII, VIII,). The S_3 treatment (25 days old seedling age) produced the maximum fruit production per hectare (41.63ton), while the S_1 (15 days old seedling age) produced the lowest fruit yield per hectare (22.92ton). It is revealed that older seedlings boosted cucumber productivity per hectare.

Different levels of training resulted in considerable differences in total cucumber production per hectare (Fig 5, Appendix VII, VIII). The T_1 treatment produced the highest yield per hectare (35.97ton). In comparison to other treatments, T_0 had the lowest yield per hectare (27.57 ton).

The combined effect of seedling age and training resulted in a statistically considerable variation in total cucumber yield per hectare (Table 12, Appendix VII). The S_3T_1 treatment combination produced the highest yield per hectare (47.73 ton) .The S_1T_0 treatment combination, on the other hand, yielded the lowest yield per hectare (19.16 ton). It is suggested that the optimal age for seedling transplantation promotes early production and yields of cucumber. Additionally, this result was consistent with Hasandokht and Nosrati (2010), Orzolek (2004), Choudhari *et al*. (2002), Jellani *et al*. (2015) , Sahar *et al*. (2005).

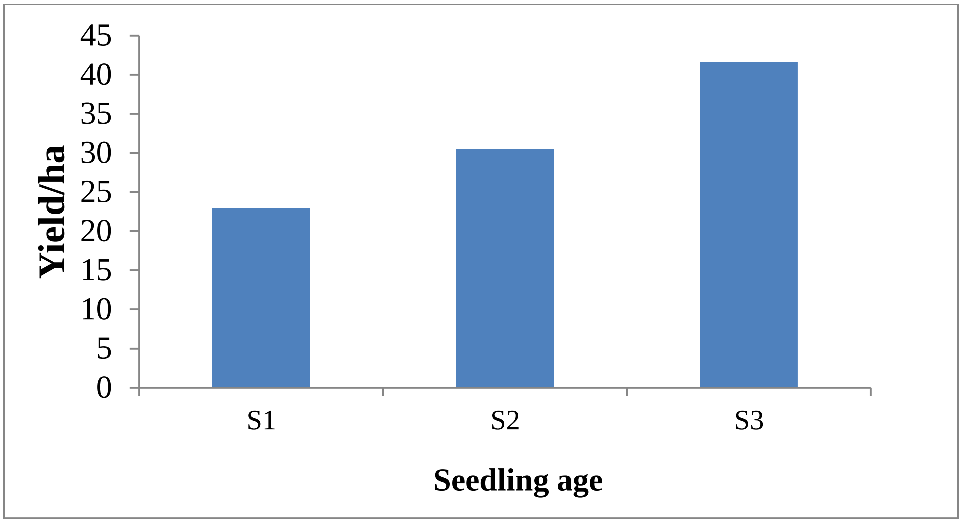


Fig. 4. Effect of different age of seedling on yield per hectare of cucumber
Where, S_1= 15 days old seedling S_2= 20 days old seedling S_3= 25 days old seedling

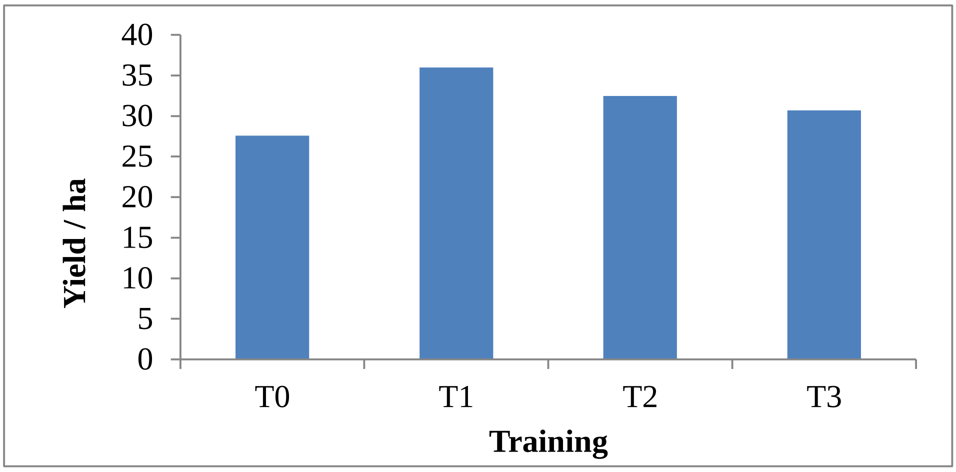


Fig 5. Effect different level of training on yield per hectare of cucumber
Where, T_0= Control T_1= Removal of all branches up to 40 cm height T_2= Removal of all branches up to 80 cm height and T_3= Removal of branches up to 120 cm height

Table 10. Effect of seedling age on yield per plant and yield per plot of cucumber

Treatment	Yield /plant(kg)	Yield /plot(kg)
S_1	1.65 c	9.90 c
S_2	2.19 b	13.17 b
S_3	2.99a	17.98a
LSD(0.05)	0.0627	0.3760
CV%	3.24	3.24

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability Here,S_1= 15 days old seedling S_2= 20 days 0ld seedling S_3= 25 days old seedling

Table 11. Effect of training on yield per plant and yield per plot of cucumber

Treatment	Yield /plant(kg)	Yield /plot(kg)
T_0	1.98 d	11.91d
T_1	2.59a	15.54a
T_2	2.33b	14.03 b
T_3	2.21c	13.26 c
LSD(0.05)	0.0724	0.4341
CV%	3.24	3.24

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability Here, T_0= Control T_1=Removal of all branches up to 40 cm height T_2= Removal of all branches up to 80 cm height and T_3= Removal of all branches up to 120 cm height

Table 12.Combined effect of seedling age and training on yield per plant, yield per plot and yield per hectare of cucumber

Treatment combination	Yield/plant (kg)	Yield/plot (kg)	Yield/ha (ton)
S_1T_0	1.38 i	8.28 i	19.16i
S_1T_1	1.83g	11.02 g	25.50g
S_1T_2	1.70h	10.24 h	23.74h
S_1T_3	1.68 h	10.08 h	23.33 h
S_2T_0	1.86 g	11.16 g	25.83g
S_2T_1	2.49d	14.98 d	34.67d
S_2T_2	2.28 e	13.70e	31.71 e
S_2T_3	2.14f	12.86 f	29.76f
S_3T_0	2.716 c	16.3 c	37.73c
S_3T_1	3.43a	20.62a	47.73a
S_3T_2	3.02 b	18.16 b	42.03 b
S_3T_3	2.81 c	16.86 c	39.02 c
LSD(0.05)	0.1253	0.7520	1.7406
CV%	3.24	3.24	3.24

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability Here, S_1= 15 days old seedling S_2= 20 days 0ld seedling S_3= 25 days old seedling T_0= Control T_1= Removal of all branches up to 40 cm height T_2= Removal of all branches up to 80 cm height and T_3= Removal of all branches up to 120 cm height

4.14 Economic analysis

Costs associated with land preparation, seed, fertilizers, irrigation, and labour necessary for all cucumber operations from planting to harvesting were recorded for each unit plot and translated to cost per hectare. The market price of cucumber was used. The following sections contain economic analysis.

4.14.1 Gross return

The combination of seedling age and training resulted in a variation in gross return. S_3T_1 treatment combination produced the best gross return (1193250Tk./ha), whereas S_3T_2 treatment combination produced the second highest gross return (1050750Tk./ha).

The combination of S_1T_0 treatment produced the lowest gross return (479000Tk./ha) (Table 13).

4.14.2 Net return

In terms of net return, various treatment combinations resulted in a range of net returns. The highest net return (730827Tk.) was achieved from the combination of S_3T_1 while the second highest net return (588327Tk./ha) was obtained from the combination of S_3T_2. The S_1T_0 treatment combination produced the lowest net return (33272Tk/ha) (Table 13).

4.14.3 Benefit cost ratio

S_3T_1 Produced the highest benefit-cost ratio (2.58) was observed whereas the second highest benefit-cost ratio (2.27) was observed S_3T_2 treatment combination. The S_1T_0 treatment combination had the lowest benefit-cost ratio (1.07) (Table 13). From an economic standpoint, the foregoing data indicate that the combination of S_3T_1 treatment was more profitable than the remainder of the combination.

Table 13. Cost and returns of cucumber cultivation as influenced by seedling age and training

Treatment combination	Cost of production (Tk./ha)	Yield of Cucumber (TK./ha)	Gross return (Tk./ha)	Net return (Tk./ha	Benefit cost ratio
S_1T_0	445728	19.16	479000	33272	1.07
S_1T_1	462423	25.5	637500	175077	1.37
S_1T_2	462423	23.74	593500	131077	1.28
S_1T_3	462423	23.33	583250	120827	1.26
S_2T_0	445728	25.83	645750	200022	1.44
S_2T_1	462423	34.67	866750	404327	1.87
S_2T_2	462423	31.71	792750	330327	1.71
S_2T_3	462423	29.76	744000	281577	1.60
S_3T_0	445728	37.73	943250	497522	2.11
S_3T_1	462423	47.73	1193250	730827	2.58
S_3T_2	462423	42.03	1050750	588327	2.27
S_3T_3	462423	39.02	975500	513077	2.10

Note: S_1= 15 days old seedling S_2= 20 days 0ld seedling S_3= 25 days old seedling T_0= Control T_1= Removal of all branches up to 40 cm height T_2= Removal of all branches up to 80 cm height and T_3= Removal of all branches up to 120 cm height

Here, Gross return = Price of cucumber

Net return = Gross return- total cost of production

$$\text{Benefit cost ratio} = \frac{\text{Gross return}}{\text{Total cost of production}}$$

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was carried out at the Sher-e-Bangla Agricultural University's Horticulture Farm to explore how seedling age and training affected cucumber (*Cucumis sativus*) yield performance. As a test crop, the cucumber cultivar 'Baromashi' (local variety) was employed. The experiment comprised of two factors- Factor A: Seedling age (Three type): S_1=15 days old seedling, S_2 = 20 days old seedling, S_3= 25 days old seedling and Factor B: Training (Four type)- T_0= Control, T_1 = Removal of all branches up to 40 cm height, T_2 = Removal of all branches up to 80 cm height,T_3 = Removal of all branches up to 120 cm height.

The experiment with two factors was designed using a Randomized Complete Block Design (RCBD) with three replications. Data was gathered on the following variables: plant height, number of branches per plant, days required to first flowering, number of male flower per plant, number of female flower per plant, days required to first fruit harvest, number of fruit per plant, fruit length, fruit diameter, individual fruit weight, yield per plant, yield per plot, yield per hectare. Using Statistic 10 software, the captured data on various parameters was statistically examined.

Plant height ranged from 220.24cm - 250.89 cm during last harvesting time of cucumber. The maximum height of a plant 244.59 cm was recorded for S_3 and lowest 227.97cm for S_1. In case of training, highest value of plant height 242.24cm was recorded for T_3 and lowest 226.98 cm was recorded from T_0 treatment. And for the combined effect, the highest value of plant height 250.89cm was obtained with the S_3T_1 treatment combination and the lowest value of plant height 220.24cm was obtained with the S_1T_0 treatment combination, which is statistically identical to the S_2T_0treatment combination.

The highest number of branches per plant (13.82) was observed in the S_3 (25 days old seedling) treatment, while the minimum number of branches per plant (11.81) was observed in the S_1 (15 days old seedling) treatment. In the case of training, the highest number of branches per plant (13.67) was observed in the T_1 treatment, while the lowest number of branches per plant (11.61) was observed in the T_0 treatment. And for the combined effect, the highest number of branches per plant (14.90) was observed when S_3T_1 treatment combination, while the lowest number of branches per plant (10.81) was observed when S_1T_0 treatment was combined.

The highest number of days required to first flowering (31.79) was obtained with the S_1 treatment, while the lowest number (28.31) was obtained with the S_3 treatment. In terms of training, the T_0 treatment had the highest days required from sowing to first flowering (31.36), while the T_1 treatment had the lowest (28.70). And for the combined effect, the highest number of days required to sow to first flowering 33.66 was obtained from the treatment combination S_1T_0, while the lowest number of days required to sow to first flowering 27.01 was obtained from the treatment combination S_3T_1, which is statistically similar to S_3T_2.

The number of male flowers on each plant varies between 26.30 and 40.30. In S_3, the highest number of male flowers per plant was found (38.07) while the lowest number was found in S_1 (28.24). In terms of training, T_1 had the highest value of male flowers per plant (34.91) and T_0 had the lowest number (30.54). In terms of combined effect, the combination of (40.30) S_3T_1 treatments resulted in the highest number of male flowers per plant when compared to other treatments.

S_3 had the maximum amount of female flowers per plant (28.48), whereas S_1 had the lowest number (18.23). In terms of training, T_1 (25.57) had the highest number of female flowers per plant and T_0 had the lowest number of female flowers per plant (20.08). Female flowers per plant were found to be highest (30.69) in the S_3T_1 treatment combination and lowest (14.88) in the S_1T_0 treatment combination.

S_3 treatment required the fewest (39.36) days for green fruit harvesting, while S_1 treatment required the most (48.19) days for green fruit harvesting. In terms of training, the T_0 treatment required the fewest (41.42) days for green fruit harvest, while the T_0 treatment required the most (45.16) days for green fruit harvest. Taking into account the combined effect of seedling age and training, the minimum number of days required to harvest the first fruit (37.09) was observed with the S_3T_1 treatment combination, while the maximum number of days required to harvest the first fruit (49.88) was S_1T_0 treatment combination, which is statistically identical to the S_1T_3 treatment combination.

The S_3 treatment produced the highest value (17.18) for total number of fruits per plant, while the lowest value (11.97) was obtained from the S_1 treatment. T_0 produced the maximum fruits (15.93) per plant. The control treatment (T_0) produced the fewest fruits per plant (12.88). In comparison to other combinations, the S_3T_1 (19.45) treatment combination produced the most fruits per plant.

The longest fruit (18.08cm) was obtained through S_3 treatment, while the shortest fruit (13.92cm) was obtained through S_1 treatment. In terms of training, the longest fruit (17.03cm) was obtained from T_1, while the shortest fruit (15.51cm) was obtained from T_0, which is statistically similar to T_3 (15.93). The S_3T_1 treatment combination produced the maximum length of fruit (18.77cm), which is statistically similar to the (17.85cm and 17.91cm) S_3T_0 and S_3T_3 treatment combinations, respectively, and the S_1T_0 treatment combination produced the shortest fruit length (12.91cm), which is statistically similar to the (13.69) S_1T_3 combination of treatment.

S_3 treatment resulted in the largest diameter of fruits (5.59cm), while S_1 treatment resulted in the smallest diameter of fruits (3.72cm). In terms of training, T_1 produced fruits with the largest diameter (5.29cm). The fruits with the largest diameter (6.22cm) were grown using the S_3T_1 treatment combination, while the fruits with the smallest diameter (3.18cm) were grown using the S_1T_0 treatment combination, which is statistically similar to the S_1T_1 treatment combination.

S_3 treatment resulted in the highest individual fruit weight (174.36g), while S_1 treatment resulted in the lowest individual fruit weight (138.10g). In terms of training, the T_1 treatment resulted in the highest individual fruit weight (160.87g), while the T_0 treatment resulted in the lowest individual fruit weight (151.64g). Taking the combined effect of seedling age and training into account, the S_3T_1 treatment combination resulted in the highest individual weight (177.91g).

S_3 treatment produced the highest fruit yield per plant (2.99kg), while S_1 treatment produced the lowest fruit yield per plant (1.65kg).In terms of training, the T_1 treatment produced the highest fruit yield per plant (2.59kg), while the T_0 treatment produced the lowest fruit yield per plant (1.98kg).In terms of the combined effect of seedling age and training, the S_3T_1 treatment combination resulted in the highest fruit yield per plant (3.43 kg), while the S_1T_0 treatment combination resulted in the lowest fruit yield per plant (1.38 kg).

The S_3 treatment (17.98kg) produced the highest fruit yield per plot of cucumber. In comparison to other treatments, S_1 produced the lowest yield per plot (9.90kg). Fruit yield per plot ranged between 11.91 and 15.54kg in case of training. In comparison to other treatments, the T_0 treatment (15.54 kg) produced the highest fruit yield per plot and the T_0 treatment (11.91 kg) produced the lowest fruit yield per plot. Taking into account the combined effect of seedling age and training, the S_3T_1treatment combination produced the highest fruit yield per plot (20.62kg), while the S_1T_0 treatment combination produced the lowest fruit yield per plot (8.28kg).

In comparison to other treatments, the S_3 treatment produced the highest fruit yield per hectare (41.63 ton), while the S_1 treatment produced the lowest fruit yield per hectare (22.92 ton). In comparison to other treatments, T_1 (35.97 ton) had the highest fruit yield per hectare and T_0 (27.57 ton) had the lowest. S_3T_1 treatments produced the highest fruit yield per hectare (47.73 ton), while S_1T_0 treatments produced the lowest fruit yield (19.16 ton) when compared to other combinations.

The S_3T_1 treatment combination yielded the highest gross return (1193250Tk/ha), while the S_3T_1 treatment combination yielded the lowest gross return (479000TK/ha). The S_3T_1 treatment combination generated the highest net return (730827Tk/ha), while the S_1T_0 treatment combination generated the lowest net return (33272Tk/ha). The maximum benefit-cost ratio (2.58) was achieved by S_3T_1 treatment combination, whereas the lowest benefit-cost ratio (1.07) was achieved by combining S_1T_0.

Conclusion

The following conclusion can be formed based on the results of this experiment:

- Treatment S_3 (25 days old seedling) performed better than the other treatments in the trial. To maximize cucumber fruit yield, 25 days old seedlings outperformed all other seedling ages. A 25 days old seedling provided a greater fruit yield, gross return, and gross margin.
- Training had a significant effect on cucumber growth and production. T_1 was shown to produce the highest yield of cucumbers across the various training techniques.
- The S_3T_1 treatment combination of 25 days old seedlings and complete removal of all branches up to 40 cm height resulted in the highest likelihood of 47.73 ton/ha with TK.730827 net income and 2.58BCR.
- Additional research of this kind may be conducted using more than 25 days old seedling for improved authentication, depending on the circumstances.

REFERENCES

Alam , M. S., Iqbal, T.M.T., Amin, M. and Gaffar, M. A. (1989). Krishitattik Fasaler Utpadon O Unnayan (in Bengali). T.M. Jubair Bin Iqbal ,Sirajgong, pp.231-239.

Anonymous. (1989). Annual Report 1987-88. Bangladesh Agricultural Research Institute. Joydebpur, Gazipur. p. 133.

AVRDC. (1999). Cucurbits report for 1998. Shanhua, Taiwan. p. 76.

Babik, I. (2000). The influence of transplant age and method of plant raising on yield and harvest time of autumn Broccoli *(Brassica OleraceaL.var. ITALICA* plenck) . *Acta. Hort*., **533**:145-152.

Bakkar, J. C. and Van de Vooren, J. (1985). Plant densisties and training systems at greenhouse cucumber . *Acta. Hort*., **156**: 43-48.

BBS. (2020). Bangladesh Bureau of Statistics. Ministry of Planning. Government of People’s Republic of Bangladesh.Yearbook of Agricultural Statistics-2019. Dhaka.p. 315.

Bucan, L., Goreta, S. and Perica, S. (2005). Influence of transplant age and type on growth and yield of seed propagated globe artichoke. *Acta* . *Hort*., **681**: 95-98.

Choudhari, S. M., More T. A. and Tazuke, A. (2002). Fertigation, fertilizer and spacing requirement of tropical gynoecious cucumber hybrids. Proc. of 2nd Int. Symposium on Cucurbit, Tsukuba, Japan. 28 Sep to 1 Oct, 2001. *Acta Hort*., **588**: 233–240.

Dhillon, N. S., Sharma, P. Kumar, P. and Singh, H. (2017). Influence of training on vegetative growth characteristics and yield of polyhouse grown cucumber *(Cucumis sativus l.).J. Exp. Agric. Intl.*,**18** (1): 1-5.

Grimstads, S. O. and Frimanslund, E. (2002). Effect of transplant age on growth and yield of cucumber (Cucumis sativus L var. Ventura). *Scientia Horticulturae.,* **53**: 192–194.

Handley, D. and Hutton, M. (2003). Effect of seeding date, transplant size and container on growth and yield of pickling cucumbers. *J. American. Soc. Hort. Sci*., **38:** 672 .

Haque, M. A., Sarker, B.C., Rahman, M., Akter, A. and Rahman, H. (2019).Effects of spacing and training on the growth and yield of capsicum. *Eco-friendly Agril. J.*, **12**(01): 01-06.

Hasandokht, M. R. and Nosrati, S. Z. (2010). Effect of transplant age and fruit pruning on earliness and total yield of greenhouse cucumber (*Cucumis sativus L. cv.* Sultan). *Plant. physiol*., **2**: 21-25.

Hebert, M. (1998). Greenhouse cucumber production; Available :http://www.uaf.edu.

Henare, M. and Ravanloo, A. (2008). Effect of transplanting stage and planting depth of seedling on growth and yield of tomato. Book of abstracts. IV Balkan Symposium on Vegetables and potatoes. P: 96.

Jankauskiene, J., Brazaityte , A., Bobinas, C. and Duchovskis, P. (2013). Effect of transplant growth stage on tomato productivity. *Acta Scientiarium Polonorum. Hotorumcultus=ogrodnictwo*., **1292**: 143-152.

Jankauskiene, J. and Brazaityte, A. (2005). Effect of transplant age on the earliness of yield and productivity of short-fruit cucumbers. *Acta. Hort.*, **24**(3): 138-146.

Jellani, G., Atif, M. J., Ullah, H., Ali, M. and Musa, M. (2015). Influence of seedling age on cucumber (*cucumis sativus l.)* production. *SAARC. J. Agri*c. **13**(2): 214-221.

Jellani, G., Atif, M. J., Ullah, H., Khan, T. N. and Saleem, N. (2016). Seedling age impact on growth and yield of bitter gourd. *Sci.Tech. Develop*., **35** (2): 94-97.

Kapuriya, V. K., Ameta, K. D., Teli, S. K., Chittora, A., Gathala, S. and Yadav, S. (2017). Effect of spacing and training on growth and yield of polyhouse grown cucumber *(Cucumis sativus L*.). *Intl J. Curr. Microbiol. App. Sci***., 6**(8): 299-304.

Kumar, S., Patel, N. B. and Saravaiya, S. (2018). Influence of fertigation and training systems on yield and other horticultural traits in greenhouse cucumber. *Indian. J. Hort.*, **75**(2): 252.

Kumar, U. and Chandra, G. (2014).Effect of spacing and training levels on growth and yield of capsicum under polyhouse in North-Bihar conditions. *J. Hill. Agric*., **5**(1):9.

Lorenz, O. A. and Maynard D. N. (1988). Knott's Handbook for Vegetable Growers, 3rd Ed. p. 14. Wiley, New York.

Lal, M., Kanwar, H. S. and Kanwar, R. (2014). Impact of spacing and training on seed yield of capsicum, *Capsicum annuum L*. under protected conditions. *Int. J. Farm. Sci.,* **4**(3): 42-48.

McCraw, B. D. and Greig. J. K. (1986). Effect of transplant age and pruning procedure on yield and fruit-set bell pepper. *Hort. Sci*., **21**: 430-431.

Naz, S., Amjad, M, Siddique, B. and Ahmad, I. (2005). Effect of different ages of transplants on the yield of chillies. *Indian. J. Plant. Sci*., **4**: 332-335.

NeSmith, D. S. (1993). Transplant age influences summer squash growth and yield. *Hort. Sci*.,**28**: 618-620.

Orzolek, M. (2004). Evaluating vegetable transplants. Vegetable, small fruit and specialty crops.*Virginia Coop. Exten*., **3**(3): 9.

Premalatha, M. G. S., Wahundeniya, K. B., Weerakkody, W.A.P. and Wicramathunga, C.K. (2006). Plant training and spatial arrangement for yield improvements in greenhouse cucumber (*Cucumis sativus L.*) varieties. *Tropic. Agric. Res*., **18**: 346-357.

Rajalingam, G. V., Rajasree, V., Arumugam, T and Saraswathi, T. (2011). Influence of different raining system in cucumber under naturally ventilated polyhouse. *Acta. Hort*., **5**(6): 1453-1455.

Sahar, T., Hafiz, I. A., Abbasi, N. A., Sajjad, Z. (2005). Effect of seedling age and different levels of phosphorus on growth and yield of cucumber (*Cucumis sativus L*). *Intl. J. Agric. Biol.*,**7**(2): 311-314.

Saxena, A. M. and Singh, S. (2019). Effect of age of transplants on growth and yield of capsicum under open ventilated polyhouse condition. *Intl. j. Res. Rev.*, **6**(7):570-574.

Sharma, D. Sharma, V. K. and Kumari, A. (2018). Effect of spacing and training on growth and yield of polyhouse grown hybrid cucumber (*Cucumis sativus.L.).Intl. J. Curr. Microbiol. App. Sci*., **7**(05): 1844-1852.

Shukla, Y. R., Chhopal, T. and Sharma, R. (2009). Effect of age of transplants on growth and yield of capsicum. *Intl. J. Farm Sci.*, **1**: 56-62.

Shukla, Y. R., Chhopal T. and Sharma, R. (2011). Effect of age of transplants on fruit and seed yield of capsicum. *Harayna J. Hort. Sci*., **38**: 352-356.

Singh, B., Tomar, B. S. and Hasan, M. (2010). Plug tray nursery raising technology for off season cucurbits cultivation. *Acta. Hort*., **871**: 279-282.

USDA. (2019). Cucumber, raw, peeled. U. S. Department of Agriculture.

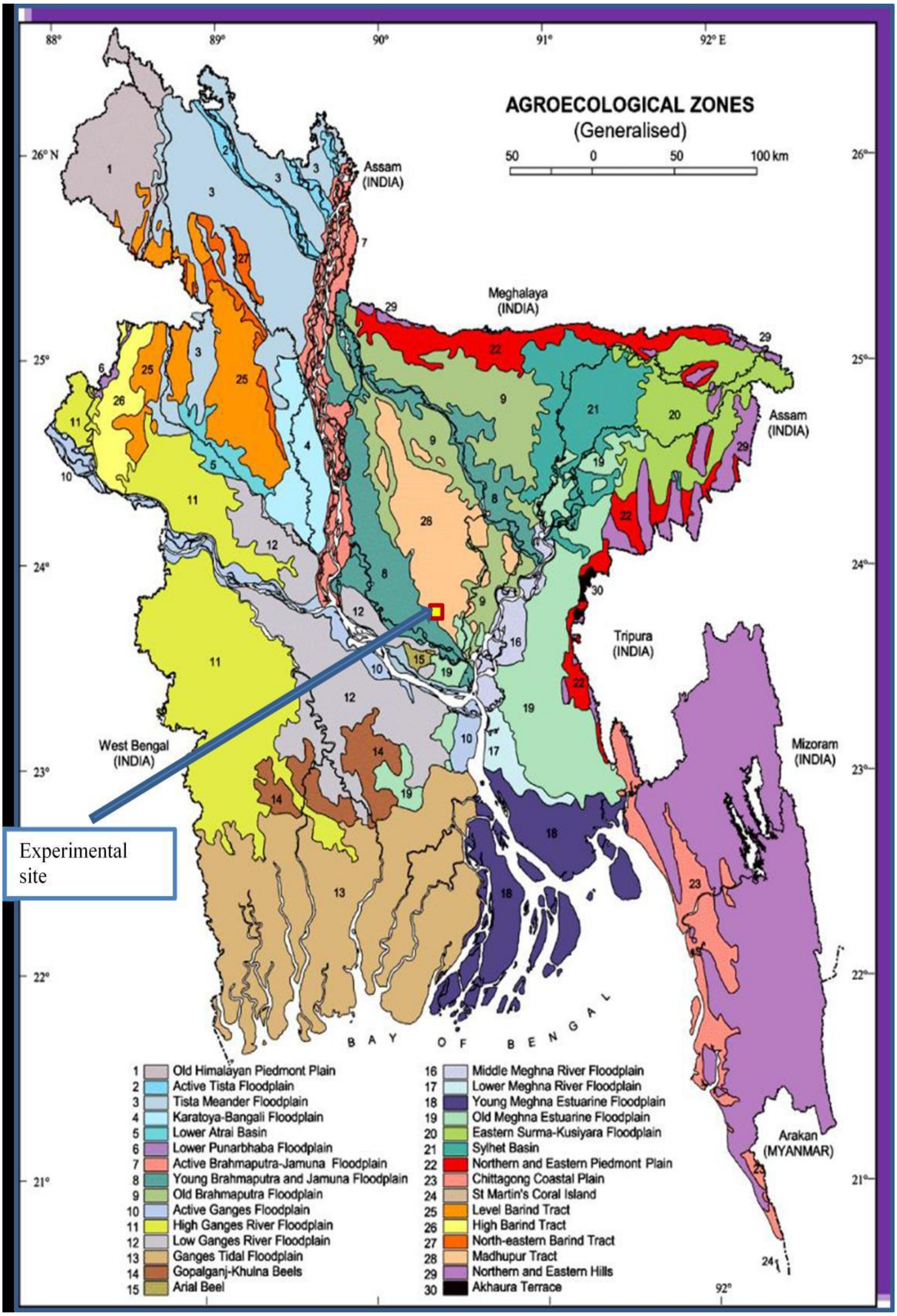
Vavarina, C. S. and Orzolek, M. D. (1993). Tomato transplant age: A review. *Hort. Tech.*, **3**:313-316.

Vavrina, C. S. (1998). Transplant age in vegetable crops. *Hort. Tech*., **8** (4): 550- 555.

Weston, L. A. (1988). Effect of flat cell size, transplant age, and production site on growth and yield of pepper transplants. *Hort. Sci*., **23**(4):709-711.

APPENDICES

Appendix I. The experimental site is shown on a map.



Appendix II. The experimental site's monthly average of air temperature, relative humidity, and overall rainfall from April to July 2019.

Month(2019)	Air temperature(^{0}C)		*Relative humidity (%	*Rainfall (mm) (total)
	Maximum	Minimum		
April	32.7	22.4	65	64.2
May	35.2	26.7	73	182.5
June	35.3	22.7	82	256
July	34.8	24.8	70	238

* Monthly average,
* Source: Bangladesh Meteorological Department (Climate &weather division) Agargoan, Dhaka – 1212

Appendix III. The physical properties and chemical composition of the experimental plot's soil

Characteristics of soil	Analytical outcome
AEZ	Madhupur Tract (28)
Land type	High land
Soil series	Tejgaon
pH	5.47-5.61
Organic matter	0.82%
Textural class	Silty clay
The total amount of nitrogen (percent)	0.04
Availablity of phosphorous	20 ppm
Exchangeable K	.13meq/100gm soil

Source: Soil Resources Development Institute (SRDI), Khamarbari, Farmgate, Dhaka

Appendix IV. Analysis of variance of influence of the data on different seedling age and training on plant height and number of branch of cucumber

Source of variation	Degrees of freedom	Mean square	
		Plant height at last harvest	Number of branch at last harvest
Replication	2	14.020	0.2521
Different seedling age (A)	2	848.330**	12.1139**
Training (B)	3	370.147**	7.0812**
Interaction (AxB)	6	15.768**	0.2459**
Error	22	5.606	0.0775

Appendix V. Analysis of variance of the data on days required to first flowering, number of male flower per plant and number of female flower per plant of cucumber as influenced by different seedling age and training

Source of variation	Degrees of freedom	Mean square		
		Days required to first flowering	Number of male flower/plant	Number of female flower/plant
Replication	2	0.1649	0.029	0.237
Different seedling age (A)	2	36.9443**	283.034**	315.14**
Training (B)	3	11.5363**	29.274**	50.176**
Interaction (AxB)	6	0.4089**	0.87**	0.862**
Error	32	0.3755	0.142	0.491

** : Statistically significant at the 0.01 level of probability

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

Appendix VI. Analysis of variance of the data on days required to first fruit harvest, number of fruit per plant, fruit length and fruit diameter of cucumber as influenced by seedling age and training

Source of variation	Degrees of freedom	Mean square			
		Days required to first fruit harvest	Number of fruit per plant	Fruit length (cm)	Fruit diameter (cm)
Replication	2	1.027	0.8801	1.2144	0.0355
Different seedling age	2	240.495**	82.3906**	53.3076**	10.4726**
Training (B)	3	24.121**	14.6158**	3.777**	1.6831**
Interaction(AxB)	6	0.735**	0.9092**	0.3052**	0.053**
Error	32	1.072	0.1843	0.3193**	0.0902

** : Statistically significant at the 0.01 level of probability
* : Statiatically Significant at the 0.05 level of probability

Appendix VII. Analysis of variance of the data on average fruit weight, yield per plant, yield per plot and yield per hectare of cucumber as influenced by seedling age and training

Source of variation	Degrees of freedom	Mean square			
		Average fruit weight (g)	Yield/plant (kg)	Yield/plot (kg)	Yield/ha (ton)
Replication	2	1.11	0.02501	0.9	4.82
Different seedling age (A)	2	3939.01**	5.50641**	198.231**	1062.18**
Training (B)	3	132.43**	0.57301**	20.628**	110.53**
Interaction(AxB)	6	17.31**	0.03014**	1.085**	5.81**
Error	32	4.88	0.00548	0.197	1.06

** : Statistically significant at the 0.01 level of probability
* : Statiatically Significant at the 0.05 level of probability

Appendix VIII. Effect of seedling age on days required to first fruit harvest and yield per hectare of cucumber

Treatment	Days required to first fruit harvest	Yield per hectare(ton)
S_1	48.19 a	22.92 c
S_2	42.50 b	30.49b
S_3	39.36 c	41.63a
LSD(0.05)	0.8767	0.8703
CV%	2.39	3.24

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability
Here,S_1= 15 days old seedling S_2= 20 days old seedling S_3= 25 days old seedling

Appendix IX. Effect of training on days required to first fruit harvest and yield per hectare of cucumber

Treatment	Days required to first fruit harvest	Yield per hectare(ton)
T_0	45.16 a	27.57 d
T_1	41.42 d	35.97a
T_2	42.69 c	32.48 b
T_3	44.13 b	30.71 c
LSD(0.05)	1.0124	1.0049
CV%	2.39	3.24

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability
Here,S_1= 15 days old seedling S_2= 20 days old seedling S_3= 25 days old seedling

Appendix X. Per hectare production cost of cucumber

A(1). Input cost

Treatment combination	Labour cost	Ploughing cost	Seed cost	Irrigation	Sticking cost	Training cost	Total (Tk.) A(1)
S_1T_0	130000	40000	7000	30000	50000	0	257000
S_1T_1	130000	40000	7000	30000	50000	15000	272000
S_1T_2	130000	40000	7000	30000	50000	15000	272000
S_1T_3	130000	40000	7000	30000	50000	15000	272000
S_2T_0	130000	40000	7000	30000	50000	0	257000
S_2T_1	130000	40000	7000	30000	50000	15000	272000
S_2T_2	130000	40000	7000	30000	50000	15000	272000
S_2T_3	130000	40000	7000	30000	50000	15000	272000
S_3T_0	130000	40000	7000	30000	50000	0	257000
S_3T_1	130000	40000	7000	30000	50000	15000	272000
S_3T_2	130000	40000	7000	30000	50000	15000	272000
S_3T_3	130000	40000	7000	30000	50000	15000	272000

A(2). Input cost

Treatment combination	Manure and fertilizer				Insecticide/ pesticides	Total Cost (Tk.) A(2)	Total input (Tk.) [A(1)+ A(2)]
	Cowdung	Urea	TSP	MOP			
S_1T_0	25000	2768	3520	1950	15000	48238	305238
S_1T_1	25000	2768	3520	1950	15000	48238	320238
S_1T_2	25000	2768	3520	1950	15000	48238	320238
S_1T_3	25000	2768	3520	1950	15000	48238	320238
S_2T_0	25000	2768	3520	1950	15000	48238	305238
S_2T_1	25000	2768	3520	1950	15000	48238	320238
S_2T_2	25000	2768	3520	1950	15000	48238	305238
S_2T_3	25000	2768	3520	1950	15000	48238	320238
S_3T_0	25000	2768	3520	1950	15000	48238	305238
S_3T_1	25000	2768	3520	1950	15000	48238	320238
S_3T_2	25000	2768	3520	1950	15000	48238	305238
S_3T_3	25000	2768	3520	1950	15000	48238	320238

Here, S_1=15 days old seedling, S_2= 20 days old seedling,S_3= 25days old seedlingT_0= Control,T_1= Removal of all branches up to 40 cm height,T_2=Removal of all branches up to 40 cm heightT_3= Removal of all branches up to 120 cm height

Appendix X (Continued)

B. Overhead cost (Tk./ha)

Treatment combination	Cost of lease of land for 6 months (12% of value of land Tk. 15,00000/year	Miscellaneous cost (Tk. 5% of the input cost	Interest on running capital for 6 months (Tk. 12% of cost/year	Sub total (Tk.) (B)	Total cost of production (Tk./ha) [Input cost (A)+ overhead cost (B)]
S_1T_0	100000	15261	25229	140490	445728
S_1T_1	100000	16011	26174	142185	462423
S_1T_2	100000	16011	26174	142185	462423
S_1T_3	100000	16011	26174	142185	462423
S_2T_0	100000	15261	25229	140490	445728
S_2T_1	100000	16011	26174	142185	462423
S_2T_2	100000	16011	26174	142185	462423
S_2T_3	100000	16011	26174	142185	462423
S_3T_0	100000	15261	25229	140490	445728
S_3T_1	100000	16011	26174	142185	462423
S_3T_2	100000	16011	26174	142185	462423
S_3T_3	100000	16011	26174	142185	462423

Here, S_1=15 days old seedling, S_2= 20 days old seedling, S_3= 25days old seedling T_0= Control, $T_{1=}$ Removal of all branches up to 40 cm height, T_2=Removal of all branches up to 40 cm heightT_3= Removal of all branches up to 120 cm height

Plate 1. Pictorial presentation of a. sowing of seed in plastic glass ; b. seedling raising period; c. vegetative stage ; d. flowering stage; e. fruiting stage ; f. harvesting time of cucumber

Plate 2. Pictorial presentation of a. removal of branch (training) b. data collection , c: measurement of individual fruit weight using digital weight machine (gm) d. measurement of fruit length using meter scale(cm)