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STUDY OF THE FIELD PERFORMANCE OF DIFFERENT PLANTING MATERIALS OF STRAWBERRY (*Fragaria xananassa Duch.*)

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Abstract

The effects of different propagating materials on the growth and yield of strawberry were evaluated at Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur. Among the three different propagating materials (tissue culture raised seedling, mother plant and runner raised seedling), the tissue culture raised seedling was found to be the best in respect of fruit uniformity, percent plant survivality (4.13 %) and fruit yield per hectare (17.45 t/ha). Mother plant showed the maximum vegetative growth, runner production (41.0/plant) and larger fruit size but have high mortality percentage (36.38 %).

Key words: Tissue culture, runner raised seedling, strawberry.

Introduction

Strawberry (*Fragaria x ananassa* Duch.), a fruit that features a fragrantly sweet flavor, is the most widely consumed berry fruits throughout the world. It belongs to the family Rosaceae, subfamily Rosoideae along with blackberries and raspberries (Anon, 2011). It is widely appreciated, mainly for its characteristic aroma but also for its bright red color and its juicy texture, and it is consumed in large quantities, either fresh or in prepared foods such as preserves, fruit juice, pies, ice creams, and milk shakes.

There are two major propagation methods for strawberry which are conventionally propagated by rooted runner in the field and *in vitro* propagation in a laboratory using tissue culture technique. To improve the strawberry varieties, conventional method is not suitable due to incidence of many disease infections and

environmental hazards that results in the gradual degeneration of cultivars performance (Boxus, 1999). On the other hand, the tissue culture technique is considered as one of the most effective methods for obtaining healthy plants (Libek and Kikas, 2003) but there are controversial statements about the yield potential of tissue culture raised plants. There are considerations that tissue culture plants do not have any significant advantages in comparison with the traditional runner plants in respect to the yield potential and fruit quality (Cameron *et al.*, 1989). Other authors reported that tissue culture raised strawberry plant has been introduced to prevent most of the plant and soil transmissible diseases. The fruit yield of tissue culture raised plants is quite high with good quality as compared to those raised through conventionally propagated runner plants and tissue cultured plants have higher runnering capacity (Sharma and Sharma, 2004).

Considering the stated facts, this study was undertaken with the following objective:

1. To study the field performance of strawberry planting materials derived from *in vitro* propagation in comparison with runner raised seedling and mother plant.

Materials and Methods

The experiment was conducted at the Horticulture Research Farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur during November 2009 to April 2010 with three types of planting materials of strawberry variety BARI Strawberry 1. The experiment was laid out in a randomized complete block design (RCBD) with six replications. The unit plot size was 1.5 m x 1.5 m. The treatments were: T_1 = Tissue culture raised seedling, T_2 = Mother plant and T_3 = Runner raised seedling of strawberry. Saplings were planted in rows with the spacing of 50 cm x 50 cm. Well decomposed cow dung, urea, Triple super phosphate (TSP), Murate of potash (MP) and gypsum were applied @ 30 tons, 250 kg, 200 kg, 220 kg and 150 kg per hectare, respectively (Uddin *et al.*, 2009). Full dose of cow dung, TSP, gypsum and half of MP were incorporated into the prepared plots during final land preparation. Urea and rest of MP were top dressed in four equal installments at 15, 30, 45 and 60 days after planting. The plants were protected from bacterial wilt by spraying copper oxychioride @ 2 g/l (Uddin *et al.*, 2009). Necessary intercultural operations were done as and when required. The data were

recorded from randomly selected five plants from each plot. The recorded data on different parameters were compiled and statistically analyzed using MSTAT-C computer program and the treatment effects were evaluated using least significant difference (LSD) test.

Results and Discussion

Different propagating materials showed significant effects on the growth and yield of strawberry. The maximum plant height (11.82 cm) was recorded at 75 days after planting in T_2 treatment which was statistically similar with T_3 treatment and the shortest plant (8.26 cm) was found from T_1 treatment (Figure 1). At 75 days after planting, the maximum number of leaves per plant (21.4) was also produced by T_2 treatment which was statistically similar with T_1 treatment minimum number (14.58) was found in T_3 treatment (Figure 2).

The maximum plant spread (NS) (18.19 cm) was obtained from the treatment T_2 while the minimum (11.23 cm) was recorded from the treatment T_1 (Table 1). Plant spread (EW) and size of leaf also varied significantly according to different propagating materials. The cause is that the initial plant height, leaf number and spreading was already higher in the older mother plants (T_2).

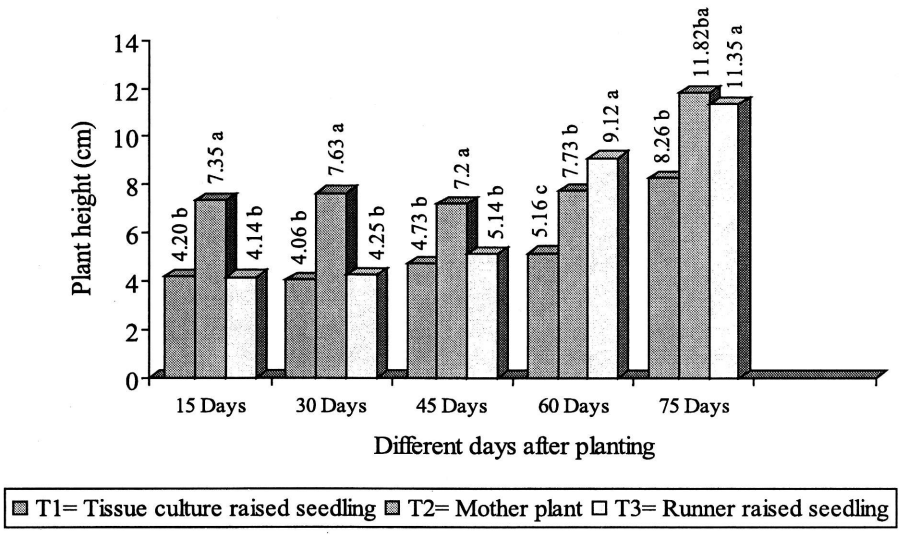

Figure 1. Effect of planting materials on plant height at different days after planting in strawberry.

Tissue culture and runner raised seedlings failed to make up the plant height, leaf number and spreading within the short cropping period. The longest petiole (8.78 cm) was found in the treatment T_2 and the shortest (7.31 cm) was recorded in T_3. The maximum number of runners (41.00) was obtained from T_2 treatment while the minimum (13.67) was produced by T_1 treatment which was statistically similar with T_3 treatment. Accumulation of more photosynthate in mother plant (T_2) resulting higher vegetative growth might be the probable cause of producing such higher number of runners.

The minimum days (40.05) required for flower initiation was recorded in the treatment T_3 and maximum days (59.7) was found in T_1 (Table 2). There was no significant effect on days to first flower opening and first fruit setting. This might be due to the plants of the three planting materials belonging to the same variety experienced with same day length and temperature for same duration for flower opening resulting less variation in number of days required for flower opening. Different planting materials had significant effect on days to first fruit harvest, harvest duration and crop duration (Table 2). The earliest (22.73 days) fruit harvest

Table 1. Effects of planting materials on vegetative growth of strawberry

Treatments	Spreading (cm)		Leaf size (cm)				Length of petiole (cm)	No. of runners/ plant
	N-S	E-W	Lateral leaflet		Terminal leaflet			
			Length	Breadth	Length	Breadth		
T_1	11.23 c	10.98 c	3.06 c	2.62 c	2.88 c	2.43 b	7.64 b	13.67 b
T_2	18.19 a	18.01 a	4.58 a	3.94 a	4.45 a	3.72 a	8.78 a	41.00 a
T_3	12.94 b	13.16 b	4.03 b	3.55 b	3.90 b	3.37 a	7.31 c	15.17 b
LSD	1.46	1.30	0.41	0.38	0.38	0.41	0.26	4.58
CV%	5.64	5.06	5.8	6.2	5.61	7.1	1.77	10.74

Means bearing the same letter(s) in a column do not differ significantly at 1% level of probability by LSD

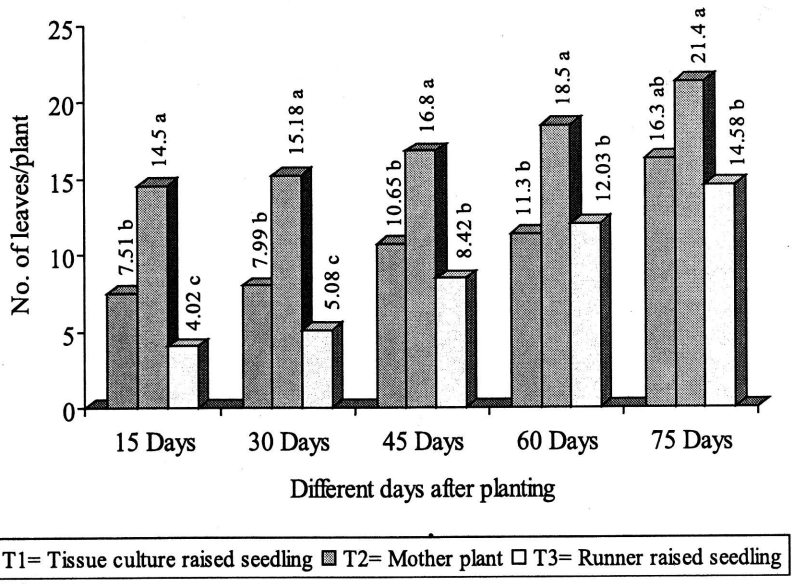

Figure 2. Effect of planting materials on number of leaves per plant at different days after planting.

was observed in T_3 while it was the most delayed (25.05 days) with T_2 which was statistically similar with T_1. The widest harvest duration (26.68 days) was observed in the treatment T_2 and the narrowest (19.33 days) was recorded from the treatment T_1 whereas the maximum crop duration (121.45 days) was observed in the treatment T_1 which was statistically identical to the treatment T_2. The number of flowers per plant increased with increasing number of days after planting up to 75 days and onwards it decreased again (Figure 3). The maximum number of flower per plant (6.65) was recorded from T_2 treatment at 75 days after planting. The cause of decrease in flower number may be explained that plants availed relatively warm temperature and long days during the later part of growing period which retarded the reproductive growth of plants. The highest number of fruit (18.78) per plant was obtained from T_2 treatment at 75 days after planting (Figure 4).

The highest fruit length (7.24 cm) and width (3.78 cm) were also recorded in treatment T_2 while the lowest fruit

Table 2. Effect of planting materials on reproductive characters, harvesting and crop durations of strawberry

Treatments	Days to first flower initiation	Days to first flower opening	Days to first fruit set	Days to first fruit harvest	Harvest Duration (Days)	Crop duration (Days)
T_1	59.7 a	13.8	5.99	23.88 ab	19.33 c	121.45 a
T_2	51.38 b	12.65	6.22	25.05 a	26.68 a	120.33 a
T_3	40.05 c	12.33	5.31	22.73 b	23.50 b	113.83 b
LSD	5.54	1.29	1.10	1.38	2.64	2.57
CV%	6.07	7.78	13.15	5.15	8.85	1.18

Means bearing the same letter(s) in a column do not differ significantly at 1% and 5% level of probability.

length (4.83 cm) and width (3.32 cm) was found in T_1 which was statistically identical with T_3 (Table 3). Higher rate of photosynthesis and diversion of photosynthates in the old mother plants led to attaining the bigger fruits in mother plants. Szczygie *et al.* (2002) also found that average fruit size was

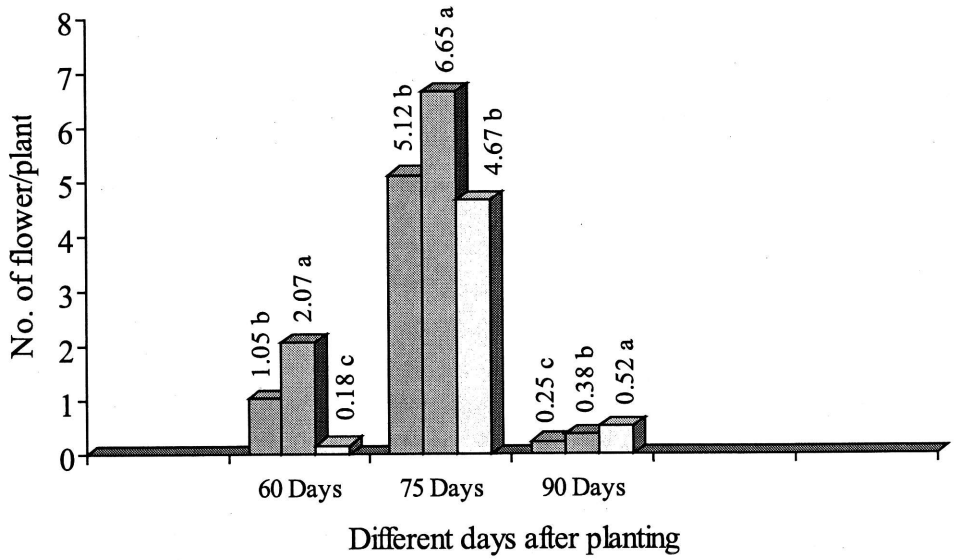

Figure 3. Number of flowers per plant at different days after planting.

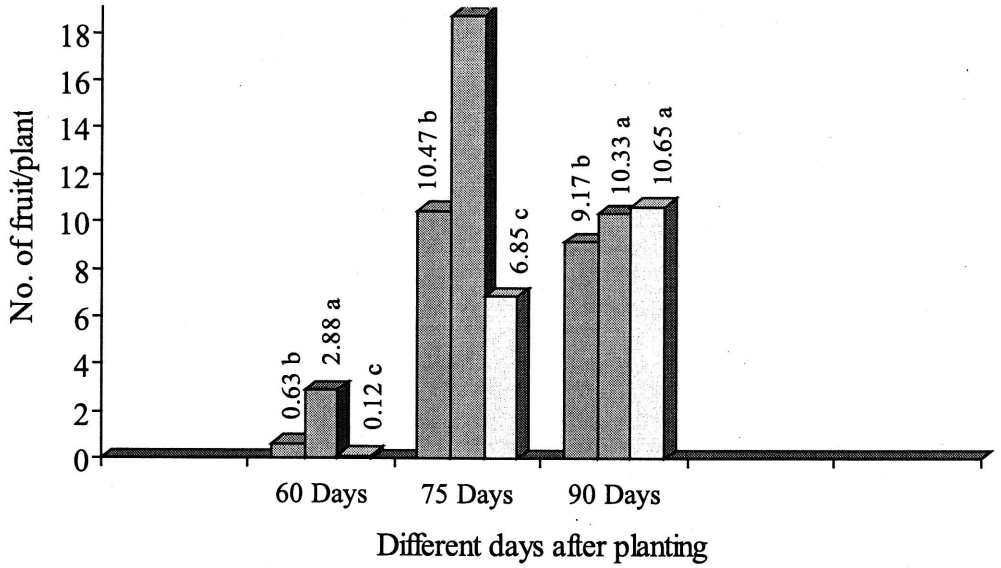

Figure 4. Number of fruits per plant at different days after planting.

usually smaller in micropropagated strawberry plantlets after planting in the field. The highest TSS (11.97%) was found in T_3 which was statistically similar to T_2 and the lowest (9.85) was recorded in T_1 (Table 3). The heaviest

Table 3. Effects of planting materials on fruit characteristics and different yield attributes in strawberry

Treatments	Fruit length (cm)	Fruit width (cm)	TSS (%)	Individual fruit weight (g)	Total number of fruits/ plant	Fruit yield/plant (g)	% mortality
T_1	4.83 c	3.32 b	9.85 b	23.43 b	26.09 ab	611.28 b	4.13 c
T_2	7.24 a	3.78 a	11.23 ab	26.65 a	28.10 a	748.77 a	36.38 a
T_3	5.58 b	3.43 b	11.97 a	24.76 ab	25.02 b	619.45 b	15.41 b
LSD	0.89	0.26	1.58	3.39	4.59	141.9	3.14
CV%	8.3	4.07	7.84	6.25	6.03	13.56	3.47

Means bearing the same letter(s) in a column do not differ significantly at 5% or 1% level of probability.

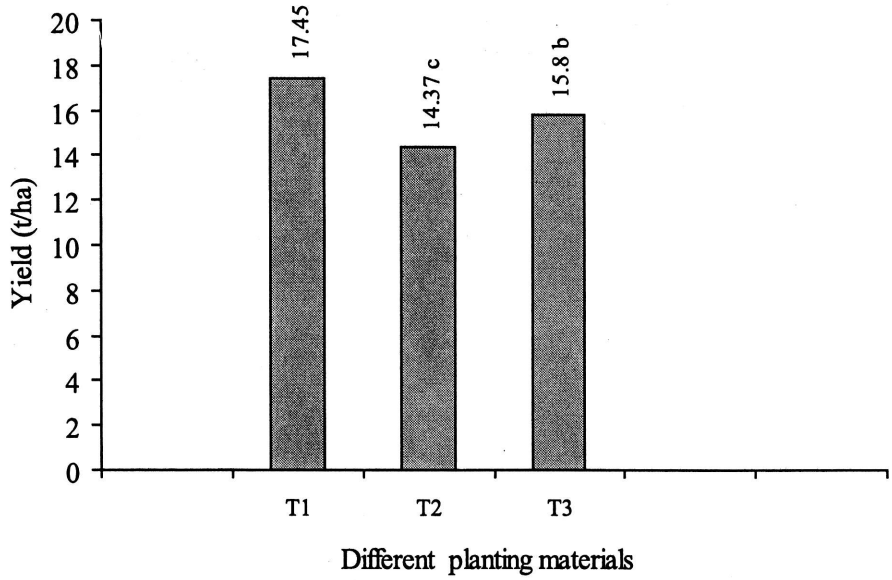

Figure 5. Effects of planting materials on fruit yield (t/ha) of strawberry.

fruit (26.65 g), maximum number of fruits (28.10) and highest fruit yield per plant (748.77 g) was recorded in T_2 (Table 3). The tiny fruit (23.43 g) and the lowest fruit yield per plant (611.28 g) were recorded in the T_1 which was statistically identical to the treatment T_3 while minimum number of fruits (25.02) was recorded in the treatment T_3 which was statistically identical to the treatment T_1. Matured mother plants had higher photosynthate accumulation and vigorous growth which might be the cause of such higher number of fruits in mother plants and it was consistent with the fruit weight. The minimum (4.13%) plant mortality was found in T_1 treatment and it was maximum (36.38%) in T_2 (Table 3). This is because the tissue culture plants are developed from disease free meristimatic tissue which can prevent the incidence of diseases in field condition causing less plant mortality.

In case of fruit weight, standard deviation (SD) was the maximum in T_2 (10.03) while it was the minimum in T_1 (4.84). Highly uniform sized fruits (21.27 to 29.93 g) were found in T_1 whereas intermediate (18.31 to 32.16 g) was in T_3 and the less uniform (15.25 to 35.08 g) was in T_2 (Table 4). The present result indicated that the tissue culture raised seedlings produced more

Table 4. Degree of uniformity on weight of fruit by comparing the standard deviation (SD) of different planting materials in strawberry

Treatments	Minimum weight of fruit (g)	Maximum weight of fruit (g)	Average weight of fruit (g)	SD (%)
T_1	21.27	29.93	23.43	4.84
T_2	15.25	35.08	26.65	10.03
T_3	18.31	32.16	24.76	6.94

uniform fruits compared to runner raised seedlings and mother plant. The highest yield per hectare (17.45 t) was obtained from treatment T1 and it was lowest (14.37 t) in T_2 (Figure 5). In mother plants, there was higher rate of plant mortality resulting lowest fruit yield per hectare compared to the tissue culture plants which had the lowest percentage of plant mortality giving the highest yield potential. The results are also in conformity with those of Sharma and Sharma (2004). Based on these findings, it may be suggested that the tissue culture raised seedling is recommended for commercial production to obtain higher yield with uniform fruits which is helpful for high market price and economic yield.

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