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Interactive Effect of Planting Date and Cultivar Over Time on Growth, Yield and Quality of Strawberry (*Fragaria* x *ananassa* Duch.) in Bangladesh

M. Moshiur Rahman[1,*], M.M. Rahman[2] and M.A.K. Mian[3]

ABSTRACT

The interactive effect were studied of four planting dates (1 September, 1 October, 1 November and 1 December) and five promising strawberry cultivars (Sweet Charlie, Festival, Camarosa, FA 008 and BARI strawberry-1) over two years from winter 2009/2010 to 2010/2011 under subtropical climatic conditions in Bangladesh. Among the interactions, the cultivar Camarosa planted on 1 September exhibited the tallest plants followed by Festival planted on the same date, while plants of BARI Strawberry-1 were the shortest when planted on 1 December irrespective of the planting year. Regardless of planting year, the highest number of leaves per plant was obtained on Festival followed by Camarosa when planted on 1 September, while plants of FA 008 produced the lowest number of leaves per plant when planted on 1 December. Plants of Festival planted on 1 September exhibited the maximum mortality percentage followed by Camarosa and Sweet Charlie planted on the same date in 2009 and 2010. On the other hand, plants of BARI Strawberry-1 planted on 1 December in 2009 and 2010 exhibited only 3 and 5% plant mortality, respectively. Among the cultivars studied, Sweet Charlie planted on 1 October produced the highest yield (16.8 $t.ha^{-1}$) in 2009/2010 and 16.7 $t.ha^{-1}$ in 2010/2011, while BARI Strawberry-1 planted on 1 December produced the lowest yields (2.4 and 2.2 $t.ha^{-1}$ in 2009/2010 and 2010/2011, respectively. The total soluble solids (TSS) and ascorbic acid contents of fruits were highly influenced by the interaction effect of planting date and cultivar and regardless of cultivar and year, fruits from early plantings contained more TSS and ascorbic acid than from late plantings in both years.

Keyword: strawberry, sub-tropical region, planting date, temperature, fruit quality

INTRODUCTION

Strawberry is highly appreciated all over the world for its excellent flavour, high nutrient profile, wonderful test and attractive colour (Hancock *et al*. 1996). The strawberry is an octoploid (x = 7, 2n = 56) species belonging to the family *Rosaceae* and is believed to have arisen from a natural hybridization between two wild *Fragaria* species—*F. virginiana* Duch., originated from North America and *F. chiloensis* (L.) Mill., from Chile (Hancock *et al*. 1996). There

1 Pomology Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh.

2 Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur 1706, Bangladesh.

3 Department of Genetics and Plant Breeding, BSMRAU, Gazipur 1706, Bangladesh.

* Corresponding author, e-mail: moshiur.bari@yahoo.com

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is substantial evidence that genetic factors control the growth, yield and fruit quality in strawberry (Avigdori-Avidov, 1986), but 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 (Zheng *et al*., 2009). However, Sharma and Sharma, (2004) indicating that strawberry can be planted at different times of the year depending on the variety, location and climate. Thus, the planting time of strawberry is important for partitioning the assimilates, which directly influence the growth and yield of strawberry and delayed planting in strawberry significantly reduced the yield (Rahman *et al.*, 2014). According to Anna *et al*. (2003), the time of planting plays a very significant role and its optimization is a prerequisite for successful strawberry cultivation.

The time of planting is a limiting factor for any winter season crop production, because of the short winter in Bangladesh and furthermore the production of strawberry depends greatly on the day temperature, humidity and day length. For example, Wang and Camp (2000) found that the effect of temperature as well as its interactions with other factors had noticeable consequences on strawberry growth. To date, there has been substantial evidence that the environmental factors during fruit development and maturity have a significant impact on the fruit quality of strawberry (Voca *et al*., 2009; Ordidge *et al*., 2010). On the other hand, fruit components were altered noticeably in response to weather conditions in different growing years (Zheng *et al*., 2009). Hence, as strawberry is a photo- and thermo-sensitive crop (Rice, 1990), the planting time, cultivar and climatic variation in different years are important for the growth and yield of strawberry.

The temperature in Bangladesh starts decreasing from the second half of October, thus allowing active growth of plants and this favorable growing period lasts until the end of February, after which the temperature starts to increase (Ahmad and Uddin, 2012). Thus, a very short growing season is available for strawberry cultivation in Bangladesh that extends from October to April (Ahmad and Uddin, 2012). In Bangladesh, strawberry is usually planted in the second fortnight of November using traditional methods, which restricts its fruiting season to only 45 to 60 d. Furthermore, higher profitability and productivity of strawberry are being achieved in many countries either through manipulating the planting time or by using different cultivars. Consequently, the study of the interaction of the planting time and the cultivar are prerequisites for achieving higher yields (Rice, 1990).

However, such agro-techniques have not yet been standardized in Bangladesh. Hence, the present study was conducted to study the interactive effect of planting time on the subsequent two years of the growth, yield and fruit quality of selected strawberry cultivars.

MATERIALS AND METHODS

Experiment site

The studies were conducted on the Fruit Research Farm of the Horticultural Research Centre at the Bangladesh Agricultural Research Institute, (latitude 23°59′ N, longitude 90°24′ E, altitude 14.33 m), Gazipur, Bangladesh during the winter season of 2009/2010 and 2010/2011. Climatic data were obtained from (Bangladesh Rice Research Institute, 2011) and monthly mean weather data during the study period are shown in Table 1. This region falls in the sub-tropical zone having hot summers (May–August) and mild winters (December–February). The cumulative rainfall is about 119 mm during August to May with average 82.9% relative humidity. The mean maximum and minimum temperatures during the cropping period studied were 26.29 and 15.75 °C, respectively. The soil on the experimental farm was a clay loam, having pH 6.2 (slightly acidic),

being low in organic carbon (0.95%), very low in available phosphorus (9 ppm) and low in potash (0.17 meq per100 g soil).

Five cultivars (Sweet Charlie, Festival, Camarosa, FA 008 and BARI Strawberry-1) were selected with four planting dates (1 September, 1 October, 1 November and 1 December).

Production of saplings

Selected plants of Sweet Charlie, Festival, Camarosa, FA 008 and BARI Strawberry-1 were planted in nursery beds for multiplication in July–August, 2009 and 2010. After 15 to 20 d, all plants started to produce runners and were considered as mother plants. Runners are two-node horizontal stems, with a 'daughter' plant produced at the distal node. The daughter plants developed a root system and became anchored to the soil. The daughter plants were collected and established in poly bags filled with sterilized 50% sand and 50% cow dung followed by tagging. The established daughter plants were used as saplings. The saplings were categorized according to the age, size, shape and number of leaves for each treatment. Saplings 30 to 35 d old were selected for planting in the experimental field.

Experimental design and layout

The experiment was conducted in a strip plot design with three replications during 2009/2010 and 2010/2011. The four planting times (1 September, 1 October, 1 November and 1 December) were assigned in the main strip and the five strawberry cultivars (Sweet Charlie, Festival, Camarosa, FA 008 and BARI Strawberry-1) were assigned in sub strips of the experiment. The unit

Table 1 Monthly mean weather data during the experimental period at Bangladesh Rice Research Institute, Gazipur, Bangladesh.

Year	Month	Temperature (°C)		Relative humidity (%)	Cumulative rainfall (mm)
		Maximum	Minimum		
2009/2010	August	27.69	22.01	87.22	463
	September	27.93	21.84	86.88	144
	October	26.79	19.30	86.31	157
	November	25.91	15.32	80.77	15
	December	21.67	11.24	79.75	00
	January	20.10	9.35	79.25	00
	February	23.89	11.51	71.49	15
	March	28.37	17.84	66.55	12
	April	25.94	21.21	77.46	42
	May	28.33	20.89	78.46	234
2010/2011	August	27.69	22.40	84.93	185
	September	26.78	21.91	87.73	64
	October	27.05	20.80	85.16	110
	November	25.33	16.04	80.88	02
	December	21.84	11.29	79.86	53
	January	22.64	10.22	81.65	00
	February	23.64	13.42	69.33	06
	March	28.54	16.87	67.49	15
	April	28.42	21.09	76.48	55
	May	28.77	18.66	85.31	74

Source: (Bangladesh Rice Research Institute, 2011)

plot size was 100 × 600 cm and the plants were spaced 50 × 40 cm on beds. A single bed was used as a single treatment. Beds were raised 30 cm above the main field with a 50 cm wide drain between beds. Each plot contained a double row accommodating 30 plants. Samples of the different strawberry cultivars were planted on the four planting dates in 2009 and then again on the same dates in 2010.

Intercultural operations

Runners were removed every 3 to 4 d to encourage the plant crown to initiate flowering. Straw mulch (2–3 cm thick) was applied around the plants as a normal practice to conserve the soil moisture, to decrease weed growth and to provide healthy conditions for the fruit. Weeds were removed whenever necessary to keep the crop weed free. Irrigation was given whenever necessary to keep maintain available soil moisture in the field for better plant growth. All other necessary cultural practices and plant protection measures were followed uniformly for all the plots and treatments during the entire period of experimentation.

Harvest of fruit

Strawberries were harvested by hand picking early in the day when it was cool, at an interval of 3 to 4 d and fruit were handled very carefully. The fruit were harvested at commercial maturity when more than 80% of the fruit surface had turned a red color. Immediately after harvesting, the strawberries were sorted to eliminate damaged fruit and selected for uniform size and color for data collection.

Observations recorded

Data were collected from the inner plants from each row to avoid any border effect. In each unit, 20 plants were selected randomly for recording data on the following parameters.

Plant height: Plant height was measured in centimeters from the base of the plant to the tip of the highest leaf of the plant under each of the different treatments during the full harvesting stage. Twenty plants of each plot were used to measure the average plant height.

Leaves per plant: The number of leaves from 20 randomly selected plants from each plot under each different treatment was counted and means were calculated as the number of leaves per plant.

Plant mortality: The number of dead plants was recorded from each plot at 10 d after planting up to 10 d before last harvesting and the plant mortality (PM) was calculated as a percentage using Equation 1:

$$PM = \frac{\text{Number of dead plants 10 d after planting to 10 d before last havest}}{\text{Total number of plants planted}} \times 100 \quad (1)$$

Yield: The total weight of fruit from 20 randomly selected plants from each plot under each different treatment was counted and then the mean was calculated and converted into tonnes per hectare.

Total soluble solid: The total soluble solid (TSS) content was determined using a refracto-meter (Model No. ATAGO N-1E, Brix 0-32 %; Maker Atago Co.,Ltd.; Minato-ku, Tokyo, Japan). Five mature fruits from each unit plot under each treatment were selected randomly. A drop of juice was squeezed from the sample and placed on the surface of the prism of the refracto-meter and the TSS as a percentage was obtained from a direct reading with the mean calculated from 20 fruit.

Ascorbic acid: The ascorbic acid was determined by the methods described by Rangana (1986).

Data analysis

Two year's interaction data for planting date and cultivar were analyzed, using the MSTAT-C program (version 5; Department of Crop and Soil Science, Michigan State University, East Lansing, Michigan 48824, USA). Mean comparisons were determined using Duncan's multiple range test.

RESULTS AND DISSCUSSION

Plant height and leaves per plant

The plant height of the different strawberry cultivars was significantly ($P < 0.01$) influenced by the interaction effect of planting time, cultivar by year (Table 2), with the plants of Camarosa planted on 1 September being the tallest (32.0 cm in 2009/2010 and 39.0 cm in 2010/2011) followed by Festival planted on the same dates (28.3 and 33.2 cm, respectively), while the shortest plants were BARI Strawberry-1 planted on 1 December in both years (13.0 and 16.0 cm, respectively).

Irrespective of the year, a significant ($P < 0.01$) influence was observed in the number of leaves per plant in the different strawberry cultivars with the time of planting. The trend of performance of cultivars for the four planting times were more or less similar (Table 2). For each planting date, the cultivar Festival performed well and produced the maximum number of leaves per plant, while FA 008 produced the minimum number of leaves. Plants of Festival planted on 1 September had the highest number of leaves (51.0 in 2009/2010 and 60.0 in 2010/2011) followed by Camarosa planted at the same times (50.0 and 55.0, respectively),

Table 2 Interaction effect of planting date and cultivar on plant height, number of leaves and plant mortality in strawberry.

Treatment	Plant height (cm)		Number of leaves per plant		Plant mortality (%)	
	2009-10	2010-11	2009-10	2010-11	2009-10	2010-11
1 Sep. × Sweet Charlie	28.0 cd	26.0 def	37.0 hij	42.0 ef	19.0 bc	20.0 b
1 Sep. × Festival	28.3 cd	33.2 b	44.0 de	46.0 d	21.5 a	21.5 b
1 Sep. × Camarosa	32.0 b	39.0 a	51.0 c	60.0 a	20.0 b	21.0 bc
1 Sep. × FA 008	23.0 f-i	22.0 f-j	50.0 c	55.0 b	17.0 de	16.0 fg
1 Sep. × BARI Strawberry-1	21.5 g-k	23.0 f-i	41.0 efg	38.0 ghi	18.0 de	17.0 ef
1 Oct. × Sweet Charlie	25.0 d-g	24.0 e-h	34.0 jkl	32.0 lmn	14.0 ij	15.0 hij
1 Oct. × Festival	26.0 def	31.0 bc	38.0 ghi	39.0 ghi	18.0 de	18.0 cd
1 Oct. × Camarosa	28.0 cd	33.0 b	40.0 fgh	43.0 def	18.0 cd	20.0 b
1 Oct. × FA 008	24.0 e-h	18.0 k-o	37.0 hij	41.0 efg	10.0 m	13.0 kl
1 Oct. × BARI Strawberry-1	22.0 g-j	18.0 k-o	32.0 lmn	34.0 jkl	9.0 mn	12.0 l
1 Nov. × Sweet Charlie	22.0 g-j	21.0 h-l	26.0 qrs	31.0 l-o	12.0 l	14.0 jk
1 Nov. × Festival	22.0 g-j	24.0 e-h	30.0 m-p	36.0 ijk	14.0 hij	16.0 fgh
1 Nov. × Camarosa	25.0 d-g	27.0 de	33.0 klm	37.0 hij	15.0 ghi	17.0 ef
1 Nov. × FA 008	20.0 i-m	19.0 j-n	31.0 l-o	37.0 hij	8.0 op	9.0 mn
1 Sep. × BARI Strawberry-1	18.0 k-o	15.0 n-q	27.0 p-s	30.0 m-p	7.0 op	9.0 m
1 Dec. × Sweet Charlie	18.0 k-o	17.0 m-p	21.0 u	26.0 qrs	6.0 pq	6.0 pq
1 Dec. × Festival	17.0 l-o	13.0 q	26.0 qrs	25.0 rst	9.0 mn	8.0 no
1 Dec. × Camarosa	20.0 i-m	23.0 e-i	24.0 stu	29.0 n-q	9.0 mn	10.0 m
1 Dec. × FA 008	17.0 l-o	14.0 opq	22.0 tu	28.0 o-r	5.0 r	5.0 qr
1 Dec. × BARI Strawberry-1	16.0 n-q	13.0 pq	24.0 stu	22.0 tu	3.0 s	5.0 r
Level of significance	**		**		**	
Coefficient of variation (%)	8.03		5.00		5.80	

a-u = Values followed by the same lowercase letter in a column do not differ significantly using Duncan's multiple range test.
** = $P < 0.01$.

while the lowest numbers of leaves per plant were found on FA 008 planted in 2009/2010 (22.0) and BARI Strawberry-1 in 2010/2011 (22.0) planted on 1 December.

Singh *et al*. (2007) found the maximum crown height and number of leaves in strawberry plants resulted from early (mid September) planting perhaps because of congenial climatic conditions, which were favorable for the growth and development of the plants. Thus, the availability of low temperatures, high relative humidity and a low light intensity for plants from the mid-October and mid-November plantings in the current study might have favored good growth in strawberry cultivars. For every planting time, the cultivar Camarosa performed well, attaining the maximum plant height as well as producing a large number of leaves per plant, while FA 008 produced the shortest plants and produced the least numbers of leaves per plant. Strawberry is a plant sensitive to temperature and day length (Palencia *et al*. 2013). Its flower initiation in Bangladesh started in the last week of November. According to Pérez-de-Camacaro *et al*. (2002), the reproductive development may antagonize the vegetative growth of strawberry. Consequently, later planting might result in less time for plants to put on height and produce leaves. On the other hand, the plant height and leaf number were higher in 2010/2011 than in 2009/2010, which might have been due to the comparatively higher temperatures prevailing in 2010/2011 (Table 1) because higher temperature hastens the vegetative growth of plants (Rahman *et al.*, 2014).

Plant mortality

Plant mortality in the different strawberry cultivars was significantly ($P < 0.01$) influenced by the time of planting, with the highest plant mortalities recorded for Festival (21.5 and 21.5%), Camarosa (20.0 and 21.0) and Sweet Charlie (19.0 and 20.0%) planted on 1 September in 2009/2010 and 2010/2011, respectively, whereas, BARI Strawberry-1 planted on 1 December exhibited the lowest plant mortality in both years (3.0% in 2009/2010 and 5.0% in 2010/2011) as shown in Table 2. The earlier plantings of Festival, Camarosa and Sweet Charlie produced higher plant mortalities (Table 2) perhaps because these three cultivars are exotic and are less adapted to conditions in Bangladesh. On the other hand, during September, the climatic conditions in Bangladesh are unfavorable to strawberry. During early planting times, high temperature coupled with a high moisture content accelerated disease infection and enhanced plant mortality. Similarly Lee *et al*. (2005) stated that damage caused by mites, thrips and powdery mildew increased with the increasing duration of the high temperature period. The cumulative temperature was higher in 2010/2011 than in 2009/2010 (Table 1) which might have accelerated plant mortality during 2010/2011.

Yield

Among all the planting times, the cultivar Sweet Charlie planted on 1 October produced the maximum yields (16.8 $t.ha^{-1}$ in 2009/2010 and 16.7 $t.ha^{-1}$ in 2010/2011) followed by Festival (15.5 and 14.8 $t.ha^{-1}$ in 2009/2010 and 2010/2011, respectively) when planted on the same date, while in both years, FA 008 produced minimum yields (2.3 and 2.1 $t.ha^{-1}$ in 2009/2010 and 2010/2011, respectively) when planted on 1 December (Table 3).

The differences in the yield per plant due to the planting time might have resulted from differences in the growing environment and in the vegetative growing phase as suggested by Chandler *et al*. (1991). Chercuitte *et al*. (1991) reported that the 'Kent' cultivar produced the highest yield from 8 May planting and the lowest from 1 August planting. Menzel and Smith (2011) stated that the planting date affected yield in nearly all cases. In most cases, 1 October plantings produced a higher fruit yield because the number of days between planting and fruiting was more suitable and favored fruiting than for the plantings

at the other three planting times perhaps because the plantings on 1 October had a longer, more favorable growing period before fruiting, while planting on 1 September led to the production of a large number of leaves which acted as a sink. Furthermore, plantings on 1 November and 1 December has less time for optimum vegetative growth, which might have led to lower yields which was supported by Chercuitte *et al.* (1991) and (Menzel and Smith, 2011). Chandler *et al*. (1991) found that the cultivar FL-4925 planted on 1 October produced the highest yield followed by 'Oso' planted on the same date, while 'Dover' planted on 1 October produced the lowest yield, which was partially in agreement with the present findings. According to Chercuitte *et al.* (1991) careful consideration must be given to the optimization of correlated vegetative characters and yield components. In most cases, the yield was higher in 2009/2010 than in 2010/2011 perhaps because the air temperature was higher in 2010/2011 and perhaps the higher air temperature hinders fruit yield in strawberry.

Total soluble solids and ascorbic acid content

The TSS content was significantly ($P < 0.01$) influenced by the interaction of the time of planting and the cultivar. The cultivar Festival

Table 3 Interaction effect of planting date and cultivar on yield and fruit quality of strawberry.

Treatment	Yield ($t.ha^{-1}$)		TSS (%)		Ascorbic acid (mg per 100 g)	
	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011
1 Sep. × Sweet Charlie	11.4 de	11.4 de	8.5 b	8.2 bc	81.0 a	80.7 ab
1 Sep. × Festival	10.0 efg	11.0 def	9.9 a	10.1 a	80.3 abc	80.5 ab
1 Sep. × Camarosa	9.5 e-h	8.3 ghi	7.4 def	6.7 ghi	75.5 hi	75.5 hi
1 Sep. × FA 008	6.0 jkl	5.4 kl	7.5 def	7.7 cde	74.5 jk	72.8 mn
1 Sep. × BARI Strawberry-1	6.2 i-l	4.5 l-o	7.2 efg	6.5 hij	66.9 r	65.1 t
1 Oct. × Sweet Charlie	16.8 a	16.7 a	7.2 efg	6.2 ijk	80.2 abc	79.1 de
1 Oct. × Festival	15.5 b	14.8 bc	9.6 ab	7.1 efg	79.8 cd	78.9 e
1 Oct. × Camarosa	14.0 bc	12.8 cd	7.2 efg	6.3 ij	71.5 o	74.8 ijk
1 Oct. × FA 008	8.0 g-j	7.5 h-k	8.1 bc	6.9 fgh	72.1 no	72.2 no
1 Oct. × BARI Strawberry-1	8.8 fgh	5.6 lmn	7.9 bcd	5.3 l	64.9 t	65.1 t
1 Nov. × Sweet Charlie	9.8 efg	9.0 fgh	8.4 b	7.2 efg	75.8 h	78.9 e
1 Nov. × Festival	9.9 efg	11.3 de	8.3 bc	8.3 bc	76.9 g	79.4 cde
1 Nov. × Camarosa	10.2 efg	9.1 fgh	7.0 fgh	6.1 jk	75.2 hij	70.5 p
1 Nov. × FA 008	5.2 lm	4.4 l-p	8.2 bc	6.4 hij	72.5 n	71.5 o
1 Nov. × BARI Strawberry-1	6.2 i-l	3.1 m-q	7.2 efg	5.7 kl	66.2 rs	61.9 u
1 Dec. × Sweet Charlie	3.9 l-q	3.9 l-q	7.9 bcd	7.3 d-g	80.0 bc	78.0 f
1 Dec. × Festival	4.8 lmn	4.7 lmn	8.2 bc	8.3 bc	77.1 g	74.2 kl
1 Dec. × Camarosa	5.0 lmn	4.6 lmn	6.9 efg	5.3 l	73.5 lm	70.5 p
1 Dec. × FA 008	2.3 opq	2.1 q	6.9 fgh	7.3 d-g	73.4 m	68.6 q
1 Dec. × BARI Strawberry-1	2.4 opq	2.2 pq	7.2 fgh	6.0 jk	66.1 s	61.8 u
Level of significance	**		**		**	
Coefficient of variation (%)	8.99		3.22		2.23	

a-u = Values followed by the same lowercase letter in a column do not differ significantly using Duncan's multiple range test.
** = $P < 0.01$.

contained the maximum TSS content from the 1 September planting, (9.9% in 2009/2010 and 10.1% in 2010/2011) followed by Festival from the 1 October planting (9.6%) in 2009/2010 and Sweet Charlie from the 1 September planting (8.2%) in 2010-11, while planting on 1 December for Camarosa produced fruit having the minimum (6.9%) TSS content in 2009/2010 and for FA 008 even less (5.3%) in 2010/2011 (Table 3).

The cultivar Sweet Charlie planted on 1 September had the maximum ascorbic acid content in 2009/2010 and 2010/2011 (81.0 and 80.7 mg per 100 g, respectively) followed by Festival planted on the same date (80.3 and 80.5 mg per 100 g in 2009/2010 and 2010/2011, respectively), while BARI Strawberry-1 had the minimum ascorbic acid content for planting on 1 December irrespective of the year (66.1 and 61.8 mg per 100 g in 2009/2010 and 2010/2011, respectively) as shown in Table 3.

The TSS and ascorbic acid contents of fruit were highly influenced by the interaction effect of the time of planting and cultivar (Table 2) with the fruit of early plantings containing greater TSS and ascorbic acid contents in both years than later plantings, perhaps because the fruit from the early plantings were exposed to more favorable conditions and had sufficient time for sugar and acid accumulation, which resulted in higher TSS and ascorbic acid contents than fruit from later plantings. The trend of cultivar performance against the four planting times was more or less similar. Rahman *et al.,* (2014) stated that fruits of early season plantings contained greater amounts of TSS and ascorbic acid due to those plants having greater exposure time under a favorable environment. Capocasa *et al*. (2008) indicated that the effect of the cultivar on strawberry nutritional quality was stronger than that of the cultivation conditions.

Due to the onset of spring, fruit development was very fast in later plantings, which might have resulted in the accumulation of lesser sugars or other quality parameters than in the fruit from the mid-September planting, which had sufficient time for development (Singh *et al.,* 2007; Rahman *et al.,* 2014). The fruit from late plantings were more exposed to high temperature which obstructed the development of TSS and ascorbic acid in strawberry fruit and this might have also had a negative effect on fruit quality in strawberry (Hassan *et al*., 2000).

CONCLUSION

Considering vegetative growth, plant mortality, yield and fruit quality irrespective of annual effect, planting on 1 October was the most suitable for strawberry cultivation under subtropical conditions in Bangladesh. Sweet Charlie and Festival were superior in yield and were considered the best for early planting, while Camarosa and Festival were suitable for late plantings in Bangladesh.

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