Variation in Growth and Yield of Tomato at Different Transplanting Time

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Abstract- The present study was carried out to examine the effect of different planting dates on growth, flowering and fruit yield of tomato during November 2013 to April 2014. Three transplanting were done at an interval of 10 days. The different transplanting dates were; December 10, December 20 and December 30. The experimental results showed that different planting dates showed significant influence on growth and reproductive characters of tomato including fruit yield. The first transplanting date, December 10 resulted in improvement of all the attributes including increased plant height (63.54 cm), leaf number (33.3), flower number (71.15 days), fruit number (41.98 days), number of flowers plant^{-1} (150), number of fruit plant^{-1} (86.08) and yield per hectare (85 t) compared to 2nd transplanting date, December 20 and 3rd transplanting date, December 30.Therfore, it is suggesting that earlier transplating produced higher friut yield of tomato.

Index Terms- Tomato; Transplanting time; Yield

I. INTRODUCTION

Tomato (*Lycopersicon esculentum* L.) is a fruit producing annually cultivated vegetable fruit crop under the family of Solanaceae (Haque *et al.,* 1999). It is native to Western South America and use as a nutritious edible fruit throughout the planet that is grown in both greenhouse and field conditions (Smith, 1994). Tomato is generally grown in the winter season in Bangladesh. Typically, it is herbaceous, 1 to 3 m in height that often sprawl over the ground. The fruit type of tomato is berry with variable in size and weight found in different varieties that can contribute to yield. It contains a large quantity of water (%), calcium (%) and Niacin all of which are of great importance in the metabolic activities of man (Olaniyi *et al.,* 2010). BARI (2010) showed that ripen tomato contains 94 g water, 0.5 g minerals, 0.8 g fibre, 0.9 g protein, 356 mg carotene, 0.12 mg vitamin B-1, 0.06 mg vitamin B-2 and 27 mg vitamin C in each 100 g. At present, it consumes as a raw salad, cooked or as processed food item such as Sauce, Ketchup, Jam, Jelly etc.

Climate change is a major threat for crop production not only Bangladesh but also all over the world. Tomato production in Bangladesh is commonly affected due to adverse environmental conditions. In some areas of our country particularly in the northwestern part, the night temperature falls even sometimes go below 5-6°C in late December to January, which results remarkable yield loss in tomato. Thus late time of sowing or transplanting-induced cold injury exhibit a significant reduction on both growth and yield of tomato. Therefore, this experiment was conducted to examine the influence of different time of transplanting on morpho-physiology and yield of tomato.

II. METHOD AND MATERIALS

The experiment was carried out at Sher-e-Bangla Agricultural University Farm, Dhaka-1207, Bangladesh which located at 90°22′ E longitude and 23°4l′ N latitude at an altitude of 8.6 meters above the sea level under the agro-ecological zone of Modhupur Tract, AEZ-28 during December 2013 to April 2014 to examine the response to different planting time on morphology, yield and yield attributes of BARI Tomato-15. The experiment was laid out in single factors randomized complete block design with five replications. Treatments of the experiment was 10 December 2013 = First transplanting time (T_1), 20 December 2013 = Second transplanting time (T_2), 30 December 2013 = Third transplanting time (T_3). The total plot number was 3 x 5 = 15.The unit plot size was 1.8 m × 1.5 m = 2.7 m^2. The distance between blocks was 1m and distance between plots was 0.5 m and plant spacing was 50 cm × 60 cm. The land was ploughed with tractor and power tiller for four times. Then the ploughed soil was brought into desirable fine tilth and leveled by laddering. The weeds and stubbles were cleaned properly. The final ploughing and land preparation were done on 1 December, 2013. According to the lay out of the experiment the entire experimental area was divided into blocks and prepared the experimental plot for the transplanting of tomato seedling. In addition, irrigation and drainage channels were made around the plot.

III. RESULT AND DISCUSSION

Plant height (cm):

It is usual that the effect of transplanting time in relation to change of temperature of the environment is reflected primarily in plant height. Many previous authors stated that different days of transplanting-induced cold condition showed the reduction of length of plant axis or height (Chen *et al.,* 1999). In this experiment, the temperature was gradually declining trend during November 2013 to January 2014. The height of 25 day age seedling was also gradually decreasing with different days of sowing or late sowing (data not shown). In this study, late

transplanting of tomato showed a significant reduction in plant height (cm) of tomato (Table. 1). The highest plant height (70.28 cm) was observed from the T_1 which was statistically similar to T_2 (69.86 cm) and the lowest (58.24 cm) was observed from T_3 time of planting at 60 days after transplanting (DAT). The variation of height of tomato plant at different DAT is identical to seedling height of tomato plant. These results indicate that late sowing of tomato have to withstand cold environment. These results are consistent with the findings of Lawahori *et. al*., (1963) who stated that plant height decreased with decreasing trend of temperature. Recently, Srivastava and Srivastava (2007) reported that transplanting time had great effect on the regulation of plant architecture as well as plant height of tomato. Altogether, the present results suggest that plant height of tomato decreased with the late planting from optimum time of our environmental conditions.

Number of leaves plant^{-1}

The leaf number is a fundamental morphological character for plant growth and development as leaf is the main photosynthetic organ. To investigate the effect of different days of transplanting of tomato on changes in the number of leaves plant^{-1} up to 60 DAT, the number of leaves were counted. Different days of transplanting showed a significant influenced on the formation of leaves plant^{-1} in tomato (Table. 1). The highest number of leaves plant^{-1} (71.76) was observed from the T_1 and the lowest (34.50) was observed from late transplanting, T_3 time. These results showed that the highest number of leaves plant^{-1} found from early transplanting time and minimum number of leaves was observed at late transplanting when the temperature was gradually declining that creates cold stress to the late planting plants. Hossain *et al*. (1986) reported that early sowing enhanced total number of leaves plant^{-1}. Therefore, altogether this experimental result indicates that the number of leaves plant^{-1} of tomato will be decreased at late planting under our environmental conditions.

Number of branches plant^{-1}

Branches plant^{-1} of tomato were significantly influenced by transplanting times (Table. 1). The highest number of branches plant^{-1} (8.981) was observed from the T_1 which was statistically similar to T_2 (8.574) and the lowest (5.537) was observed from T_3. Among dates of planting, early planting recorded the highest vegetative growth Singh *et al*. (2005). Number of branches plant^{-1} was found to be gradually decreased with the late transplanting dates (Mira *et al.*, 2011). Therefore, the presented results are consistent with many other previous findings published.

SPAD value

There was a clear effect of transplanting time on the SPAD value of tomato plant leaf for T_1, T_2 and T_3 (Table. 1). The SPAD value of tomato leaves higher in T_1 other than T_2 and T_3 decreased at late transplanting. The highest SPAD value was observed from the T_1 (59.83) and the lowest (54.30) was observed from T_3. From this experiment it was observed that the SPAD value decreased gradually when transplanting of tomato done at early December to late December.

Table: 1. Data on plant height, number of leaves, SPAD value and number of branches of tomato as influenced by different transplanting time.

Time	Plant Height	Leaf No.	Branch No.	SPAD value
T_1	70.28 a	71.76 a	8.981 a	59.83 a
T_2	69.86 a	44.61 b	8.574 a	56.39 b
T_3	58.24 b	34.50 c	5.537 b	54.30 c
LSD $_{(0.05)}$	3.429	6.205	1.121	1.383
CV (%)	7.65	18.21	19.16	3.59

Number of flowers plant^{-1}

Planting time had significant effect on number of flowers plant^{-1} of tomato (Table. 2). The highest number of flowers plant^{-1} was observed from the T_1 (149.9) and the lowest (137.3) was observed from T_3 treatment which was statistically similar to T_2 (140.9). Hossain *et al.* (1986) reported that early sowing enhanced total number of flowers plant^{-1}. From these results, it was found that the early transplanted tomato seedlings produce more flower than lately transplanted tomato seedlings.

Number of fruits plant^{-1}

Number of fruits plant^{-1} of tomato showed significant differences in response to transplanting time (Table. 2). The highest Fruits number plant^{-1} (86.08) was observed from the T_1 which was statistically similar to T_2 (84.04) and the lowest (73.89) was observed from T_3. Maximum number of fruits plant^{-1} from early and the minimum from late transplanting due to high temperature (BARI, 1989). Adelana (1976) and Drost and Price (1991) had also reported that late transplanting reduce fruits number and early showed increasing trend. Jong *et al.* (2009) had reported that the initiation of tomato fruit growth, fruit set, is very sensitive to environmental conditions. So it can easily understand that environmental condition regulate the number fruits plant^{-1}as when near optimum temperature was present produced the highest number of fruits and in unfavorable temperature condition decreased the number of fruits plant^{-1}.

Fruit diameter (cm)

In this study planting time showed significant variation in the fruit diameter (cm) of tomato (Table. 2). The highest fruit diameter (5.50) was observed from the T_1 which is statistically similar with T_2 (5.41) and the lowest (5.31) was observed from T_3 treatment. Madhumathi and Sadarunnisa (2013) reported that date of transplanting affected the fruit diameter of tomato. From the study of results it was found that early transplanting provide higher fruit diameter than the late transplanted tomato plant.

Fruit length (cm)

As consistent to fruit diameter planting time had significant influenced on fruit length (cm) of tomato (Table. 2). The highest fruit length (6.24) was observed from the T_1 which was statistically similar to T_2 (6.19) and the lowest (5.96) was observed from T_3. These data showed that early transplanting time increased fruit length (cm) in contrast to late transplanting. Madhumathi and Sadarunnisa (2013) had reported that early transplanting showed the maximum fruit length of tomato fruit among different varieties.

Table: 2. Data on Flower number, Fruit Number, Fruit Diameter and Fruit length of tomato as influenced by different transplanting time.

Time	Flower No.	Fruit No.	Fruit Diameter	Fruit length
T_1	149.9 a	86.08 a	5.503 a	6.237 a
T_2	140.9 b	84.04 a	5.408 ab	6.195 a
T_3	137.3 b	73.89 b	5.306 b	5.963 b
LSD $_{(0.05)}$	7.555	4.912	0.1645	0.1560
CV (%)	7.82	8.91	4.49	3.74

Yield (kg plot^{-1}) and (t ha^{-1})

As morphological characters the yield of tomato also significantly reduced by late transplanting-induced cold stress (Fig. 1, A and B). The highest yield plot^{-1} (21.73 kg) and yield ha^{-1} (80.46 t) were observed from the T_1 and the lowest yield plot^{-1} (15.80 kg) and yield ha^{-1} (58.53 t) were observed from T_3 or late planting. The results of both yield (kg plot^{-1}) and yield (t ha^{-1}) of tomato is gradually decreasing with the late transplanting, T_3. These results are consistent with the yield contributing characters which are analyzed in this experiment such as number of flowers plant^{-1}, fruit diameter and fruit length (Table. 2). These information are also dependable on growth measuring parameters of this study (Table. 1). In addition, Sanjoy (1999) showed a declining trend in fruit yield and other yield attributing characters when planted lately. Tongova and Zhelev (1975) reported that early sowing or early planting of tomato gave increased yield. Previous authors reported as well that early transplanting of tomato gave increased fruit weight and yield of tomato (Adelana 1976). These results suggest that suitable transplanting time is more favorable to produce highest plant height, leaf number, branch number as a result higher flower produced which enhance the higher fruit set and development i.e. fruit diameter and length of tomato which contribute to maximum yield than late transplanting-induced cold injury.

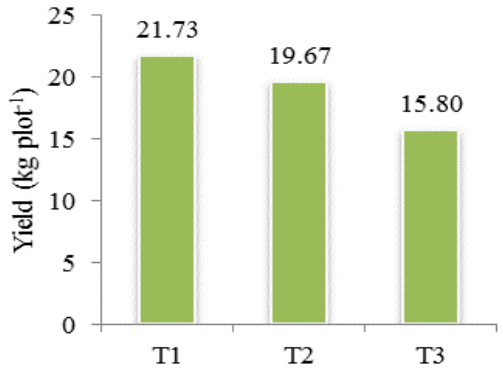

Fig. : 1. A

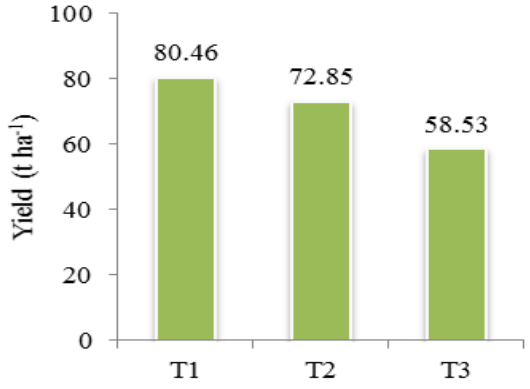

Fig. : 1. B

T_1 – First transplanting time, 10 December 2013
T_2 – Second transplanting time, 20 December 2013
T_3– Third transplanting time, 30 December 2013

Fig. : 1. Effect of transplanting time on the yield plot^{-1} in kg (A) and yield in t ha^{-1} (B) of tomato ($LSD_{0.05}$ = 1.150 and 4.259 for yield kg plot^{-1} and t ha^{-1} respectively).

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