Original Research Article

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

ABSTRACT

An experiment was conducted 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 which in combination made 12 treatment combination. 'Baromashi' (local variety) was used in this experiment. Different seedling age and levels of training showed significant variations on most of the parameters. In case of seedling age, the maximum number of fruits per plant (17.18), individual fruit weight (174.33 gm) and fruit yield (41.63 ton/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 gm) 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 gm) and the highest yield (47.73 t/ha) while the lowest were (10.47, 132.40gm and 19.16 ton/ha) recorded from S_1T_0treatment combination respectively. The highest net income (730827 tk/ha) and benefit cost ratio (2.58) was noted from S_3T_1 treatment. It may therefore be concluded that the 25 days old seedling and removal of all branches up to 40 cm height showed more economical than rest of the combinations in cultivation of cucumber.

1. Introduction

Cucumber (*Cucumis sativus*) is broadly cultivated creeping vine plant in the gourd family (*Cucurbitaceae)* that bears cucumiform fruits which are used as vegetables. Cucumbers contain high levels of bitter-tasting nutrients known as cucurbitacin [1]. It is mostly cultivated for its little tender fruits. The origin of cucumber is in southern Asia, but a great number of cultivars have been introduced and are grown globally [2]. Cucumber is a vital vegetable crop of Bangladesh. It is mostly taken as fresh. It is a primary source of vitamins and mineral of man [3]. Cucumber fruits contain a great amount (95%) of water. It contains little amount of calories, different plant compounds and antioxidants that may help treat and even restrain some conditions [4]. Usually, in our country cucumber is reachable in all the year round. The total production of cucumber was 73220 M.ton during the year 2018-2019 [5]. But the production of cucumber is not satisfactory to fulfill the demand of the people. The performance of any crop depends upon the excellence of the seed used for sowing, kind of cultivar, cultural practices and different environmental factors, etc. In Bangladesh cucumber is mainly cultivated by direct sowing of seed. Transplantation of cucumber seedling is less popular among the farmers. For cucumber cultivation, transplantation of cucumber seedling is one of the factors, which affect growth and yield, but normally this factor is unnoticed by the farmers. The optimum seedling age depends on the soil, environmental factors (temperature, moisture), location and cultural practices [6]. Seedlings are used broadly to establish a range of vegetable crops. Young aged or over aged seedlings are not suitable for better yield. Older seedling are more long-lasting to stress and produce fruits earlier, while young transplants are less enduring [7[.Transplantation of different age of seedling effect a great impact on vegetative growth as

well as reproduction phase of cucumber. Optimum seedling age for better plant establishment could increase productivity of cucumber crop [8].That's why, optimum seedling age is required for early establishment of plant and production of cucumber as well as higher yield which helps the farmers to get top market price.

For getting higher yield of cucumber, training is an important cultural practices to boost up the production by removing excessive growth of the plant and maximum use of resources. For successful cucumber production training practices plays a great role for increase yield, early harvest, easy harvesting of fruits and amenities in intercultural operation without damage to the fruits or plants. Training system will not only good for better management of crops and uniform light to the plants but also higher yield of larger sized fruits and increasing higher yield of good quality seeds[9]. By training, plants get the required amount of sun light needed for growth of the plant which ultimately helps in higher yield of cucumber. The proper training method gave higher yield of cucumber [10]. So, by these proper training practices it may be help for good vegetative growth and yield of the cucumber plant.

Yet, very limited study was conducted to observe the effect of seedling age and training system to advance the growth and yield of cucumber. Comprehensive and methodical study is needed to find out the suitable seedling age for transplanting and training for maximum yield and economic benefit of cucumber in Bangladesh.

2. Materials and Methods

2.1 Experimental site and experimental framework The research was conducted at the Horticultural Farm of Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh during the period of April 2019 to August 2019 .The experiment was carried out in summer season. The location of the experimental site is situated at 90° 22 ' E longitude and 23° 41' N latitude. The altitude of 8.6 meters above sea level. The soil was having a texture of sandy loam with pH and organic matter 5.47 – 5.63 and 0.83%, respectively. 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 two factors experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. An area of 30.3 m × 8.4 m and the total area of the experimental plot was 241.92 m^2. The total area is divided into three equal blocks. Each block was divided into 12 plots where 12 treatments combination were allotted at random. There was a total of 36 unit plots in the experiment. The size of each plot was 2.4 m × 1.8 m. The distance maintained between two blocks and two plots were 75cm and 50cm, respectively. Both the row to row and plant to plant distances were 60 cm and 60 cm, respectively.

2.2 Planting materials and raising of seedling Seeds of 'Baromashi' local variety cucumber was used as the test crops and the seeds were collected from LalTeer Seed Company, Siddique Bazar, Gulistan, Dhaka. Seeds were sown in the in polyethylene bags containing a mixture of equal proportion of well decomposed cowdung, sand and soil. Regular irrigation was done to bring moist condition for proper seed germination. The polybags were reserved in cool place. They were watered frequently during the seedling- raising period. Seedlings were transplanted at three different ages viz.;15 days,20 days and 25 days after germination.

2.3 Application of training treatment Side branches on main stem were removed according to treatments. When the branches were appeared from the main stem and became 2-3 cm long then that was removed. Training was done according to treatments. In 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.

2.4 Economic analysis The cost of production was calculated to find out the most economic combination of seedling age and training. All input cost like the cost for land lease and interests on running capital were computing in the calculation. The interests were calculated @ 12% in simple rate. The market price

of cucumber was considered for estimating the return. Analyses were done according to the procedure of [11]. The benefit cost ratio (BCR) was calculated as follows: Benefit cost ratio (BCR) = Gross return per hectare (Tk.) /Total cost of production per hectare (Tk.)

2.5 Statistical analysis The recorded data on different parameters were statistically analyzed using Statistic 10 software. The significance of the difference among the treatments means was estimated by the least significant difference test (LSD) at 5% level of probability.

3. Results and Discussion

3.1 Plant height (cm)

Plant height was taken only at harvesting time. Plant height of cucumber varied significantly due to different seedling ages. At harvesting time, the highest plant height (244.59 cm) was obtained from S_3 (25 days old seedling) whereas the lowest plant height (227.97cm) was found from S_1 (15 days old seedling) treatment. Data indicated that the 25 days old seedling produced the longest plant (Table 1). Mainly cucumber is mostly cultivated by direct sowing in our country. But if transplantation of seedling can be done, it will affect the growth and yield of cucumber but generally, this factor is overlooked by the farmers. Corresponding findings was also observed from earlier experiment [12]. Results indicated that maximum vine length (242.24 cm) was recorded from T_3 (removal of all branches up to 120 cm) treatment while the shortest plant (226.98 cm) was recorded from T_0 (control) treatment (Table 2).Training of cucumber improve growth and expand fruiting area. An appropriate training system will facilitate better management and uniform light to the plants. An appropriate training in cucumber will boost up the vegetative growth of cucumber [13]. Combined effect between seedling age and training has significantly effect on plant height. The highest value of plant height (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) (Table 3) which is statistically identical to S_2T_0 treatment combination (Table 3).

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

Treatment	Plant height (cm) At harvest	Branch number/plant 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

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

Treatment	Plant height (cm) At harvest	Branch number/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

3.2 Number of branches per plant

Variation on number of branches per plant of cucumber differed significantly due to different level of seedling ages. Data were taken at harvesting of cucumber. At harvest, the maximum number of branches per plant (13.82) was recorded from S_3 (25 days old seedling) treatment while the minimum number of branches per plant (11.81) was recorded from S_1 (15 days old seedling) treatment (Table 1). Significant influence was observed on number of branches per plant of cucumber due to different level of training .At harvests, maximum number of branches per plant (13.67) was found from T_1 (removal of all branches up to 40 cm height) treatment while the minimum number of branches per plant (11.61) was recorded from T_0 (control) treatment(Table 2). Training helps minimizes overcrowding of branch at a single place. Similar findings also observed on earlier experiment [13]**.** Combined effect between different seedling age and training remarked statistically significant variation in terms of number of branches per plant of cucumber. The greatest number of branches per plant (14.90) was observed from S_3T_1 (25 days old seedling and removal of branches up to 40 cm height) treatment combination and the minimum number of branches per plant (10.81) was recorded from S_1T_0 (15 days old seedling and control) treatment combination (Table 3).

3.3 Days required to 1st flowering

Days required for 1st flowering showed a significant variation in relation with different seedling age. The lowest (28.31) days required for 1st flowering was obtained from S_3 (25 days old seedling) treatment (Table 4) and the highest (31.79) days required for 1st flowering was obtained from S_1 (15 days old seedling) treatment. It can be inferred that later transplants tend to reproduce earlier as compared to earlier transplants [14]. Days required to first flower initiation of cucumber showed positively significance by the application of different level training. The lowest (28.70) days required for 1st flowering was recorded from T_1 (removal of all branches up to 40 cm height) treatment (Table 5) and the highest (31.36) days required for 1st flowering was recorded from T_0 (Control) treatment. It was significantly influenced by various levels of training. This result is in agreement with the findings of [13]. Significant variation was observed due to the combined effect of different seedling age and training in terms of days required to 1st flowering. The minimum number of days required to 1st flowering (27.05) was observed from S_3T_1 (25 days old seedling and removal of all branches up to 40 cm height) treatment combination and the maximum number days required to 1st flowering was recorded from S_1T_0 (15 days old seedling and control) (33.66) treatment combination (15 days old seedling and control) (Table 6).

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 harvest	Number of branch /plant at 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	13.08 cd
S_3T_0	238.65 cd	12.28 ef
S_3T_1	242.79 b	14.90 a
S_3T_2	246.03 b	14.13b
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 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

3.4 Number of male flower per plant

The data on number of male flower per plant was found to be significant in terms of different seedling age of cucumber. The maximum number of male flowers per plant (38.07) was observed from S_3 (25 days old seedling) treatment. On the other hand, the lowest number of male flowers per plant (28.24) was found from S_1 (15 days old seedling) treatment (Table 4). Application of different level of training on cucumber showed significant effect on number of male flowers per plant. The highest (34.91) number of male flowers per plant was observed from T_1 (removal of all branches up to 40 cm height) treatment (Table 5), treatment and the lowest (30.54) number of male flowers per plant was recorded from was recorded from T_0 (Control) treatment .It is indicated that training help to produce more male flower. Combined effect between different seedling age and training showed statistically significant variation in terms of number of male flowers per plant of cucumber. The maximum number of male flowers per plant (40.30) was observed from S_3T_1 (25 days old seedling and removal of all branches up to 40 cm height) treatment combination and the minimum number of male flowers per plant was found from S_1T_0 (26.33) (15 days old seedling and control) treatment combination (Table 6).

3.5 Number of female flower per plant

Number of female flowers per plant showed statistically significant variation due to different seedling age of cucumber (Table 4). The maximum number of female flowers per plant (28.48) was recorded from S_3 (25 days old seedling) treatment. On the other hand, the lowest number of female flowers per plant (18.23) was found from S_1 (15 days old seedling) treatment (Table 4). Femaleness is increased in four weeks old cucumber transplants [15]. Number of female flowers per plant of cucumber influenced significantly by the application of different level of training The highest (25.57) number of female flowers per plant was recorded from T_1 (remove all branch up to 40 cm height) treatment (Table 5) and the lowest (20.08) number of female flowers per plant was recorded from T_0 (Control) treatment. It is indicated that training help to produce more female flower. It was significantly influenced by various levels of training. Training in cucumber increase female flower of cucumber [16]. Remarkable variation was found on number of female flower per plant influenced by of different seedling age and training of cucumber. It was verified that the maximum number of female flowers per plant (30.69) was observed from S_3T_1 treatment combination (25 days old seedling and removal of all branches up to 40 cm height) and the minimum number of female flowers per plant was recorded from S_1T_0 (14.88) treatment combination (15 days old seedling and control) (Table 6).

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

Treatment	Days 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	38.07a	28.48 a
LSD(0.05)	0.5188	0.644	0.5932
CV%	2.05	2.41	3.00

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

Treatment	Days 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

3.6 Days required to first fruit harvest

The days required to first harvesting of cucumber fruit was significantly influenced by various levels of seedling age (Table 3).The lowest (39.36) days required for harvest of green fruit was recorded from S_3 (25 days old seedling) treatment and the highest (48.19) days required for harvest of green fruit was recorded from S_1 (15 days old seedling) treatment (Fig 1). Older transplant are help in getting reproductive phase earlier than young transplant [14]. Application of different levels of training showed significant variation on days required to first harvesting of cucumber (Fig 2). Due to application of different training system the lowest (41.42) days required for harvest of green fruit was recorded from T_1 (removal of all branch up to 40 cm height) treatment and the highest (45.16) days required for harvest of green fruit was recorded from T_0 (control) treatment (Fig 2). The above results are supported with the conclusions drawn by [13], [17].

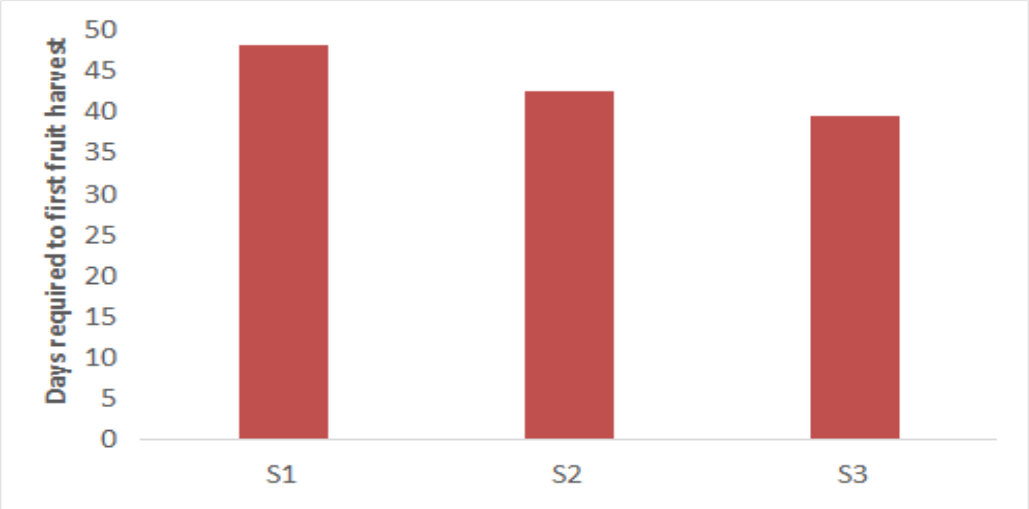

Fig.1. Effect of seedling age on days required to first fruit harvest of cucumber

Where,S_1= 15 days old seedling S_2= 20 days 0ld seedling S_3= 25 days old seedling

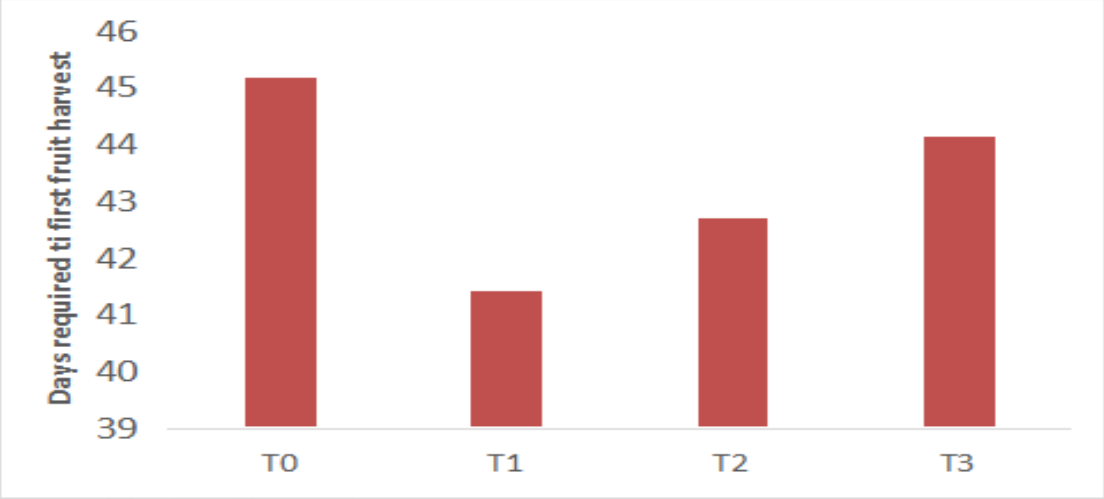

Fig.2. Effect of training on days required to first fruit harvest of cucumber

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

Significant variation was recorded from the combined effect of different seedling age and training in terms of days required to first fruit harvest of cucumber (Table 6) .The minimum days required to first fruit harvest (37.09) was observed from S_3T_1 (25 days old seedling and removal of all branches up to 40 cm height) treatment combination and the minimum days required to first fruit was recorded from S_1T_0 (49.88) treatment combination (15 days old seedling and control) which is statistically identical to the S_1T_3 treatment combination (48.96). This is might be due that old age seedling develop early reproduction phase than young seedling.

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

Treatment combination	Days 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

3.7 Number of fruit per plant

The total number of fruit per plant showed statistically significant variation due to different seedling age of cucumber (Table 7). The maximum number of fruit per plant (17.18) was recorded from S_3 (25 days old seedling) treatment. On the other hand the lowest number of fruit per plant (11.97) was found from S_1 (15 days old seedling treatment (Table 7). The vigorous vegetative growth might be the contributing factor towards reduced number of fruits in 15 days and 21 days old seedlings. Maximum number of fruits was found from 28 days old seedlings reported by [18]. Older seedlings produce more fruit per plant than others. The result is similar with [19]. There was significant variation on number of fruit per plant due to different level of training (Table 8). The maximum number of fruit per plant (15.93) was recorded from T_1 (removal of all branches up to 40 cm height) treatment. On the other hand, the lowest number of fruit per plant (12.88) was found from T_0 (control). The present finding is agreed with the findings of [9] [13]. Combined effect of different seedling age and training showed statistically significant variation in terms on number of fruit per plant (Table 9) .The highest total number of fruit per plant (19.45) was observed from S_3T_1 (25 days old seedling and removal of all branches up to 40 cm height) treatment combination and the lowest number of fruit per plant (10.47) was recorded from S_1T_0 (15 days old seedling and control) treatment combination.

3.8 Fruit length (cm)

Fruit length of cucumber showed statistically significant variation due to different seedling age (Table 7). The longest fruit (18.08cm) was recorded from S_3 (25 days old seedling) and shortest fruit length was recorded (13.92cm) from S_1 (15 days old seedling) treatment (Table 7). Statistically significant variation was obtained in fruit length due to different level of training (Table 8). The longest fruit (17.03cm) was recorded from T_1 (removal of all branches up to 40 cm height) treatment. The shortest fruit length (15.51 cm) was recorded from T_0 (control) treatment which was statistically similar to T_3 (15.93) treatment (removal of all branches up to 120 cm height). Combined effect between different seedling age and

training showed significant variation in terms of fruit length of cucumber (Table 9). The longest fruit length (18.77cm) was recorded from S_3T_1 (25 days old seedling and removal of all branches up to 40 cm height) treatment combination which was statistically similar to (17.85cm and 17.91cm) S_3T_0 and S_3T_3 treatment combination and the shortest fruit length (12.91cm) was recorded from S_1T_0 treatment combination which was statistically similar to (13.69) S_1T_3 treatment combination.

3.9 Fruit diameter (cm)

The highest diameter of fruits (5.59 cm) was recorded from S_3 (25 days old seedling) treatment and lowest diameter of fruits (3.72 cm) was found from S_1 (15 days old seedling) treatment (Table. 7). Different training levels showed significant impact on the diameters of fruits. The highest diameter of fruits (5.29 cm) was recorded from T_1 (removal of all branches up to 40 cm height) treatment (Table 8).The lowest diameter of fruits (4.28 cm) was found from T_0 treatment which is statistically similar to (4.53 cm) T_3 (removal of all branches up to 120 cm height) treatment. Combined effect between different seedling age and training noted significant variation in terms of fruit diameter of cucumber (Table 9). The highest fruit diameter (6.22 cm) was recorded from S_3T_1 (25 days old seedling and removal of all branches up to 40 cm height) treatment combination and the lowest diameter of fruit (3.18 cm) was recorded from S_1T_0 treatment combination which was statistically similar to S_1T_1 (3.65 cm) treatment combination.

3.10 Individual fruit weight (gm)

Statistically significant variation was obtained in terms of different age of seedling in individual fruit weight of cucumber The highest individual fruit weight (174.33 gm) was obtained from S_3(25 days old seedling). Whereas the lowest individual fruit weight (138.10 gm) was found from S_1(15 days old seedling) treatment (Table 7). This result is also similar with [20]. Weight of cucumber was greatest when seedlings were 25 days old at transplanting. Different levels of training remarked statistically significant variation in individual fruit weight of cucumber (Table 8). The highest individual fruit weight (160.87gm) was recorded from T_1 treatment (Table 8) whereas the lowest individual fruit weight (151.64 gm) was found from T_0treatment.Similar findings was also noted in their early experiment[13] [17].

Combined effect of different seedling age and training showed remarkable significant variation in terms of individual fruit weight (Table 9).The highest individual fruit weight (177.91 gm) was recorded in the S_3T_1 treatment combination (25 days old seedling and removal of all branches up to 40 cm height) and the lowest (132.40 gm) was recorded in the S_1T_0 treatment combination (Table 9).

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

Treatment	Total no of fruit per plant	Length of fruit(cm)	Diameter of fruit(cm)	Individual fruit weight(gm)
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

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

Treatment	Total no of fruit per plant	Length of fruit(cm)	Diameter of fruit(cm)	Individual fruit weight(gm)
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

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

Treatment combination	Total no of fruit per plant	Length of fruit(cm)	Diameter of fruit(cm)	Individual fruit weight(gm)
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

3.11 Yield per plant (kg)

Significant variation was noted on yield per plant of cucumber influenced by different seedling age The highest fruit yield per plant (2.99 kg) was observed from S_3 (25 days old seedling) treatment whereas the lowest fruit yield per plant (1.65 kg) was found from S_1 treatment (Table 10). The higher fruit yield per plant can be positively correlated with more number of fruits per plant. Higher fruit yield with 25 days old seedling also agreed by [18][21].Different levels of training varied significantly in terms of fruit yield per plant of cucumber .The highest fruit yield per plant (2.59 kg) was found from T_1 (Removal of all branches up to 40 cm height) treatment whereas the lowest fruit yield per plant (1.98 kg) was found from T_0 treatment (Table 11). Combined effect between seedling age and training showed statistically significant variation in terms of fruit yield per plant of cucumber (Table 12).The highest fruit yield per plant (3.43 kg) was observed from S_3T_1 treatment combination (25 days old seedling and removal of all branches up to 40 cm height). Whereas the lowest fruit yield per plant (1.38 kg) was found from S_1T_0 (15 days old seedling and control) treatment combination.

3.12 Yield/ plot (kg)

The total yield per plot showed statistically significant variation due to different seedling age of cucumber (Table 10). The maximum number fruit yield per plant (17.98 kg) was recorded from S_3 treatment (25 days old seedling age). The lowest number of fruit yield per plant (9.90 kg) was found from S_1 (15 days old seedling age) treatment. Vegetables cultivated from older seedlings produced higher yields [8]. Different levels of training varied significantly in terms of total yield per plot of cucumber .The highest yield per plot (15.54 kg) was found from T_1 treatment (removal of all branches up to 40 cm height). Whereas the lowest yield per plot (11.91 kg) was found from T_0 (control) treatment (Table 11). By appropriate training system, it will helps for improving growth and increase fruiting area. Results indicated that seedling age and training showed statistically significant variation in terms of total fruit yield per plot of cucumber. The highest fruit yield per plot (20.62 kg) was observed from S_3T_1 (25 days old seedling and removal of all branches up to 40 cm height).treatment combination. Whereas the lowest fruit yield per plot (8.28kg) was found from S_1T_0 (15 days old seedling and control) treatment combination (Table 12).

Table 10.Effect of seedling age on yield per plant, 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

Table 11.Effect of training on yield per plant, 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

4.13 Yield per hectare (ton)

Different Seedling age showed significant variation in terms of fruit yield per hectare of cucumber (Fig3). The highest fruit yield per hectare (41.63 ton) was recorded from S_3 treatment (25 days old seedling age) treatment, whereas the lowest fruit yield per hectare was recorded from (22.92 ton) S_1 (15 days old seedling age) treatment. Similar result was also reported by [20][21][22][23].They also found that older seedling produced higher yield production in different vegetables crops. Different levels of training varied significantly in terms of total yield per hectare of cucumber (Fig 4). The highest yield per hectare (35.97 ton) was found from T_1 treatment. On the other hand, the lowest yield per hectare (27.57 ton) was found from T_0 treatment compared to other treatments. This results are in line with the findings of [13][17][10]. By proper training method plants are capable of produced maximum production of yield by removing unnecessary growth of the plant and using maximum resources.

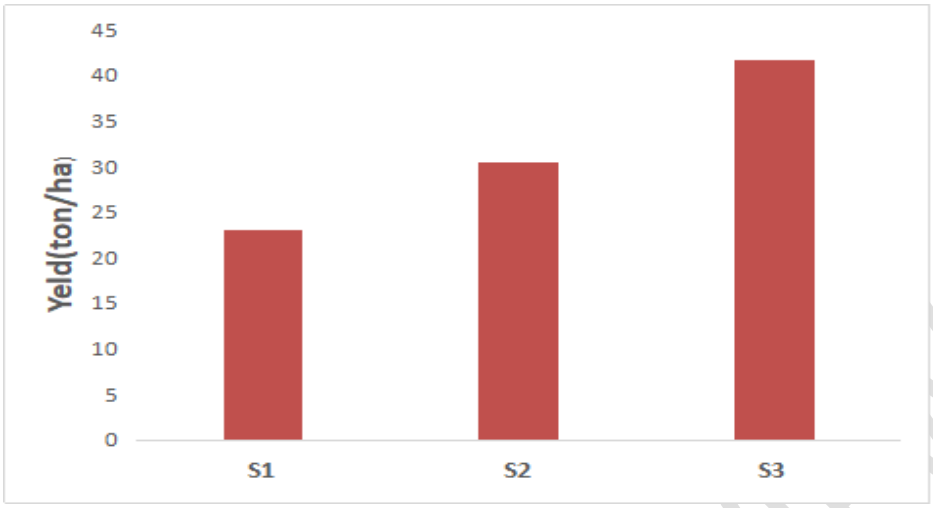

Fig 3. Effect of seedling age on yield per hectare of cucumber

Where,S_1= 15 days old seedling S_2= 20 days old seedling S_3= 25 days old seedling

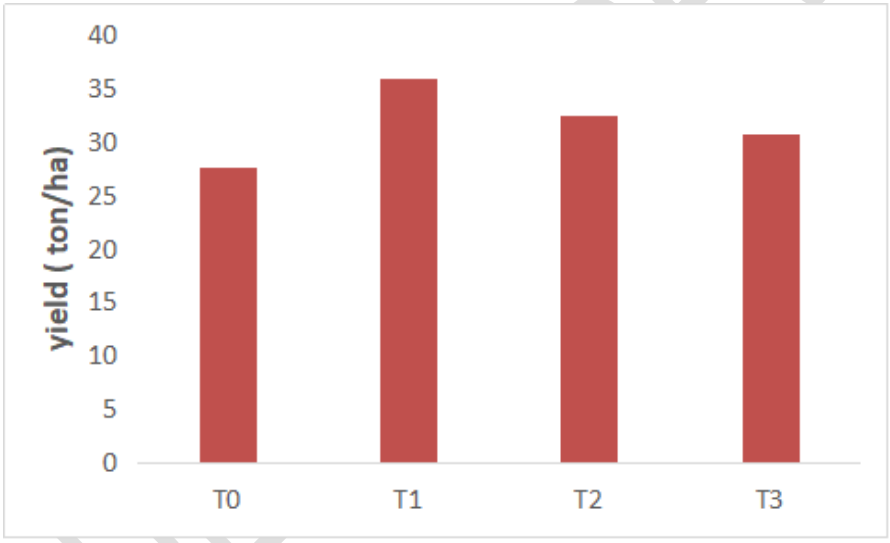

Fig 4. Effect of training on yield per hectare of cucumber

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 all branches up to 120 cm height

Combined effect between different seedling age and training remarked statistically significant variation in terms of total yield per hectare of cucumber. The highest yield per hectare (47.73 ton) was observed from S_3T_1 treatment combination (Table 12).Whereas the lowest yield per hectare (19.16 ton) was found from S_1T_0 treatment combination.

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	13.70 e	31.71 e
S_2T_3	2.14f	12.86 f	29.76f
S_3T_0	2.71c	16.34 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 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

3.16 Economic analysis

Input costs for land preparation, seed cost, fertilizers, irrigation and manpower required for all the operations from planting to harvesting of cucumber were recorded for unit plot and converted into cost per hectare. Price of cucumber was considered as per market rate. The economic analysis presented under the following headings

3.16.1 Gross return

The combination of seedling age and training showed different gross return. The highest gross return (1193250Tk./ha) was obtained from S_3T_1 treatment combination and the second highest gross return (1050750Tk./ha)was found in S_3T_2. The lowest gross return (479000Tk./ha) was obtained fromS_1T_0 treatment combination (Table 13).

3.16.2 Net return

In case of net return different treatment combination showed different net return. The highest net return (730827Tk.) was found from S_3T_1 treatment combination and the second highest net return (588327Tk./ha) was obtained from S_3T_2 treatment combination. The lowest (33272Tk/ha) net return was obtained from S_1T_0 treatment combination (Table 13).

3.16.3 Benefit cost ratio

In the combination of seedling age and training highest benefit cost ratio (2.58) was noted from S_3T_1 treatment combination and the second highest benefit cost ratio (2.27) was estimated fromS_3T_2 treatment combination. The lowest benefit cost ratio (1.07) was obtained from S_1T_0 treatment combination (Table 13). From economic point of view, it was apparent from the above results that the combination of S_3T_1 treatment combination was more profitable than rest 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 (ton/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, Price of cucumber 25 TK/kg

Conclusion:

Considering the above result of this experiment, the following conclusion can be drawn. In the experiment, treatment S_3 (25) days old seedling was excellent to the others treatment. For obtaining the maximum fruit yield of cucumber, 25 days old seedling was performed the best among the others ages of seedling. Among different training system T_1 was found best for higher yield of cucumber than others. The treatment combination of S_3T_1 comprising of 25 days old seedling and removal of all branches up to 40 cm height showed the best capability of 47.73 ton/ha with TK.730827 net income and 2.58BCR.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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