

# Effects of planting dates and variety on growth and yield of strawberry

Chaitanya Paul<sup>1</sup>, Joydeb Gomasta<sup>2</sup>, M. M. Hossain<sup>3</sup>

<sup>1</sup>Assistant Director, Bangladesh Agricultural Development Corporation (BADC), Dhaka, Bangladesh

<sup>2</sup>Scientific Officer, Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Rahmatpur, Barisal, Bangladesh

<sup>3</sup>Professor, Department of Horticulture, Bangladesh Agricultural University (BAU), Mymensingh, Bangladesh

**Abstract**— A field experiment was conducted with two varieties viz; BARI strawberry-1 and Rabi strawberry-1 and three different planting dates viz; November 01, December 01 and January 01 at Bangladesh Agricultural University, Mymensingh, Bangladesh during November 2015 to March 2016 to study the effects of planting date and variety on growth and yield of strawberry. Significantly higher number of leaves per plant, plant height and leaf area with not significant but earlier flowering and fruit setting were observed in BARI strawberry-1 while number of fruits per plant, yield per plant, yield per hectare and individual fruit weight were found higher in Rabi strawberry-1 but variation was not significant and again dry matter and TSS content of fruit were found significantly higher in BARI strawberry-1. Among the planting dates 1<sup>st</sup> November planting was found to have the maximum number of leaves per plant, plant height and leaf area with the longest duration to get flowering and fruit setting and finally resulted in maximum number of fruits per plant, yield per plant, yield per hectare and individual fruit weight followed by 1<sup>st</sup> December and 1<sup>st</sup> January planting. But dry content and TSS matter content was found maximum in 1<sup>st</sup> January and 1<sup>st</sup> December planting, respectively. Again, it was observed that BARI strawberry-1 with 1<sup>st</sup> November planting gave maximum number of leaves per plant (13.66), tallest plant (22.50 cm) and maximum leaf area (189.38 cm<sup>2</sup>), while shorter period for flowering (33.66 days), fruit setting (5.33 days) were recorded in BARI strawberry-1 with 1<sup>st</sup> January planting and early fruit harvesting (16.66 days) was done from BARI strawberry-1 with 1<sup>st</sup> December planting. On the other hand, number of fruits per plant (20.66) was found maximum in BARI strawberry-1 with November planting but fruit yield per plant (319.22 g), fruit yield per hectare (13.30 t/ha) and fresh individual fruit weight (20.45 g) were found maximum in Rabi strawberry-1 with 1<sup>st</sup> November planting followed by BARI strawberry-1 with 1<sup>st</sup> November planting. Thus, singly variety had no significant contribution to growth and yield characters which planting dates lonely possessed. Eventually, 1<sup>st</sup>

November planting in both Rabi strawberry-1 and BARI strawberry-1 yielded maximum having other positive growth characters.

**Keyword**— Strawberry, planting times, variety, growth, yield and quality.

## I. INTRODUCTION

Strawberry, belonging to the family Rosaceae, is one of the most delicious and sweet flavoured fruit. It has a unique place among all the berry fruits because of its charming red color and its nutritive value [1] and enriched with organic and vitamins [2]. Though it is a major fruit of temperate region but it can be grown even in both tropical and subtropical region [3] and the area under this crop in the sub-continent is increasing rapidly [4]. Strawberries have been introduced in Bangladesh recently and getting popularity with a very small scale cultivation [5]. It grows well in the winter especially October-November is the best time for its planting so that it can complete its life cycle before March [6]. Being a winter season crop, it has to face a lot of natural adverse like poor soil moisture, temperature fluctuation and so on specially during flowering and fruiting [1]. The time of planting is a limiting factor for strawberry because of the short winter in Bangladesh and furthermore the production of strawberry depends greatly on the day temperature, humidity and day length. The cultivars are significantly influenced by weather conditions and planting time, with the latter having a direct effect on day and night temperatures, day light intensity and photoperiod, which affect the floral induction, fruit size, quality and production [7]. Thus, the planting time of strawberry is important for partitioning the assimilates, which directly influence the growth and yield of strawberry [8]. Hence, the present research experiment has been planned and designed with the objectives of searching out appropriate date of planting for better growth and development of strawberry in Bangladesh context.

## II. MATERIALS AND METHODS

### 2.1 Experimental location

The field experiment was conducted during November 2015 to March 2016 at field Horticulture Farm, Bangladesh Agricultural University (BAU), Mymensingh belonging to the Old Brahmaputra Floodplain Alluvial Tract under the Agro Ecological Zone 9. The selected site was a well drained, silty loam, medium high land having soil pH 6.8 with heavy rainfall, high humidity, high temperature and relatively long day during the month of April to September and scanty rainfall, low humidity, low temperature and short day period during the rest period of the year [9].

### 2.2 Field preparation, transplanting and harvesting

Two varieties of strawberry namely BARI strawberry-1 and Rabi strawberry-1 were planted separately in three planting dates namely 1<sup>st</sup> November 2015, 1<sup>st</sup> December 2015 and 1<sup>st</sup> January 2016 following Randomized Complete Block Design with three replications. The whole experimental plot was 10.7m x 6.8m which was divided into 3 equal blocks. Each block was divided into 6 plots where 6 treatment combinations were allotted at random resulting in 18 unit plots altogether. The size of a unit plot was 1.6m x 1.2m. A distance of 0.5m between the plots was kept to facilitate different intercultural operations. Field preparation was done appropriately and accordingly fertilizer was applied following Fertilizer Recommendation Guide (BARC 2012). Healthy, disease free and uniform about 25-day old saplings were transplanted at the recommended date of planting maintain a spacing of 60cm x 40cm. Intercultural operations were done as per necessary. Fruits were harvested at ripening stage when three-fourth of the fruit skin attained red color as it is a non-climacteric fruit [10].

### 2.3 Data collection and analysis

Finally, for the experimental purpose data were collected on the following parameters like number of leaves per plant (at 15, 30, 45 and 60 days after transplanting), plant height (at 15, 30, 45 and 60 days after transplanting), leaf

area (cm<sup>2</sup>), days to flowering, days to fruit setting, days to fruit harvesting, number of fruits per plant, yield per plant (g), yield per hectare (ton), total soluble contents (%) and dry weight (%) of fruits. Statistical analysis was done by using MSTAT-C statistical package program. The difference among treatments was evaluated by Least Significant Difference (LSD) test at the 1% and 5% level of probability [11].

## III. RESULTS AND DISCUSSION

### 3.1 Number of leaves per plant

Significant variation was observed between the varieties in respect of number of leaves per plant at 45 and 60 days after transplanting (DAT). At 45 DAT higher (11.2) number of leaves per plant was observed in variety BARI strawberry-1 and the lower (10.66) number of leaves per plant was observed in Rabi strawberry-1. Similar pattern was also found at 60 DAT (Fig. 1). At 15 DAT the highest (7.05) number of leaves per plant was observed in 1<sup>st</sup> November planting and the lowest (5.10) was observed in 1<sup>st</sup> January planting. Similar pattern was also found at 30 and 45 DAT. At 60 DAT the highest number of leaves per plant was observed in 1<sup>st</sup> November planting (12.33) and the lowest in 1<sup>st</sup> January planting (11.16) (Fig. 2).

During the growth period maximum number of leaves was found in BARI strawberry-1 with 1<sup>st</sup> November planting and it was 7.77, 10.22, 12.55 and 13.66 after 15, 30, 45 and 60 days of transplanting, respectively which was followed by Rabi strawberry-1 with 1<sup>st</sup> December planting. On the other hand, minimum number of leaves per plant after 15, 30 and 60 days of transplanting was observed 4.66, 7.33, 9.00 and 10.66, respectively in Rabi strawberry-1 with 1<sup>st</sup> January planting whereas after 45 days of transplanting minimum number of leaves per plant was recorded 8.33 in BARI strawberry-1 with December planting (Table 1). Singh *et al.* (2007) found maximum crown height and number of leaves in strawberry plants in early planting [12].

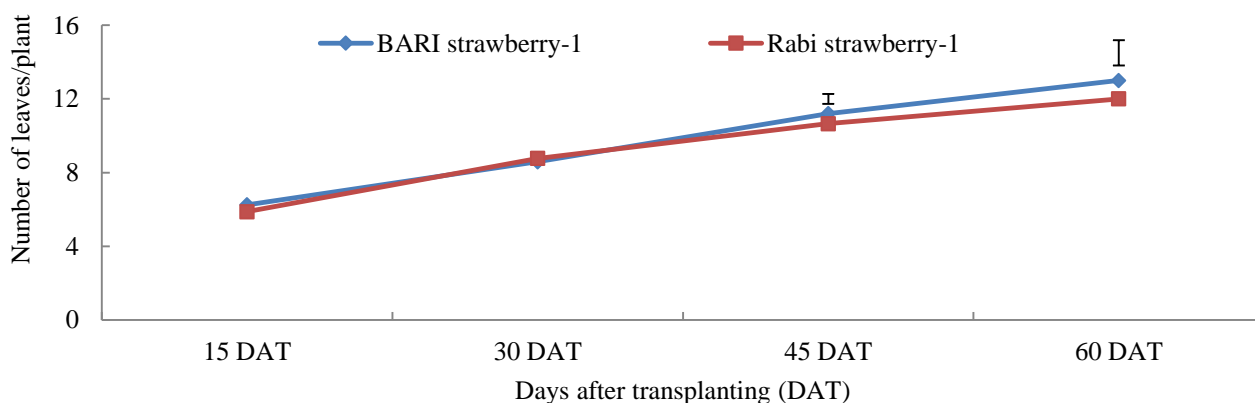


Fig. 1: Main effect of varieties on number of leaves per plant at different DAT. Vertical bars represent LSD at 1% level of significance.

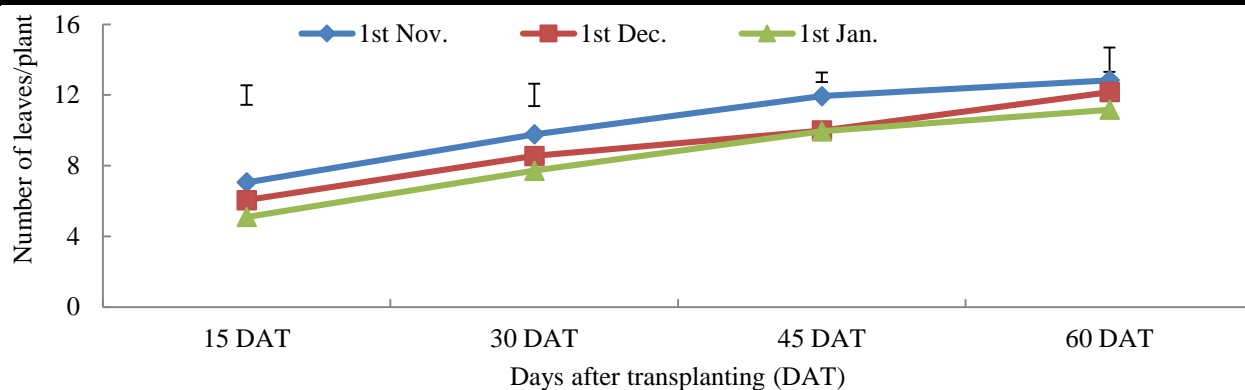


Fig.2: Main effect of different planting date on number of leaves per plant at different DAT. Vertical bars represent LSD at 1% level of significance.

Table.1: Combined effect of variety and planting date on number of leaves per plant at different days after transplanting

Variety × Treatment	Number of Leaves at different DAT			
	15 DAT	30 DAT	45 DAT	60 DAT
V <sub>1</sub> T <sub>1</sub>	7.77	10.22	12.55	13.66
V <sub>1</sub> T <sub>2</sub>	5.44	7.44	8.33	11.00
V <sub>1</sub> T <sub>3</sub>	5.53	8.11	10.88	11.66
V <sub>2</sub> T <sub>1</sub>	6.33	9.33	11.33	12.00
V <sub>2</sub> T <sub>2</sub>	6.66	9.66	11.66	13.33
V <sub>2</sub> T <sub>3</sub>	4.66	7.33	9.00	10.66
LSD <sub>0.05</sub>	1.51	2.02	2.34	2.54
LSD <sub>0.01</sub>	2.14	2.87	3.33	3.61
Level of significance	**	**	**	*

V<sub>1</sub>= BARI Strawberry-1, V<sub>2</sub>= Rabi Strawberry-1

T<sub>1</sub>= 1<sup>st</sup> November planting 2015, T<sub>2</sub>= 1<sup>st</sup> December planting 2015 T<sub>3</sub>= 1<sup>st</sup> January planting 2016

\*\*= Significant at 1% level of probability, \*= Significant at 5% level of probability

### 3.2 Plant height

Plant height was increased with the age of plant up to a limit. The highest plant height (20.25 cm) was obtained from BARI Strawberry-1 and the lowest plant height (16.5 cm) was obtained from Rabi Strawberry-1 at 60 DAT (Fig. 3). This result indicates that the plant heights of different strawberry varieties were not same and this character was genetically controlled. An increase in plant height was recorded with the delayed planting time. In case of 1<sup>st</sup> November planting plant height increased from 16.07cm to 22.11cm in 15 to 60 DAT (Fig. 4).

Significant differences were observed due to the interaction effect of variety and planting date on plant height at 15, 30, 45 and 60 DAT. It was observed that tallest (22.50 cm) plant was produced in BARI Strawberry-1 with 1<sup>st</sup> November planting (V<sub>1</sub>T<sub>1</sub>) and the shortest plant (15.22 cm) was obtained from Rabi Strawberry-1 with 1<sup>st</sup> January planting (V<sub>2</sub>T<sub>3</sub>) treatment at 60 DAT (Table 2). Similar phenomenon was observed at 45 DAT. The highest value of growth parameters observed in plants from early planting may be due to higher temperature that prevails during growth period hastening vegetative growth of plants [8].

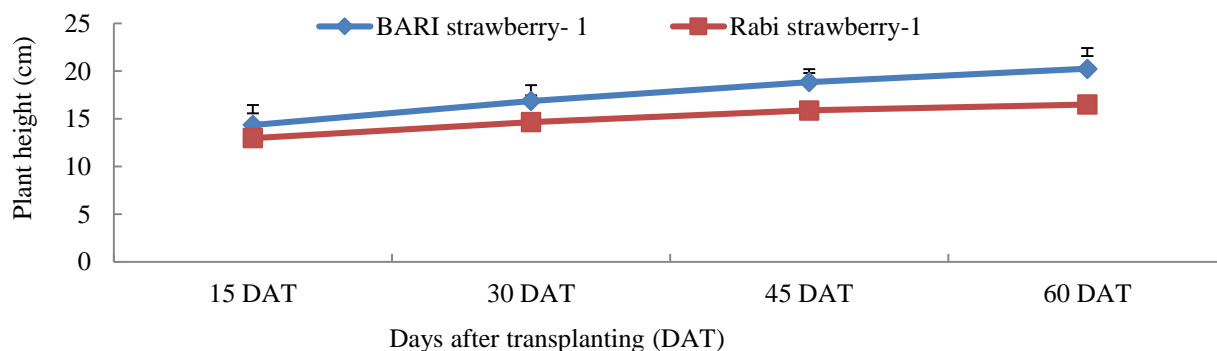


Fig. 3: Main effect of Varieties on plant height at different DAT. Vertical bars represents LSD at 1% level of significance.

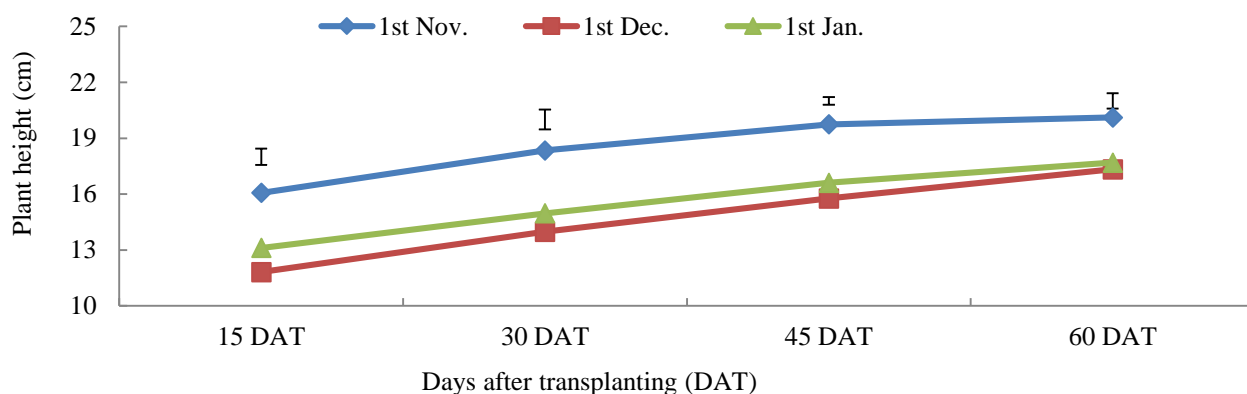


Fig. 4: Main effect of different planting date on plant height at different DAT. Vertical bars represents LSD at 1% level of significance.

Table.2: Combined effect of variety and planting date on plant height at different days after transplanting

Variety × Treatment	Plant height at different DAT			
	15 DAT	30 DAT	45 DAT	60 DAT
V <sub>1</sub> T <sub>1</sub>	17.98	20.22	22.16	22.50
V <sub>1</sub> T <sub>2</sub>	11.76	14.47	15.88	18.08
V <sub>1</sub> T <sub>3</sub>	13.33	15.93	18.55	20.16
V <sub>2</sub> T <sub>1</sub>	14.16	16.47	17.33	17.72
V <sub>2</sub> T <sub>2</sub>	11.86	13.49	15.65	16.58
V <sub>2</sub> T <sub>3</sub>	12.90	14.00	14.67	15.22
LSD <sub>0.05</sub>	2.08	1.49	1.81	1.86
LSD <sub>0.01</sub>	2.97	2.12	2.57	2.65
Level of significance	**	**	**	**

V<sub>1</sub>= BARI Strawberry-1, V<sub>2</sub>= Rabi Strawberry-1

T<sub>1</sub>= 1<sup>st</sup> November planting 2015, T<sub>2</sub>= 1<sup>st</sup> December planting 2015, T<sub>3</sub>= 1<sup>st</sup> January planting 2016

\*\*= Significant at 1% level of probability; DAT= Days after transplanting

### 3.3 Leaf area

Maximum leaf area was observed in variety BARI strawberry-1 (152.94cm<sup>2</sup>) and minimum leaf area was observed in Rabi strawberry-1 (128.98cm<sup>2</sup>) (Fig. 5). Leaf area was significantly varied by the planting dates. The highest leaf area (170.36cm<sup>2</sup>) was observed in 1<sup>st</sup> November planting and the minimum leaf area (112.99 cm<sup>2</sup>) was obtained in 1<sup>st</sup> January planting (Fig. 6). On the

other hand, the highest leaf area (189.09cm<sup>2</sup>) was found in BARI strawberry-1 with 1<sup>st</sup> November planting followed by BARI strawberry-1 with 1<sup>st</sup> December planting while the lowest (108.09cm<sup>2</sup>) was found in Rabi strawberry-1 with 1<sup>st</sup> January planting (Table 3). This finding shows maximum leaf area from early planting than that of late planting, which has got the support from research experiment [12].

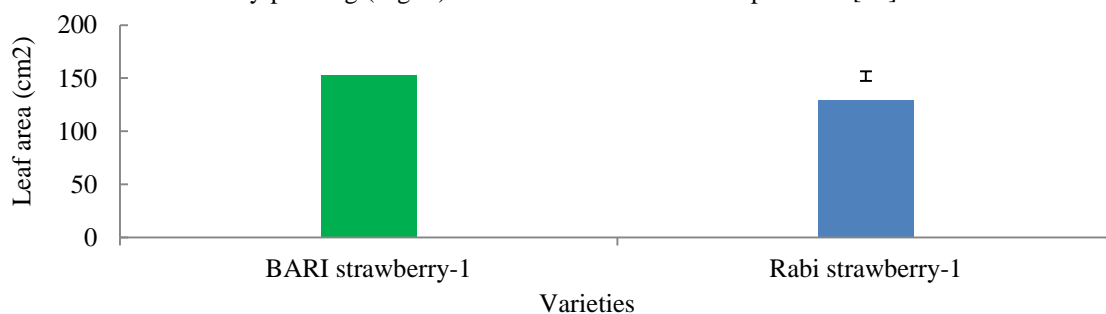


Fig.5: Main effect of varieties on leaf area. Vertical bar represents LSD at 1% level of significance.

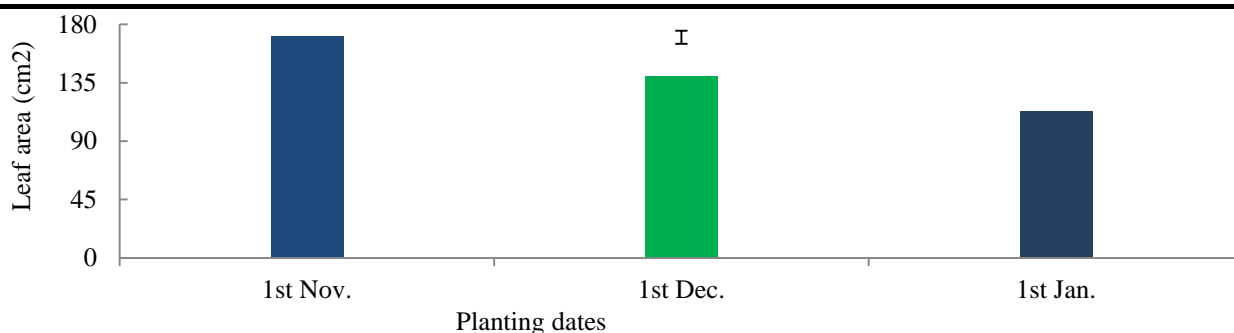


Fig. 6: Main effect of different planting date on leaf area. Vertical bar represents LSD at 1% level of significance.

### 3.4 Days to first flowering

Strawberry variety showed no significant variation in terms of days required to first flowering from transplanting (Fig. 7). 1<sup>st</sup> January transplanting required minimum days and 1<sup>st</sup> November transplanting required maximum days for flowering (Fig. 8). The maximum number of days (67.00) was recorded from Rabi

strawberry-1 with 1<sup>st</sup> November planting followed by BARI strawberry-1 with December planting and minimum days (41.33) were recorded from Rabi strawberry-1 with 1<sup>st</sup> January planting (Table 3). Temperature rise was an important factor for bringing early flowering in late planted plant.

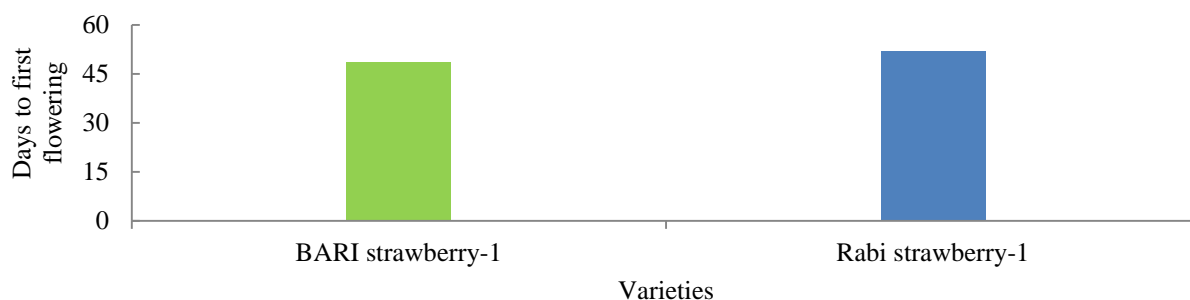


Fig. 7: Main effect of varieties on days required to first flowering. No significant difference between two varieties.

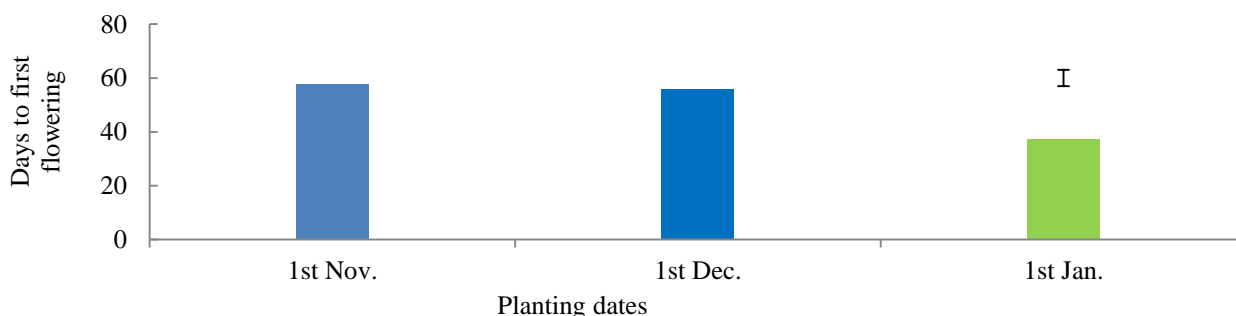


Fig. 8: Main effect of different planting date on days required to first flowering. Vertical bar represent LSD at 5% level of significance.

Table.3: Combined effect of variety and planting date on leaf area, number of days required for flowering, fruit setting and fruit harvesting.

Variety × Treatment	Leaf area (cm <sup>2</sup> )	Days to flowering	Days from flowering to fruit setting	Days from fruit setting to harvesting
V <sub>1</sub> T <sub>1</sub>	189.38	48.33	6.33	25.00
V <sub>1</sub> T <sub>2</sub>	151.56	64.00	6.00	16.66
V <sub>1</sub> T <sub>3</sub>	117.90	33.66	5.33	19.33
V <sub>2</sub> T <sub>1</sub>	151.35	67.00	7.00	21.00
V <sub>2</sub> T <sub>2</sub>	127.52	47.66	6.66	21.66
V <sub>2</sub> T <sub>3</sub>	108.09	41.33	5.33	18.33
LSD <sub>0.05</sub>	13.82	21.29	2.01	4.31

LSD <sub>0.01</sub>	19.66	30.29	2.86	6.14
Level of significance	**	**	NS	**

V<sub>1</sub>= BARI Strawberry-1, V<sub>2</sub>= Rabi Strawberry-1

T<sub>1</sub>= 1<sup>st</sup> November planting 2015, T<sub>2</sub>= 1<sup>st</sup> December planting 2015 T<sub>3</sub>= 1<sup>st</sup> January planting 2016

\*\*= Significant at 1% level of probability

3.5 Days from flowering to fruit setting

For fruit setting shorter period was required by BARI Strawberry-1 than Rabi strawberry-1 (Fig. 9). Planting dates also did not show any significant variation on fruit setting of strawberry (Fig. 10). But 1<sup>st</sup> November planting required maximum number of days for fruit setting and 1<sup>st</sup> January planted strawberry gave fruit in minimum times.

Interaction of variety and planting date on days required fruit setting from flowering was found insignificant (Table 3). Here, highest (7.00) in Rabi strawberry with 1<sup>st</sup> November planting and lowest in 1<sup>st</sup> January planting. The experimental result was similar to that of Singh *et al.* (2007) [12].

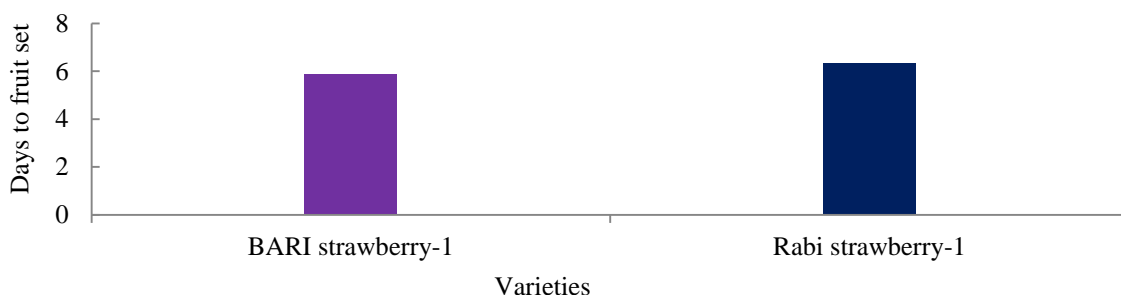


Fig.9: Main effect of different varieties on days to fruit setting of strawberry. No significant difference between two varieties.

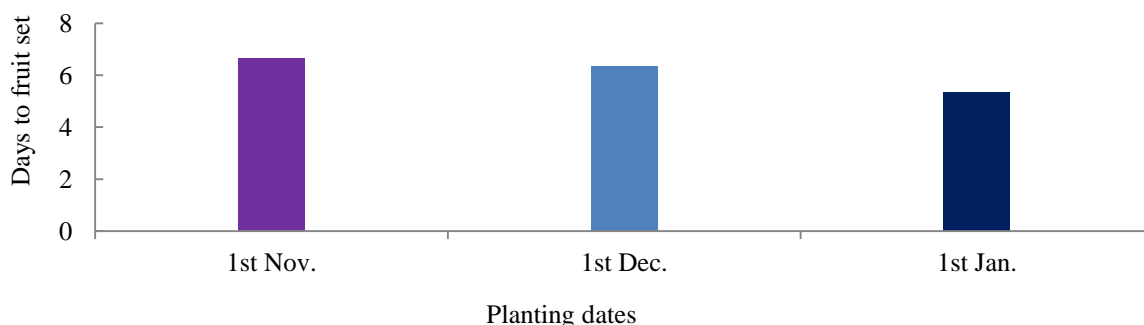


Fig. 10: Main effect of different planting date on days to fruit setting of strawberry. No significant difference among three planting dates.

3.6 Days from fruit setting to fruit harvesting

BARI strawberry-1 and Rabi strawberry-1 required almost equal duration for fruit harvesting (Fig. 11). The maximum days required to fruit harvesting (23) was obtained from 1<sup>st</sup> November planting and the minimum days (18.33) from 1<sup>st</sup> January planting (Fig. 12). The

maximum number of days (25.00) required to fruit harvesting was recorded in BARI strawberry-1 with 1<sup>st</sup> November planting and the minimum number of days (16.66) was recorded from BARI strawberry-1 with 1<sup>st</sup> December planting (Table 3).

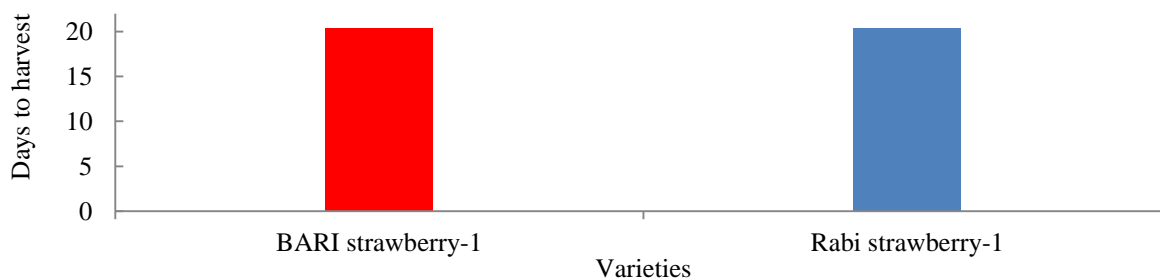


Fig. 11: Main effect of different varieties on days required to fruit harvesting of strawberry. No significant difference between two varieties.

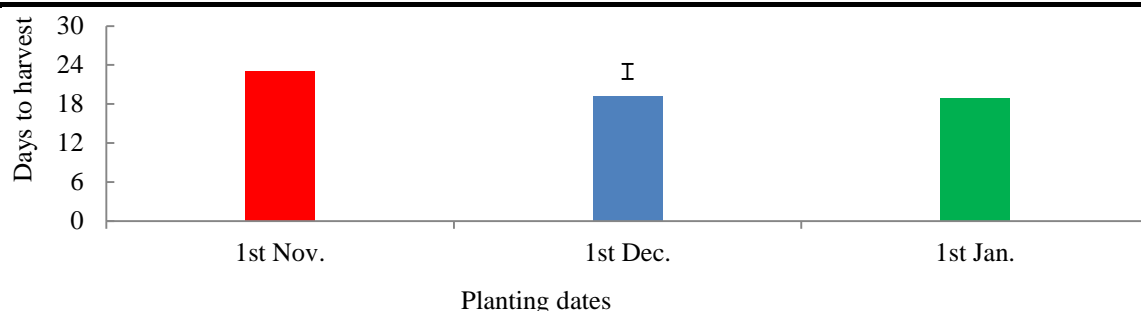


Fig. 12: Main effect of different planting date on days to fruit harvesting. Vertical bar represents LSD at 5% level of significance.

### 3.7 Number of fruits per plant

Rabi Strawberry-1 beard higher number of fruits than that of BARI Strawberry-1 (Fig. 13). Among the different planting dates number of fruits per plant was the highest (18.16) in 1<sup>st</sup> November planting and lowest (6.66) in 1<sup>st</sup> January planting (Fig. 14). Again, the highest number of fruits per plant (20.66) was observed in BARI Strawberry-1 with 1<sup>st</sup> November planting followed by

Rabi strawberry -1 with 1<sup>st</sup> November planting and lowest number of fruits per plant (5.66) was found in BARI Strawberry-1 with 1<sup>st</sup> January planting (Table 4). Significant reduction in number of fruits per plant in lately transplanted strawberry had also got the similarity with the result obtained by Chercuitte *et al.* (1991) [13] and Menzel and Smith (2011) [14].

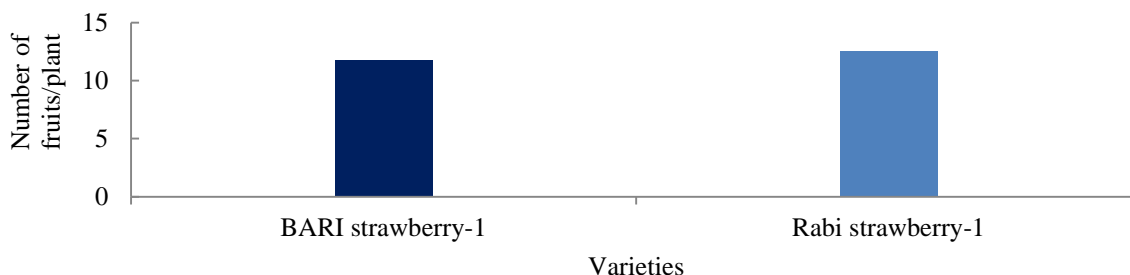


Fig. 13: Main effect of varieties on number of fruits per plant. No significant difference between two varieties.

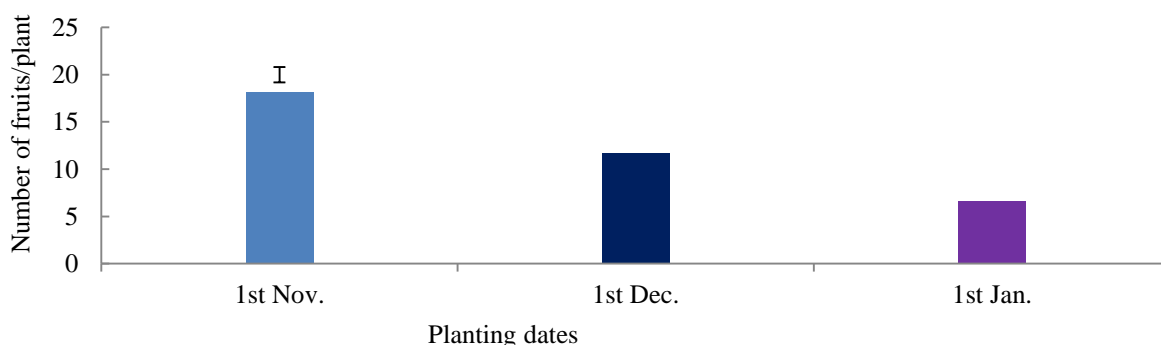


Fig. 14: Main effect of different planting date on number of fruits per plant; vertical bar represents LSD at 1% level of significance.

Table.4: Combined effect of variety and planting date on fruit number per plant, average fresh weight per fruit, and fruit length

Variety × Treatment	Number of fruits/plant	Fruit yield/plant (g)	Fruit yield/ha (t)
V <sub>1</sub> T <sub>1</sub>	20.66	316.15	13.17
V <sub>1</sub> T <sub>2</sub>	9.00	134.87	5.61
V <sub>1</sub> T <sub>3</sub>	5.66	106.59	4.43
V <sub>2</sub> T <sub>1</sub>	15.66	319.22	13.30
V <sub>2</sub> T <sub>2</sub>	14.33	228.78	9.52
V <sub>2</sub> T <sub>3</sub>	7.66	141.11	5.87
LSD <sub>0.05</sub>	4.79	78.94	3.29

LSD <sub>0.01</sub>	6.81	112.3	4.67
Level of significance	**	**	**

V<sub>1</sub>= BARI strawberry-1, V<sub>2</sub>= Rabi strawberry-1

T<sub>1</sub>= 1<sup>st</sup> November planting 2015, T<sub>2</sub>= 1<sup>st</sup> December planting 2015 T<sub>3</sub>= 1<sup>st</sup> January planting 2016

\*\*= Significant at 1% level of probability, NS= Not- significant

### 3.8 Yield per plant

There was no significant variation between the varieties in response of fruit yield per plant (Fig. 15). It was found higher (229.70g) in Rabi Strawberry-1 and lower (185.87g) in BARI Strawberry-1. Significant variation among the planting dates in case of fruit yield per plant was observed. It was found maximum (317.69g) in 1<sup>st</sup> November planting and minimum (123.85g) in 1<sup>st</sup> January planting (Fig. 16). Again, the maximum fruit yield per

plant (319.22) was observed in Rabi Strawberry -1 with 1<sup>st</sup> November planting followed by BARI Strawberry -1 with 1<sup>st</sup> November planting and minimum (106.59g) was observed in BARI Strawberry-1 with 1<sup>st</sup> January planting (Table 4). The difference in yield per plant due to planting time might be the differences in growing environment in vegetative growth phase, which was similar to that of Chandler *et al.* (1991) [15].

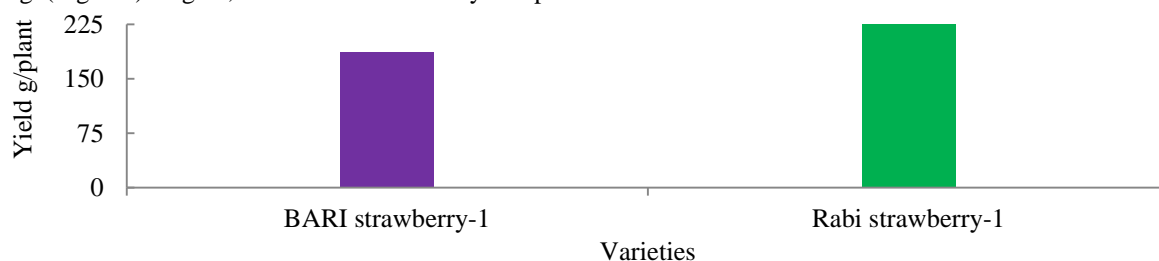


Fig.15: Main effect of varieties on yield per plant of strawberry. No significant difference between two varieties.

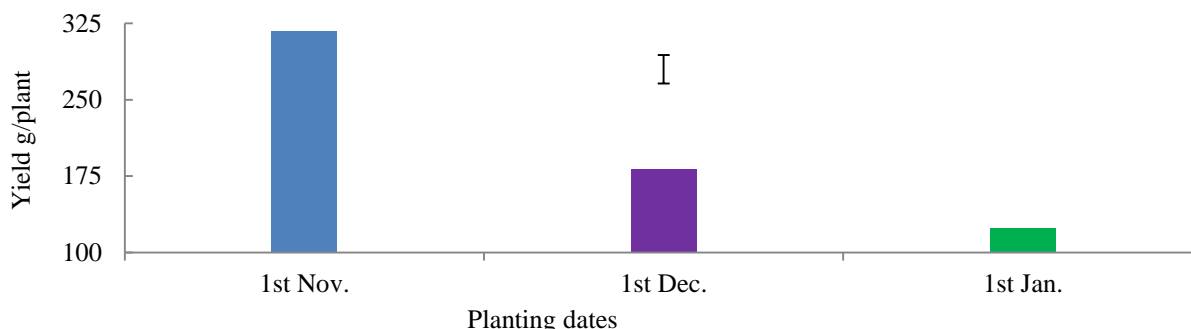


Fig. 16: Main effect of different planting date on fruit yield per plant. Vertical bar represents LSD at 1% level of significance.

### 3.9 Yield per hectare

Rabi strawberry-1 (9.56 ton/ha) yielded more than BARI strawberry-1 (7.73 ton/ha) (Fig. 17). Again, highest fruit yield per hectare (13.23 ton) was recorded in 1<sup>st</sup> November planting followed by 1<sup>st</sup> December planting and 1<sup>st</sup> January planting (5.15 ton) (Fig. 18). The interaction effect between varieties and different planting dates on fruit yield per hectare was found to be

significant. The maximum fruit yield per hectare (13.30 ton) was observed in Rabi strawberry -1 with 1<sup>st</sup> November planting followed by BARI Strawberry -1 with 1<sup>st</sup> November planting and minimum (4.43 ton) was observed in BARI Strawberry-1 with 1<sup>st</sup> January planting (Table 4). Rahman *et al.* (2014) also observed that delayed planting significantly reduced the yield of strawberry.

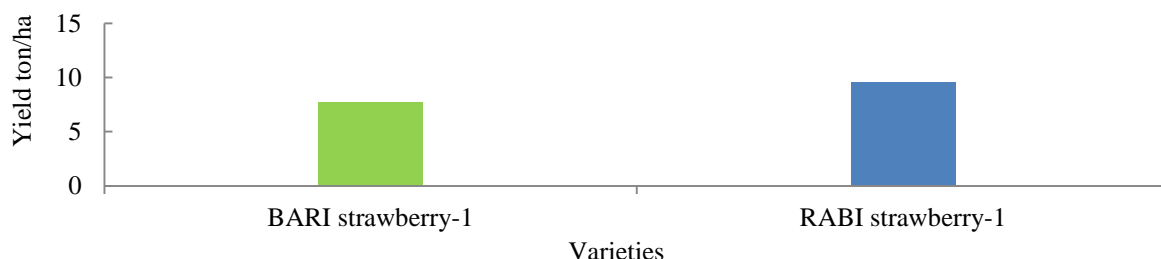


Fig. 17: Main effect of varieties on yield per hectare of strawberry. No significant difference between two varieties.



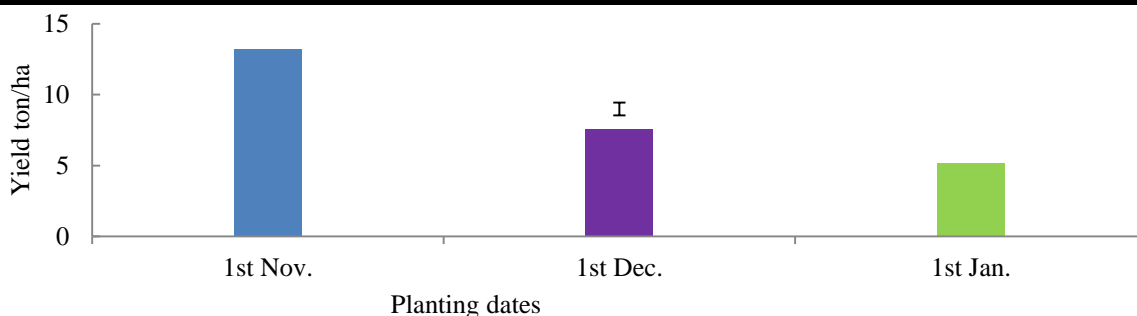


Fig. 18: Main effect of different planting date on fruit yield per hectare of strawberry. Vertical bar represents LSD at 1% level of significance

### 3.10 Fresh weight of single fruit

Here higher weight of single fruit (18.41g) was found in Rabi Strawberry-1 than that of BARI Strawberry-1 (16.47g) (Fig. 17). Effect of planting dates as well as interaction effect was also found insignificant on fresh weight of strawberry. Maximum fruit weight (20.45g) was observed in Rabi strawberry-1 with 1<sup>st</sup> November

planting followed by BARI strawberry -1 with 1<sup>st</sup> November planting and minimum fruit weight (15.24g) was found in BARI strawberry-1 with 1<sup>st</sup> January planting (Table 5). In later plantings, primarily because with the onset of spring, the temperature rose which resulted in smaller fruits as well as lower fruit yield. This result was almost similar with Singh *et al.* (2007) [12].

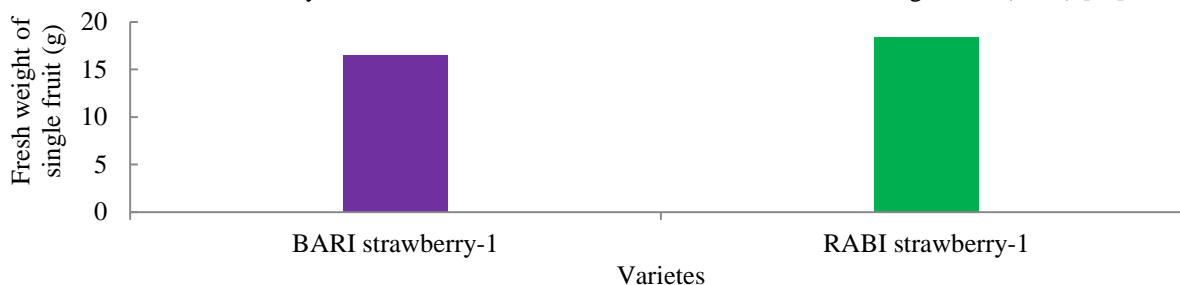


Fig. 19: Main effect of varieties on fresh weight of fruit. No significant difference between two varieties.

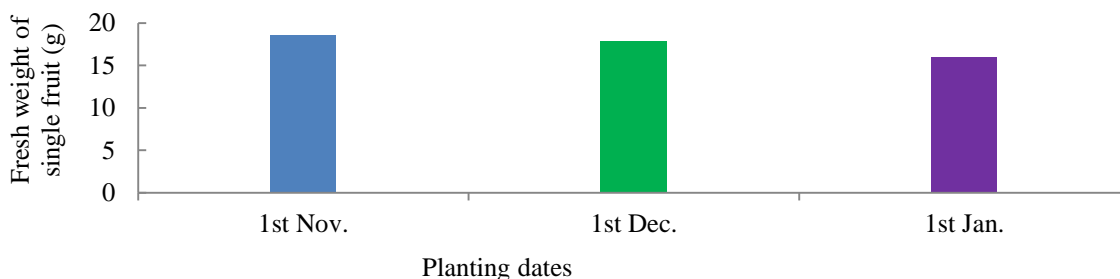


Fig. 20: Main effect of different planting date on fresh weight of fruit. No significant difference among three planting dates.

### 3.11 Dry matter of fruit (%)

The highest dry matter of fruit (9.57%) was produced from BARI Strawberry-1 and the lowest (8.16%) was recorded from Rabi Strawberry-1 (Fig. 21). Again, fruit dry matter was maximum (9.99%) in 1<sup>st</sup> January planting

while minimum (8.25%) was recorded from 1<sup>st</sup> December planting (Fig. 22). Furthermore, the highest dry matter (10.07%) was found in Rabi strawberry-1 with 1<sup>st</sup> January planting while the lowest (6.67%) was found in Rabi strawberry-1 with 1<sup>st</sup> December planting (Table 5).

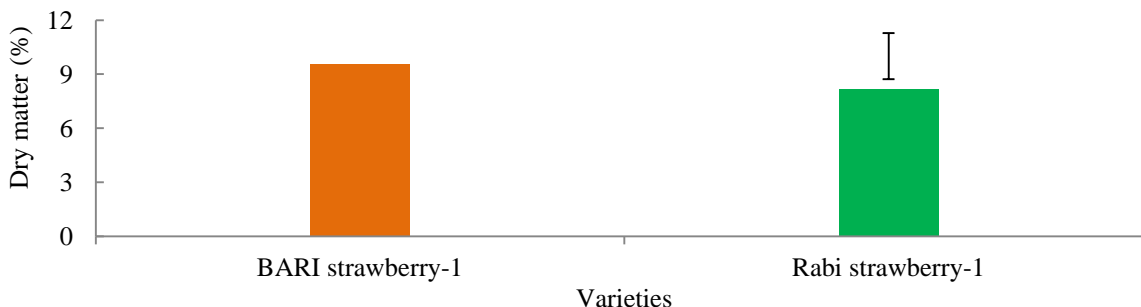


Fig. 21: Main effect of varieties on dry matter of fruit (%). Vertical bar represents LSD at 1% level of significance.

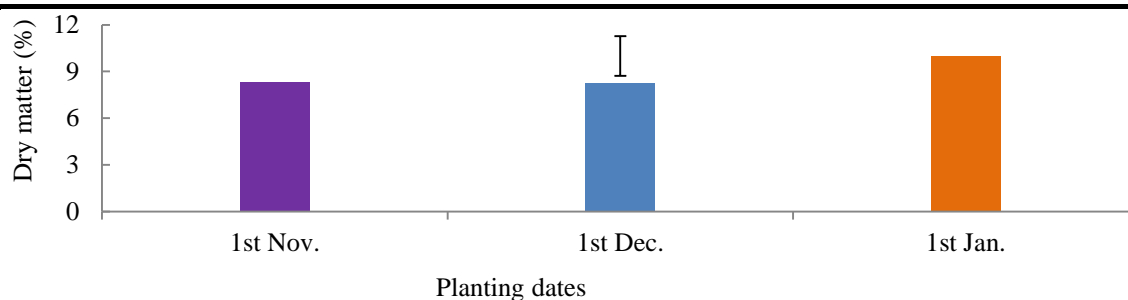


Fig. 22: Main effect of different planting date on dry matter of fruit. Vertical bar represents LSD at 1% level of significance.

Table.5: Combined effect of variety and planting date on fresh weight of fruit, dry matter (%), and TSS (%) content of fruit

Variety × Treatment	Fresh weight of single fruit (g)	Dry matter (%)	TSS (%)
V <sub>1</sub> T <sub>1</sub>	18.69	9.08	12.40
V <sub>1</sub> T <sub>2</sub>	15.48	9.73	14.06
V <sub>1</sub> T <sub>3</sub>	15.24	9.90	12.06
V <sub>2</sub> T <sub>1</sub>	20.45	7.64	11.30
V <sub>2</sub> T <sub>2</sub>	18.42	6.78	11.06
V <sub>2</sub> T <sub>3</sub>	16.38	10.07	11.20
LSD <sub>0.05</sub>	4.12	0.89	0.73
LSD <sub>0.01</sub>	5.86	1.27	1.04
Level of significance	NS	**	**

V<sub>1</sub>= BARI Strawberry-1, V<sub>2</sub>= Rabi Strawberry-1

T<sub>1</sub>= 1<sup>ST</sup> November planting 2015, T<sub>2</sub>= 1<sup>ST</sup> December planting 2015 T<sub>3</sub>= 1<sup>ST</sup> January planting 2016

\*\*= Significant at 1% level of probability

### 3.12 Total soluble solids (TSS)

TSS percentage was found higher in BARI Strawberry-1 than that of Rabi Strawberry-1(Fig. 23). Among the planting dates, TSS was the highest (12.56%) in 1<sup>st</sup> December planting while the lowest (11.63%) was recorded from 1<sup>st</sup> January planting (Fig. 24). It was founded that the highest (14.06%) was found in BARI strawberry-1 with 1<sup>st</sup> December planting while the lowest

(11.06%) was found in Rabi strawberry-1 with 1<sup>st</sup> December planting (Table 5). This finding is to some extent contradictory with Rahman *et al.* (2014) [8] who observed fruits of early planted plants contained more TSS due to exposure under favorable environment. Again, it was reported that fruits of late planted plants were exposed to high temperature which obstructs TSS content in strawberry fruits [16].

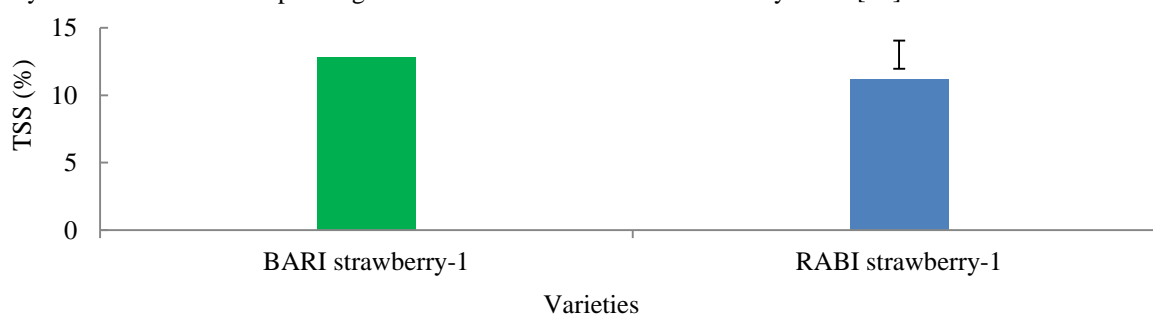


Fig. 23: Main effect of varieties on TSS of fruit (%). Vertical bar represents LSD at 1% level of significance.

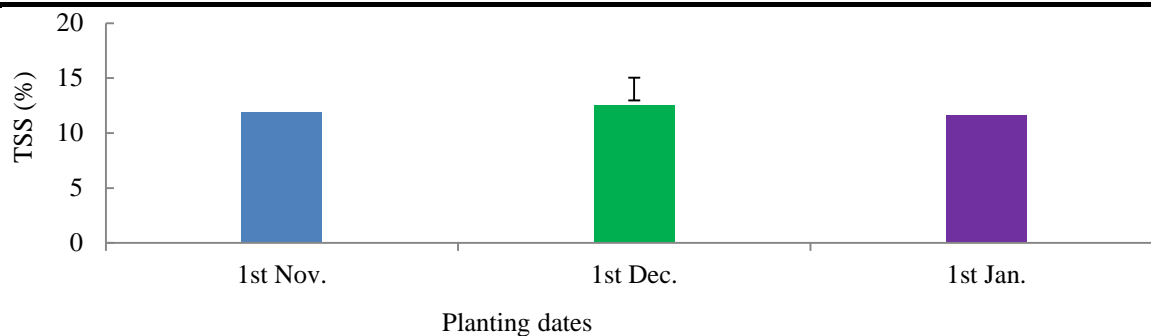


Fig. 24: Main effect of different planting date on TSS fruit. Vertical bar represents LSD at 5% level of significance.

#### IV. CONCLUSION

BARI strawberry-1 and Rabi strawberry-1 showed statistically similar results in case of both growth and yield parameters. But irrespective of variety, planting time greatly influenced the growth and yield of strawberry in Bangladesh context giving positive results in earlier plantings. Again, when varietal performances are combined with the effects of the three different planting times, Rabi strawberry-1 was found promising in attaining favorable yield in 1<sup>st</sup> November planting.

#### V. ACKNOWLEDGEMENT

The author expresses his thankful gratitude to the Ministry of Science and Technology, Bangladesh for funding the research work under “National Science and Technology Fellowship” program.

#### REFERENCES

- [1] N.C. Sharma, S.D. Sharma and R.S. Spehia, 2013. Effect of plastic mulch colour on growth, fruiting and fruit quality of strawberry under polyhouse cultivation. *International Journal of Bio-resource and Stress Management*, 4(2), 314-315.
- [2] R.R. Sharma, 2002. *Growing strawberries*. International Book Distributing Co., Lucknow, India.
- [3] R.B. Ram, D. Maurya, D.H. Dwivedi and S.K. Chaturvedi, 2009. Effect of different spacing on growth, flowering, fruiting, yield and quality of Strawberry (*Fragaria x ananassa*) cv. Chander. *Advanced Plant Science*, 22(2), 517-519.
- [4] G.H. Singh and R. Asrey, 2009. Growth, earliness and fruit yield of micro-irrigated Strawberry as affected by planting time and mulching in semi arid regions. *Indian Journal of Horticulture*, 62(2), 148-151.
- [5] A.N. Chowdhury, A. Nargis, M.Z. Rahman, A.K.M.S. Alam, M. Ibrahim and S. Akhter, 2013. Freezing adaptability and chemical composition of strawberry (*Fragaria x ananassa*) in Bangladesh. *Journal of Environmental science Toxicology and Food Technology* 7(4), 50-54.
- [6] M.M. Hossain (2009). *Bangladeshe strawberry chas (In Bengali)* (Third Edition). Somokal Publication, Dhaka, Bangladesh, 5-9.
- [7] J. Zheng, B. Yang, S. Tuomasjukka, S. Ou and H. Kallio, 2009. Effects of latitude and weather conditions on contents of sugars, fruit acids, and ascorbic acid in black currant juice. *Journal of Agricultural Food Chemistry*, 57(7), 2977–2987.
- [8] M.M. Rahman, M.M. Rahman, M.M. Hossain, Q.A. Khaliq and M. Moniruzzaman, 2014. Effect of planting time and genotypes on growth, yield and quality of strawberry (*Fragaria x ananassa* Duch.). *Scientia Horticulturae*, 167, 56–62.
- [9] K.M. Edris, A.T.M.T. Islam, M.S. Chowdhury and A.K.M.N. Hay, 1979. Detail Soil Survey, BAU Farm, Mymensingh, Bangladesh Department of Soil Survey, Government of the People’s Republic of Bangladesh, 212-213.
- [10] R.B. Wills, M. Glasson, D. Grahm and J. Joyce, 2004. *Postharvest: Introduction to the physiology and handling fruits, vegetables and ornaments* (Fourth Edition). University of New South Wales press Ltd., Sydney, Australia.
- [11] K.A. Gomez and A.A. Gomez, 1984. *Statistical procedure for agricultural research* (Second Edition). John Willy and Sons, New York, United Nations of America.
- [12] R. Singh, R. Sharma and R.K. Goyal, 2007. Interactive effects of planting time and mulching on ‘chandler’ strawberry (*Fragaria x ananassa* Duch.). *Scientia Horticulturae*, 111(4), 344–351.
- [13] L. Chercuitte, J.A. Sullivan, Y.D. Desjardins and R. Bedard, 1991. Yield potential and vegetative growth of summer-planted strawberry. *Journal of American Society of Horticultural Science*, 116(6), 930–936.
- [14] C.M. Menzell and L. Smith, 2011. Effect of time of planting, plant size, and nursery-growing environment on the performance of ‘festival’ strawberry in a subtropical environment. *Horticulture Technology*, 21, 156-66.
- [15] Gharbia H. Danial, Daa A. Ibrahim, Mobasher S. Omer, P.(2016). Response of Running Shoot tips of

- Strawberry (*Fragaria x ananasa*) for in vitro Propagation in Kurdistan Region of Iraq. International Journal of Environment Agriculture and Biotechnology(ISSN: 2456-1878).1(2), 164-169.10.22161/ijeab/1.2.11
- [16] C.K. Chandler, E.E. Albrechts and C.M. Howard, 1991. Planting time affects early season strawberry production in West Central Florida. Proceeding of the Florida State Horticultural Society 140, 227–228.
- [17] G.I. Hassan, A.K. Godara, K. Jitender, A.D. Huchche and J. Kumar, 2000. Effect of different mulches on the yield and quality of 'Oso Grande' strawberry (*Fragaria x ananassa*). Indian Journal of Agricultural Science 70(3), 184–185.