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RESEARCH ARTICLE

EFFECTS OF VARIETIES AND SEEDLINGS AGE ON GROWTH AND YIELD OF CAULIFLOWER

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ABSTRACT

The experiment was conducted at “Nabagram Farmhouse”, Mannan Nagar in Noakhali, Bangladesh during the period from September 2018 to January 2019. The purpose of this study to evaluate the growth and yield of different varieties of cauliflower [Brassica oleracea var. botrytis L.] by the effect of different age of seedlings. The two factor experiment (7 treatments) were laid out in Randomized Complete Block Design (RCBD) with three replications where the unit plot size was 9 m² and spacing was 45 cm × 60 cm for plant to plant and row to row respectively. Factor: A: three varieties viz., T1= Snow crown, T2= Early shoot and T3= Silver cup 65 and Factor: B: different aged seedlings viz., T4 = 18 days old seedlings, T5 = 28 days old seedlings, T6 = 38 days old seedlings and T7 = 48 days old seedlings. Plant height (cm), number of leaves, curd initiation (DAT), curd harvesting (DAT), curd weight (kg) and curd yield (t/ha) were taken as parameters on the growth and yield of the plant. The findings of the experiment indicated that among the different varieties the highest yield can be obtained from T3 = 25.54 t/ha in comparison with T1= 24.34 t/ha. In case of seedling ages, T5 (28 days old seedlings) gives highest growth and yield (26.39 t/ha) whereas the lowest yield (17.00 t/ha) was obtained from T7 (48 days old seedlings). In combined T5 (28 days) old seedlings of Silver cup 65(T3) produced highest yield (26.13 t/ha) in comparison with others treatment combinations. It could be concluded that planting Silver cup 65 F1 (T3) genotype at 38days (T6) old seedling recorded the highest growth values 19.78 cm meanwhile planting the same genotype at 18 days (T4) evaluated the lowest 7.27 cm.

KEYWORDS

Cauliflower Variety (Genotype), Seedling Age, Growth, Yield

1. INTRODUCTION

Bangladesh is one of the densely populated countries in the world whose population is increasing day by day but most of the people of the country suffer from malnutrition (Rana et al., 2019). According to the FAO recommendation, the amount of consumption of vegetables should be at least 200 g/day/person but the average intake of vegetables by the people of Bangladesh is far below the standard (FAO, 2017). By increasing the production of cole vegetable crops, we can ensure nutritional demand of the country and contribute in national economy. Cauliflower (Brassica oleracea var. botrytis L.) belongs to Brassicaceae family that occupies the most important position among all vegetables of all over the world for its white tender curd and, now-a-days, many of the tropical type varieties are well adapted under our climatic conditions (Nidhi et al., 2016).

Cauliflower is a biannual crops, moreover it's a famous winter season vegetables which is locally popular as “Phulkapi” (Hossain et al., 2015;

Rahman et al., 2016). Cauliflower is often considered one of the healthiest foods on Earth, because supply of health-promoting phytochemicals, high level of anti-inflammatory compounds, and ability to ward off cancer, heart diseases and brain diseases (USDA, 2018). Vegetable consumption in Bangladesh is very low, only 32 g per person per day against the minimum recommended quantity of 200g per day (FAO, 2007). The total vegetable production in Bangladesh is far below the requirement. In 2016-2017, cauliflower covered an area of 48,725 acres with a total production of 277,500 metric tons (BBS, 2017). In general, cauliflower is not difficult to grow, but it is sensitive to extreme temperatures. Primarily a cool-weather crop, cauliflower won't produce heads in hot weather and is frost-tolerant only as a mature fall crop (Din et al., 2007).

Most cultivators need about 3 months of cool weather to mature. To grow cauliflower successfully, the key steps are to choose the right cultivar for climate, plant at the proper time, and appropriate age of seedlings.

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Cauliflower is very sensitive to temperature depending on varieties so, selection of varieties depends on time of planting. Selection of suitable varieties for sowing at proper time is the key factor for successful cauliflower production (Refai and Hassan, 2019). The sowing and transplanting time should be adjusted in such a manner that plants put up maximum vegetative growth before the temperature goes very low. Date of sowing is an important non-monitory input which plays an important role in deciding growth and yield of crops (Kumari et al., 2019). Generally, cauliflower reproduces through seeds which sown on the seed bed and seedlings are transplanted into the main field. It's growth is best at a temperature of about 15 to 25°C and neutral or slightly acid soil (pH 6.0 to 6.5) (Yearbook of Agricultural Statistics, 2017). Well drained sandy loam soils are suited to early varieties whereas loamy and clay loam are suited to late ones.

In Bangladesh the best time of cauliflower cultivation is late October to mid-November (BBS, 2014). Bangladesh are growing cauliflower following indigenous methods having the poor yield rate. The reasons behind such low yield due to lack of high yielding variety, method of production practices and appropriate aged seedlings followed by the local growers. Plant spacing is an important key factor for the growth and yield of the cauliflower. In general, 45 cm is considered best for getting higher yield of the cauliflower (Iqbal et al., 2007). The yield of cauliflower can be increased by adopting improve production technology like proper plant spacing, proper age of seedling and proper planting system. Thus, this study is revealed that the varieties and age of the seedlings has a significant impact on the cauliflower growth as well as its total yield.

2. MATERIALS AND METHODS

2.1 Experimental site

The research had been done in Noakhali, Bangladesh from September 2018 to January 2019 (Rabi Season) in the field of Nabagram Farmhouse, Mannan nagar, Noakhali. It is situated in between 22°38' and 22°59' north latitudes and in between 90°54' and 91°15' east longitudes which fall under the AEZ 18 i.e. Young Meghna Estuarine Flood plain. The experimental site is indicated on the map of AEZ of Bangladesh. During conduction of the experiment, the highest temperature 30.67°C was recorded during the month of November while RH 99% was recorded

during the month of November. Highest amount of rainfall 2mm was recorded in the month of September.

Figure 1: Experimental site on GPS Map

2.2 Soil Condition of the Experimental site

The soil was tested by Soil Resource Development Institute, Noakhali. According to test report, it was found that amount of N is 0.04%, which is very low. P is present at 27.79 µg/g soil which is optimum at upland and higher in wet land. K is present at 0.18 mEq/100g soil which is lower in upland and medium in wetland. The soil is slightly alkaline with pH 8.30 with organic matter content is about 0.64% which is very low.

2.3 Experimental Materials

The research material were cauliflower seedlings varieties named Snow crown, Silver cup 65 and Early shoot used. The research material was collected from different seed shops in Noakhali districts.

2.4 Experimental Treatments

The experiment was carried out in two factors: Factor A and Factor B which is showed in the table no 1. Each treatments conducted with three replication where 8 plants used in each replication.

Table 1: Treatments of the Experiment

Treatments	Factor A (Variety/Genotype, F1)			Factor B (Age of Seedlings)			
	T1	T2	T3	T4	T5	T6	T7
	Snow crown	Early shot	Silver cup 65	18 Days	28 Days	38 Days	48 Days

2.5 Experimental Design

Total 12 treatment combinations and number of plot 36 were used in the experiment. The land was ploughed to fine tilth properly and applying the proper amount of fertilizers. The field was fertilized with urea, triple super phosphate (TSP), muriate of potash (MP) at the rate of 1.5 kg/plot,

0.75 kg/plot, 0.70 kg / plot respectively of the basal application in final land preparation. Applying at the rate of 75 gm, 35 gm and 30 gm of urea, triple super phosphate and muriate of potash respectively/ plant in ring system during 25 DAT and 40 DAT. Seed sowing was done on 19th September 2018 in the seedbed that was 0.9 m² in size and 0.05 m in height. Before sowing, seed treatment was done with carbandazim 50 WP. After that seedlings were uprooted carefully from the seed bed at four installment 18, 28, 38 and 48 aged seedlings in each genotype. Among the genotypes (varieties) 18 days aged seedlings on 14th October, 28 days aged seedlings on 24th October, 38 days aged seedlings on 4th November and 48 days aged seedlings were transplanted on 14th November maintaining spacing 45 cm × 60 cm at the rate of one seedlings per hill.

2.6 Weed and Water Management

During the growth period of the crop the weed should be removed from the field. Generally, hand weeding are done at 20, 35 and 50 days after transplanting (DAT). Watering were done at 10, 25, 35 and 50 days after transplanting.

2.7 Collection of Data

Continuous observation was done to ensure better growth of plants for good yield. The data were collected from the 5 plants from each plot in different stages of crop growth for obtaining various growth and yield parameters.

2.8 Statistical Analysis of Data

The experiment was arranged in Randomize Complete Block Design (RCBD) statistical methods. The recorded data of different parameters in this study were analyzed statistically by using IBM SPSS software (version

25) and post hoc analysis (Tukey HSDa.b homogeneity test) to check the significant or non-significant differences within treatments at 5% probability according to (Gomez and Gomez, 1984).

3. RESULTS AND DISCUSSION

3.1 Vegetative Growth Parameters (Height and No. of Leaves)

In the Table 2, the result clearly showed that the growth characters of plant height (cm), number of leaves per plants and yield were significantly influenced by the different seedlings ages as well as genotypes of the cauliflower. Plant height increased i.e. 56.58 cm at 55 DAT in T1 variety whereas other varieties provided almost similar height in all stages of transplanting, 35 DAT and 55 DAT respectively. The maximum number of

leaves was 14.91 at 35 days of seedling transplanting which is recorded from T1 genotype and minimal number of leaves was about 12.91 obtained from T2 genotype in the case of Factor A. Moreover, the highest plant height of seedling observed from T1 genotype at transplanting stage which was 14.09 cm. On the top of that, in the Factor B, seedlings plant height at transplanting stage 22.74 cm at T7 old seedlings seems to be the highest in comparison with the treatments T4, T5 and T6 old seedlings height i.e. 7.49 cm, and 13.66 cm respectively. Similarly, plant height also varies at 35 DAT and 55DAT in case of T4, T5 and T6 old seedlings individually. Maximum number of leaves was recorded 14.08 in the T4 and minimum 11.93 in the T7 old seedlings at 35 DAT. Particularly, some investigators studied the differences among genotypes of varieties under Egyptian conditions where they revealed that wide variation among vegetative growth of cauliflower is caused by the different varieties (Zaki et al., 2012; Ray and Mishra, 2017).

Table 2: Effects of Variety and Age of seedlings on Growth and Yield of Cauliflower

Treatments	Seedling height (cm)	Plant height (cm)		No of leaves/plant 35 DAT	Yield (ton/ha)
		35 DAT	55 DAT		
Factor A : Variety					
T1	14.09a**	41.09a**	56.58a**	14.91a**	24.34b**
T2	13.75b**	35.60c**	50.52c**	12.91c**	21.73c**
T3	12.71c**	36.65b**	52.59b**	13.75b**	25.54a**
CV (%)	0.831	1.115	0.206	1.410	1.504
Factor B: Age of Seedling					
T4	7.49d**	38.97a**	57.18a**	14.08a*	24.11b**
T5	13.66c**	38.07a**	56.65a**	13.90a*	26.39a**
T6	18.70b**	35.76b**	49.08b**	13.23a*	19.76c**
T7	22.74a**	28.52c**	37.72c**	11.93b*	17.00d**
CV (%)	3.046	2.544	1.733	4.321	2.810

N.B: **= 1% Level of Probability, *=5% Level of Probability, Mean separation by DMRT at 5% level.

3.2 Cauliflower Yield Performance

The data presented in table 2 showed that more yield (25.54 t/ha) was found from the T3 genotype while less yield (21.73 t/ha) gained from T2 genotype which is comparatively lower than the yield obtained from another genotype T1 i.e. 24.34 t/ha which were influenced by the genotype of cauliflower. It is also indicated that the maximum early yield (26.39 t/ha) recorded at 28 days (T5) old seedlings and minimal yield (17.00 t/ha) found from 48 days (T7) old seedlings in case of seedling ages differences. Some researchers mentioned in their study that late planting unfavorable for yield of cauliflower, this might be due to the transition in weather towards lowering down the average maximum and minimum temperature whereas higher yield in the early sown crop might also be as a result of the accumulation of more photosynthates for higher production which are very closely in line of the conducted experimental findings (Gomez and Gomez, 1984; Oad et al., 2002). Moreover, sometimes the genetic differences of genotype of the cauliflower significantly influenced the performance of the genotypes (Refai and Hosseiny, 2005).

3.3 Curd Initiation

Significant variations were recorded regarding age of seedlings on the initiation of curd of cauliflower varieties (Table 3). Number of days to visible curds was significantly affected by cauliflower genotypes. In the study, T1 genotypes took 60.56 days to initiate the curd while T2 required 34.68 days after transplanting. This might be due to the varieties differences for visible curds could be ascribed to the differences in their genetic makeup. The result are in agreement with those reported (Ray and Mishra, 2017). The maximum time (47.10 days) took for initiating curd in T4 old seedlings and the minimum, (41.67 days) required in T6 old seedlings. On the contrary, T5 and T7 old seedlings took respectively 44.53 days and 43.33 days to initiate its curd. It is observed that different duration required for curd initiation to the different genotype due to the unique genetic characteristic of the genotypes (Pandy et al., 1981).

3.4 Curd Development and Harvesting

Development of curd significantly influenced by the age of seedlings as well as the varieties used in the study. From the table 3 it is illustrated that T1 genotype required 20.33 days for curd development and 81.27 days for its harvesting. Similarly, lowest days i.e. 12.44 days recorded in T3 genotype curd development whereas 46.27 days required for T2 Curd harvesting. On the other hand, T7 old seedlings took highest days (61.33) for harvesting and lowest days (56.66) recorded for T5 old seedlings.

However, in case of curd development minimum 13.22 days needed in case of T4 old seedlings while maximum days (19.33) required for development the curd at T7 old seedlings. The results of Salter's work and our works maybe caused because of the cultivars used in the study. Salter recorded a positive correlation between duration of the curd initiation and duration of the harvesting though it has a considerable variation and the relation which was cultivar dependent (Booij, 1990). But in other experiment they did not find a relation between duration of the initiation and the harvesting period for winter heading cauliflower cultivars (Wurr et al., 1981).

Table 3: Effects of Variety and Age of seedlings on Curd Growth of Cauliflower

Treatments	Curd initiation (DAT)	Harvesting (DAT)	Curd development time (Days)	uration (Days)	Curd weight/plant (kg)
Factor A : Variety					
T1	60.56a**	81.27a**	20.66a**	109.00a**	0.64a*
T2	34.69c**	46.27c**	13.84b**	74.00c**	0.56b*
T3	38.64b**	51.11b**	12.44c**	80.00b**	0.67a*
CV (%)	0.666	0.425	3.377	1.317	5.566
Factor B: Age of Seedling					
T4	47.10a**	60.33ab**	13.22c**	78.56d**	0.63b**
T5	44.53b**	56.66c**	13.78c**	86.55c**	0.69a**
T6	41.67b**	59.44b**	18.33b**	96.33b**	0.51c**
T7	43.33c**	61.33a**	19.33a**	102.00a**	0.45d**
CV (%)	1.398	1.306	2.897	0.673	5.101

N.B. **= 1% Level of Probability, *= 5% Level of Probability. Mean separation by DMRT 5% level.

3.5 Weight of Curd

All the growth and yield parameters significantly differences in both of the at 1% level of probability and 5% level of probability except marketable curd weight in which the level of significance recorded at 5% level of probability (Table 3). In case of marketable curd parameters, highest marketable curd obtained from T3 genotype (0.67 kg) i.e., Silver cup 65 variety. The lowest weight of marketable curd 0.56kg gained from T2 genotype per plant. Table. 3 also showed that the age of seedlings, the peak marketable curd had weighted 0.69 kg per plant from T5 age old seedlings which was nearest weight of curd observed from T4 aged seedlings. However, the steep weight of curd was 0.45 kg recorded from T7 age old seedlings. More weight curd might be obtained as a result of optimally spaced plant utilization which was recommended in their findings that 45 cm spacing used for getting higher yield of cotton whereas the narrow plant spacing could not record optimum plant characters (Oad et al., 2002).

3.6 Combined Effect of Varieties and Age of Seedlings

All the growth and yield parameters significantly influenced of the combination of variety and age of seedlings (Table 2). The highest yield (26.13 t/ha) were obtained from the Early Shoot with 28 days old seedlings (T2T5). Silver shoot with its 48 days old seedlings (T2T7) gave the lowest yield (16.08 t/ha). Recorded data showed that, better yield were found from the 28 days old seedlings in compare with others aged seedlings in associated with different varieties. 23.56 t/ha, 26.04 t/ha, 22.49 t/ha and 16.60 t/ha yield which were recorded in T1T4, T1T5, T1T6 and T1T7 respectively. T3T4, T3T5, T3T6 and T3T7 treatment combination gave 22.39 t/ha, 23.80 t/ha, 20.52 t/ha and 16.17 t/ha yield. In case of marketable curd weight significantly variation were recorded in

Snow crown (T1), Early shoot (T2) and Silver cup 65 T3) varieties with its 18, 28, 38 and 48 days old seedlings (Table 4).

Highest curd (0.68 kg/plant) were recorded in both Silver Crown (T1) and Early Shoot (T2) with 28 days old seedlings (T1T5 and T2T5) and lowest (0.423 kg/plant) was found in 48 days old seedlings of Silver cup 65 variety (T3T7). The recorded data indicated that better curd/plant was found in 28 days old seedlings in associated with different varieties in compare with others treatment combinations. Early Shoot variety in 18, 38 and 48 days old seedlings gave 0.64 kg, 0.54 kg and 0.44 kg marketable curd/plant while 0.58 kg, 0.62 kg and 0.53 kg curd were obtained from Silver cup 65 variety (T3T4, T3T5 and T3T6) respectively. In case of plant height, maximum 21.81cm at transplanting stage were obtained in Snow crown (T1) with its 48 days old seedlings (T1T7) and minimum plant height 7.40 cm in Snow crown (T1) with its 18 days old seedlings (T1T4).

Plant height at 35 DAT were observed in Snow crown (T1) with its 18, 28, 38 and 48 days old seedlings (T1T4), (T1T5), (T1T6) and (T1T7) was 42.32 cm, 43.47 cm, 38.34 cm and 35.28 cm respectively. In Early Shoot (T2) with its 18 and 48 days old seedlings gave the highest (38.77 cm) and lowest (30.61 cm) plant height at 35 DAT. Different varieties gave higher plant height at 18 and 28 days old seedlings stage, 35 DAT and 55 DAT in compare with 38 and 48 days old seedlings. Consequently, number of leaves at 35 DAT higher (13.89) in Early Shoot (T2) with 18 old seedlings in comparison with other varieties. From the table 4 it is clearly illustrated that among all varieties Snow Crown (T1) gave maximum growth and yield though seedling age has a great effect on it. Meanwhile, another two varieties has also influenced by the seedling aged but Silver cup 65 variety gave the lowest growth in all parameters and it is same in yield production too.

Table 4: Combined Effects of Treatments on Growth and Yield of Cauliflower

Combined Treatment	Seedling height (cm)	Plant height (cm)		No leaves/plant (DAT)	ofCurd initiation DAT	Harvest DAT	Curd Development (Days)	uration (Days)	Curd weight/plant (kg)	Yield (t/ha)
		35 DAT	55 DAT							
T1 T4	7.40f	42.32b	62.71a	13.11cd	68.33a	81.27a	13.47e	93.27e	0.62b	23.56c
T1 T5	15.31d	43.47a	58.65b	13.33bc	59.33b	80.8ab	21.28b	108.39c	0.68a	26.04a
T1 T6	18.96c	38.34c	48.01e	13.11cd	54.11d	80.14b	26.17a	118.17b	0.58c	22.49d
T1 T7	21.81a	35.28d	41.74g	12.33e	58.22c	72.30c	14.50d	125.39a	0.44e	16.60f
T2 T4	7.55f	38.77c	56.51c	13.89ab	42.22e	55.39d	13.61e	73.33h	0.64b	24.77b
T2 T5	14.23e	38.18c	53.11d	13.77ab	40.00f	50.79e	10.02h	77.95g	0.68a	26.13a
T2 T6	18.26c	33.65e	45.50f	13.33bc	34.11i	48.29f	14.50d	86.39f	0.54d	20.96e
T2 T7	20.75b	30.61f	40.08h	12.55de	38.11g	50.28e	12.45f	95.86de	0.44e	16.08f
T3 T4	7.52f	35.55d	57.3bc	14.00a	34.22i	48.28f	14.61d	64.33i	0.58c	22.39d
T3 T5	14.69de	35.26d	54.22d	13.33bc	35.11h	47.11g	11.50g	74.39h	0.62b	23.80c
T3 T6	19.05c	32.97e	47.63e	13.00cd	35.22h	50.47e	15.33c	85.33f	0.53d	20.52e
T3 T7	21.41ab	30.74f	42.49g	12.66de	33.11j	43.44h	12.36f	98.11d	0.42e	16.17f
CV (%)	3.673	1.699	1.616	2.687	1.036	1.068	2.064	1.686	3.437	1.419
Level of Sig.	**	**	**	**	**	**	**	**	**	**

N.B. **= 1% Level of Probability *= 5% Level of Probability. Mean separation by DMRT 5% level.

4. CONCLUSION

On the basis of results, it is revealed that the growth parameters and yield of cauliflower was significantly affected by seedling ages as well as the different varieties. The findings of the experiment indicated that the 28 days age seedlings of Silver cup 65 F1 is far better than the 28 days age seedlings of Snow crown F1 because the 28days aged seedlings gave more yield which required lower days from the seed sowing to curd harvesting in 45cm×60cm plant spacing condition that would be beneficial for better growth parameters and yield production of cauliflower. But in case of combined treatment, it will better use Snow Crown than other two as it showed much more productivity in all parameters.

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