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INFLUENCE OF DIFFERENT STRAWBERRY TRANSPLANT ORDERS ON TRANSPLANT PRODUCTION, YIELD AND FRUIT QUALITY UNDER LOW PLASTIC TUNNELS

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ABSTRACT

This study was carried out during 2007/2008 and 2008/2009 seasons in two experiments. The first was conducted to investigate the effect of four strawberry nursery mother plant orders, i.e., nucleus, foundation, registered and certified and two promising cultivars, i.e., Tamar and Festival on number and quality of transplants in the nursery. The second experiment aimed to study the same treatments on yield and fruit quality using transplants derived from the above mentioned orders and cultivars. A split plot design was adopted.

Results of the first experiment indicated that nucleus plant order showed the highest values of number of transplants/plant, number of roots and crown diameter/transplant. Plants derived from foundation order exhibited the highest values in crown diameter and root length. Also, plants derived from certified order showed the highest root length. As for the cultivar effect, Tamar cultivar showed higher significant values in number of transplants/plant and number of roots than Festival, while Festival plants indicated significant increases in root length and plant height as compared with Tamar. Results of the interaction showed that nucleus plants of Festival cv exhibited the highest values of number of transplants while plants derived from nucleus Tamar showed the highest values of root length and transplant height.

Results of the second experiment indicate that transplants derived from nucleus order showed the lowest values of early yield while those derived from foundation order exhibited the highest values of fruit firmness and total acidity. The highest early and total yields as well as total soluble solids were produced from plants derived from registered order. Results showed also that Festival cv, showed higher values of early and total yield and total acidity than Tamar while Tamar fruits indicated higher total soluble solids and ascorbic acid than Festival.

The interaction show that plants derived from registered Festival cv gave the highest values of early and total yield while the heaviest fruits were harvested from plants derived from nucleus Tamar cv. The study conclude that it could be recommended to use registered plants (the second generation from tissue culture plants) of Festival to obtain high early and total yield for local market also with high acidity and firmness for export markets.

Keywords: strawberry, plant material order, cultivars, transplant production, yield, fruit quality.

INTRODUCTION

Strawberry is one of the most important vegetable crops for local consumption and export. In strawberry production, the availability of high quality plants is one of the most important factors in obtaining good yields. Starting production with healthy plants that have bigger crown size, longer roots and higher starch concentration gives the grower a greater chance of high productivity. In order to improve quality factors and the number of commercial plants from nursery, mother plant order affects the quality of the obtained transplants and subsequent yield (Pertuze *et al*. 2006). In recent

years, the development of strawberry growing in the open field and under plastic tunnels in Egypt has led to the appearance of new strawberry runner nurserymen. However, the runner plant production is limited to ecological conditions (Turkben, 2008). Therefore, Kaska *et al*. (1984) mentioned that growers have difficulties in obtaining sufficient runner plants of high quality. Moreover; growers often propagate runner plants from their stocks. This application has mostly been the main reason of lower fruit yield and quality in strawberries. Turkben *et al*. (1997) and Maisender *et al*. (2006) found that using tissue culture plants as first generation, reduced disease incidence which reduces the quality of nursery plant material pests, fungi, bacteria and viruses. Also Czynezyk (2006) mentioned that mother plants for nursery should be free from strawberry harmful organisms which reduce the quality of nursery plant material; pests, fungi, bacteria and viruses. Palonen and Liden (2002) reported that the field evaluation did not reveal any differences in the winter survival among certified virus free Elite plants from tissue culture, certified plants from Elite plants and runner plants from strawberry. For this reasons no differences in yields were found among the three above tested orders. In another study, Zebrowska *et al*. (2003) reported that micro-propagated plants frequently produced a greater number of runners through the enhanced axillary bud activity stimulated by the addition of 6-benzyladenine (BA) to the medium. Also, produced more leaves, inflorescences and yield. Vanesbroeck *et al*. (2008) compared the performance of plug plants derived from foundation, registered and certified Camarosa, Chandler, Sweet Charlie and Bish strawberry cultivars, for fruit production under grower conditions. They found no differences in fruit yield and quality in both registered and certified plants. Also the certified plants produced a higher number of tips than registered and foundation for both Bish and Chandler. On strawberry El-Sayed (2000), Mohamed (2003) and Ahmed (2009) found varietal differences in number of transplant, root length, crown diameter, number of leaves, plant length, early and total yield, average fruit weight, fruit firmness, titratable acidity and ascorbic acid. Also, Aranda *et al*. (2005), Faedi *et al*. (2008), Nir-Dai *et al*. (2008) and Simposon *et al*. (2008) recorded significant differences in early and total yield among some new strawberry cultivars.

Therefore, the objectives of this investigation were to study, first, the effect of different nursery mother plant orders and cultivar and their interaction on number of transplants and some transplant growth characters in the nursery stage, second, the effect of the same treatments on plant vegetative growth, yield and fruit quality of the derived plants.

MATERIAL AND METHODS

This study was carried out during 2007/2008 and 2008/2009 seasons in two experiments as follows:-

1- The First experiment (transplant production):

This experiment was carried out in a private farm at Ismailia Governorate. The aim of this study was to investigate the effect of different plant material orders (nursery mother plant) on number and quality of

transplants. Four treatments were used i.e., nucleus (tissue culture plants or tube plants as first generation), foundation or super elite (first generation produced from nucleus plants) under screenhouses, registered (first generation produced from foundation plants) and certified plants (transplants produced from registered plants in the open nursery which can be used for fruit production. on April 1, thirty plants from adapted nucleus, foundation, registered and certified orders from the two short day cultivars Tamar and Festival were planted in 150 ml. cups filled with 1:1 peat moss and vermiculite and kept in the screen- house until the nursery planting dates (1st and 3rd of May in the two tested seasons respectively). Plants with 3 to 4 leaves were arranged in a split plot design with three replicates. Whereas, cultivars were distributed in the main plots while the plant orders were arranged in the sub plots. Ten plants were used in each replicate and planted at 1.5x1.5 m for runner and transplant production. Plot area was 22.5 m^2. The drip irrigation system was taken place in the first month after planting and the sprinkler irrigation system was used after the first month to the end of the season until transplant harvest. The soil texture was sandy with pH of 7.1 and EC of 1.06. Recommended irrigation, fertilization and pest control programs for the strawberry nurseries were followed. Data were recorded on random samples of ten plants from each experimental plot in mid September (transplant harvest) to determine number of transplants, number of roots, root length and crown diameter.

2- The second experiment (fruit production).

This experiment was conducted to study the effect of the same cultivars and transplant orders on yield and fruit quality at Barage Horticultural Research Station, Qaluobia Governorate. Planting dates were September 15 and 17 in the first and second seasons, respectively. Treatments were arranged in a split plot design with three replicates. The, cultivars were distributed in the main plots while the plant orders were arranged in the sub plots. Fresh transplants derived from all tested transplant orders (nucleus, foundation, registered and certified) were dipped in 0.2% Rhizolex solution as a fungicide for 20 minutes before transplanting. Plants were arranged in four rows-bed system with 120 cm width and 40 cm height. Plant distances were 25cm apart (16 plants/m^2) Sprinkler irrigation system was taken place during the first month then drip irrigation system was used under mulching until the end of the season, the plot area was 30.6 m^2. Three beds each with 6 m length and 1.7m width were covered with 40 micron plastic mulch with 180cm width and the plants were covered with 80 micron plastic tunnels 70 cm height and 220 cm width). All replicates were received similar agricultural practices as regards to cultivation, fertilization, irrigation, and pest and disease control as commonly followed in the district.

Data on vegetative growth, yield and its components and chemical composition of fruits were recorded as follows:

1-Vegetative growth characteristics:-

1-1- Number of leaves/plant: It was counted 45 days from planting.

1-2- Plant length: It was measured from the base of the plant crown to the tip of the longest leaf after 45 days from planting.

2- Yield:

2-1- Early yield: It was determined as weights of all harvested fruits from each plot during the first five harvests (November and December).

2-2- Total yield: The weights of all harvested fruits all over the season

3-Physical characteristics of fruits:

Samples of ten fruits from each experimental plot at the full color stage were randomly chosen on March 1 to determine the following:-

3-1- Average fruit weight: Five fruits from each experimental plot were weighed and average fruit weight was calculated.

3-2- Fruits firmness: It was determined by using a Shatillon penterometer.

4- Chemical characteristics of fruits:-

4-1- Total soluble solids contents (TSS): The percentage of total soluble solids content was determined using the hand refractometer.

4-2- Total titratable acidity (TA %): Samples of 100g fruits from each experimental plot were used to determine the acidity of juice by titration with 0.1 NaOH solution, using phenol phethalein indicator, according to the method described in A.O.A.C. (1990).

4-3- Ascorbic acid content: It was determined by using 2, 6 dichloro – phenol indophenols for titration as the method mentioned in A.O.A.C. (1990).

5 -Statistical analysis

Data were statistically analyzed according to the analysis of variance as described by Waller and Duncan (1969).

RESULTS AND DISCUSSION

The first experiment:

1- Number of transplants:

Results shown in Table (1) indicate that there were significant increments in number of transplants/m^2 and per feddan in September for those produced from nucleus plants as compared with the other tested orders in the two tested seasons, This increment in number of transplants may be attributed to the high plant health of this generation because those plants are usually free from different diseases and pests as mentioned by Turkben *et al*. (1997) and Maisender *et al*. (2006) or to the enhanced axillary's buds activity stimulated by the addition of 6-benzyladenine to the medium as reported by Zebrowsky *et al*. (2003). As for cultivars, there was significant increment in number of transplants/m^2 and per fadden produced from cv Tamar plants as compared with cv Festival in the two tested seasons. These results agree with those of El-Sayed (2000), Mohamed (2003) and Ahmed (2009). As regards to the interaction between plant order and cultivar, results showed that the highest number of transplants was obtained from nucleus order of cv Festival plant while the lowest number of transplants were produced from the certified cv Festival and registered cv Tamar plants.

Table (1): Effect of plant orders, cultivars and their interaction on number of transplant per m^2 and per fadden during 2007/2008 and 2008/2009 seasons.

Treatments	Number of transplant/m^2		Number of transplants/ feddan (1000 plant)	
	2007/2008	2008/2009	2007/2008	2008/2009
mother order				
Nucleus	52.90a	55.10a	222.2a	245.6a
Foundation	40.53b	38.49b	173.0b	154.0c
Registered	39.02b	39.64b	162.6b	158.6bc
Certified	38.95b	40.81b	163.2b	163.3b
Cultivars				
Tamar	44.47a	45.55a	186.8a	190.5a
Festival	41.22b	41.47b	173.7b	170.2b
Order x CV				
Tamar x nucleus	49.00b	51.77b	203.8b	217.43b
Tamar x foundation	41.67c	40.17c	175.0c	168.71c
Tamar x registered	39.67c	40.07c	166.6c	160.30c
Tamar x certified	47.57b	50.25b	199.8b	211.05b
Festival x nucleus	58.80a	58.43a	238.6a	245.40a
Festival x foundation	39.40c	36.86cd	171.1c	154.81cd
Festival x registered	38.37c	39.21c	158.5c	164.68c
Festival x certified	30.33d	31.36d	126.7d	131.71d

Values in same column followed by the same letter do not significantly differ from each other according to Duncan`s multiple range tests at 5 % level.

2- Number of roots/plant:

As for the effect of plant orders on number of roots, results in Table (2) showed clearly that the highest number of roots/plant was obtained from nucleus and registered plants in the first season, while it was obtained from nucleus plants in the second season. On the other side, certified transplant order produced the lowest number of roots in the two tested seasons. Concerning the effect of cultivars on number of roots/plant, Tamar cultivar showed higher significant values as compared with cv Festival.

As regards to the effect of the interaction between cultivar and plant order on number of roots/plant, results in Table (2) show that nucleus plants of cv Tamar cultivar produced the highest number of roots/plant. On the other hand, certified Tamar plants as well as foundation and certified cv Festival cultivar showed the lowest values in the two tested seasons.

3- Root length:

As regards to the effect of plant orders on root length, results in Table (2) indicated that the highest values were obtained from foundation, registered and certified order in the two tested years. Whereas nucleus plants recorded significant decrement as compared with all tested orders in the first season, while this decrement in root length of nucleus plants was significant only as compared with certified order in the second year. Such decrement in root length in transplants produced from nucleus plants as compared with the other three tested orders could be due to the short roots of the nucleus plants produced *in vitro* as compared with the other tested orders grown in greenhouse or in the open nursery.

Concerning cultivar effect, the results showed that there was a significant increment in root length of cv Festival plants as compared with cv Tamar in this trait in the two studied years. Our results confirm those of El-Sayed (2000).

As for the interaction effect on root length, results in Table (2) indicated that foundation of cv Festival in the first season and nucleus order of the same cultivar in the second season gave the highest values. On the other hand, nucleus and foundation orders of cv Tamar plants showed the lowest values in the two tested years.

4- Crown diameter:

Regarding the effect of mother plant orders on crown diameter of transplants, results in Table (2) indicated that nucleus and foundation plants produced the highest values of transplant crown diameter while the registered plants produced the lowest values in the two tested years. Healthy plants of nucleus produced bigger crowns as reported by Pertuze *et al*. (2006) because they were produced normally from the tissue culture Lab. and free from virus, pests and diseases mentioned by Turkben *et al* (1997) and Maisender *et al*. (2006).

Table (2): Effect of plant orders, cultivars and their interaction on number of roots, root length and crown diameter of transplants during 2007/008 and 2008/2009 seasons.

Treatments	Number of roots		Root length (cm)		Crown diameter (cm)	
	2007/2008	2008/2009	2007/2008	2008/2009	2007/2008	2008/2009
mother order						
Nucleus	30.58a	30.48a	10.18c	11.47b	0.90ab	0.93a
Foundation	27.00b	27.10c	12.08a	11.92ab	0.97a	0.91a
Registered	29.00a	29.22b	11.15b	11.93ab	0.83b	0.70c
Certified	24.50c	25.52d	11.58ab	12.05a	0.88b	0.85b
Cultivars						
Tamar	30.16a	28.78a	9.29b	10.27b	0.88a	0.82b
Festival	25.64b	27.38b	13.21a	13.41a	0.92a	0.78a
Order x CV						
Tamar x nucleus	34.30a	34.00a	8.40f	8.20f	1.00a	1.13a
Tamar x foundation	30.80b	27.77c	9.20ef	10.20e	0.93ab	0.90c
Tamar x registered	30.50b	27.70c	10.10d	11.43d	0.73c	0.60g
Tamar x certified	25.03de	25.67de	9.46de	11.27d	0.83bc	0.66f
Festival x nucleus	26.87cd	26.67cd	11.97c	14.73a	0.80c	0.73e
Festival x foundation	23.40e	26.43c-e	14.97a	13.63b	1.00a	0.93c
Festival x registered	27.93c	30.73b	12.20c	12.43c	0.93ab	0.80d
Festival x certified	24.37e	25.37e	13.70b	12.83e	0.93ab	1.03b

Values in same column followed by the same letter do not significantly differ from each other according to Duncan`s multiple range tests at 5 % level.

Concerning the effect of cultivar on crown diameter, no significant differences were detected between the two tested cultivars in the first season, while Tamar cultivar exhibited higher significant values as compared with cv Festival in the second season. These results agree with those recorded by El-Sayed (2000).

Results in Table (2) show also that there was significant effect for the interaction between the cultivar and plant order on crown diameter. The , nucleus plants of cv Tamar showed the highest values in the two tested seasons, Also, foundation of cv Tamar plants as well as the three orders of cv Festival cultivar, i.e., foundation, registered and certified, gave the highest crown diameter in the first season. On the contrary, the lowest values of crown diameter were obtained from registered and certified cv Tamar plants as well as nucleus of cv Festival plants.

The second experiment:

1- Vegetative growth characteristics:

1-1- Number of leaves/plant:

Results in Table (3) show that the plants derived from the registered and certified mother plant orders gave significant increment in number of leaves/plant as compared with those derived from nucleus and foundation orders in the first season. While in the second season, nucleus and foundation plants gave the highest values. In this connection, no significant differences were detected between foundation plant order and each of registered and certified ones.

As for cultivar affect on number of leaves/plant, a significant increment in number of leaves of Tamar cultivar was detected as compared with cv Festival in the first season, while this increment was not significant in the second season .These results agree with those of Mohamed (2003) and Ahmed (2009) who mentioned that number of leaves was differed among strawberry cultivars.

As for the effect of the interaction between cultivar and plant order, results in Table (3) indicated that significant increments were found in plants derived from both certified and registered orders of cv Tamar plants in the first season, but in the second season, the significant increment was found in nucleus of cv Tamar plants as compared with the other tested cultivars and orders.

1-2- Plant length:

The effect of different nursery mother plant orders on plant length was not significant in the two tested seasons, as shown in Table (3).

Concerning the cultivar effect on plant length, results showed that cv Festival plants exhibited higher significant values as compared with Tamar ones in the two tested seasons. These results are similar to those of Mohammed (2003) and Ahmed (2009).

Concerning the interaction effect on plant length, results show that plants derived from all tested plant orders of Festival cultivar in addition to those of foundation of cv Tamar plants gave the highest significant values in the first season, while in the second season, the highest values were obtained from nucleus, registered and certified of cv Festival plants.

Table (3): Effect of plant orders, cultivars and their interaction on the number of leaves and length (cm) of derived plants during 2007/008 and 2008/2009 seasons.

Treatments	Number of leaves/plant		Plant length (cm)	
	2007/08	2008/09	2007/08	2008/09
mother order Nucleus	8.25b	6.78a	14.17a	15.18a
Foundation	8.80b	6.44ab	15.17a	14.90a
Registered	12.75a	6.00b	13.52a	14.82a
Certified	13.07a	5.96b	12.97a	15.70a
Cultivars				
Tamar	13.67a	6.39a	12.33b	14.18b
Festival	7.76b	6.19a	15.57a	16.12a
Order x CV				
Tamar x nucleus	10.2bc	7.50a	11.00c	13.67ef
Tamar x foundation	10.63b	6.42b	14.57ab	14.67de
Tamar x registered	16.00a	5.92b	12.93bc	13.37f
Tamar x certified	17.83a	5.75b	10.83c	15.00cd
Festival x nucleus	6.30e	6.07b	17.33a	16.70a
Festival x foundation	6.96de	6.47b	15.77ab	15.13bd
Festival x registered	9.50bc	6.00b	14.10ab	16.27ac
Festival x certified	8.30cd	6.25b	15.10ab	16.40ab

Values in same column followed by the same letter do not significantly differ from each other according to Duncan`s multiple range tests at 5 % level.

2- Early and total yield:

2-1- Early yield

Concerning the effect of different nursery mother plant orders on early yield, results in Table (4) showed that plants derived from registered mother plants gave the highest significant values in the two tested seasons in addition to those derived from certified plants in the second season.

With regard to the cultivar effect on early yield, results showed that cv Festival plants exhibited higher significant values as compared with cv Tamar ones in the two successive seasons. Our results are in agreement with those of El-Sayed (2000), Mohamed (2003) and Ahmed (2009).

As for the interaction effect on early yield, results showed that the plants derived from registered cv Festival plants gave the highest significant values in the two seasons, in addition to those derived from certified order of cv Festival in the first season (Table 4 and Fig. 1). These results are in harmony with those of Faedi *et al.* (2008), Nir-Dai *et al.* (2008) and Simposon *et al.* (2008). The high early yield of plants derived from registered cv Festival plants may be attributed to their vigorous growth resulted in their propagation stage in the open nursery (out of the screenhouse) under the suitable growth conditions, i.e., light intensity and temperature.

2-2- Total yield

Data in Table (4) indicate that plants derived from registered mother plants showed significant increment in total yield, on the other hand, nucleus plants gave the lowest significant values. However, those of foundation and certified plants showed medium values in the two tested seasons. The lowest total yield produced from nucleus plants may be due to their high productivity of runners and subsequent daughter plants from most lateral buds which affected negatively the number of differentiated buds into flowers and fruits.

In Table (4) and Fig. (1) results showed also significant increment in total yield of cv Festival plants as compared with cv Tamar plants in both seasons.

Regarding the interaction effect on total yield per plant and fadden, results show that plants derived from registered of cv Festival plants in the two tested seasons and plants derived from certified of cv Festival plant in the first season gave the highest values. These results confirm those of Faedi *et al*. (2008). The high total yield of plants derived from registered and certified orders of cv Festival could be due to their adaptability for yielding while the nucleus and foundation orders usually used for runnering and transplant production as mothers for nurseries.

Table (4): Effect of plant orders, cultivars and their interaction on the early and total yield of derived plants during 2007/008 and 2008/2009 seasons.

Treatments	Early yield/plant (g)		Early yield/ fadden (ton)		Total yield/plant (g)		Total yield/ fadden (ton)	
	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09
mother order								
Nucleus	64.35c	68.78b	2.574c	2.75b	305.0c	408.3c	12.204c	16.330b
Foundation	68.06c	67.54b	2.722c	2.702c	340.0b	422.4b	13.600b	16.900a
Registered	76.32a	75.01a	3.053a	3.000a	381.6a	431.9a	15.264a	17.160a
Certified	70.92b	75.83a	2.837b	3.030a	354.6b	422.9b	14.186b	16.920a
Cultivars								
Tamar	60.58b	65.03b	2.423b	2.601b	302.9b	397.3b	12.116b	15.89b
Festival	79.22a	78.55a	3.169a	3.142a	387.8a	445.4a	15.512a	17.76a
Order x CV								
Tamar x nucleus	54.37d	63.54de	1.815d	2.542de	271.8e	392.2d	10.872e	15.69d
Tamar x foundation	59.93d	65.84de	2.397d	2.634de	299.7d	398.6d	9.188d	15.95d
Tamar x registered	67.03c	61.10e	3.917c	2.444e	335.2c	396.2d	13.408c	15.85d
Tamar x certified	60.97cd	69.65cd	2.439cd	2.786cd	304.8d	402.5d	12.192d	16.09d
Festival x nucleus	74.33b	74.03c	2.973b	2.961c	338.3c	424.5c	13.532c	16.980c
Festival x foundation	76.07b	69.23cd	2.769b	2.769cd	380.3b	446.2b	15.212b	17.850b
Festival x registered	85.60a	88.93a	3.424a	3.557a	428.0a	467.5a	17.120a	18.470a
Festival x certified	80.87ab	82.01b	3.235ab	3.280b	404.3a	443.5b	16.172a	17.740b

Values in same column followed by the same letter do not significantly differ from each other according to Duncan`s multiple range tests at 5 % level.

3- Physical fruit characteristics:

3-1- Average fruit weight:

Results in Table (5**)** show that plants derived from nucleus and foundation nursery mother plant orders exhibited higher values of fruit weight compared with those of registered and certified ones in the first season, while in the second season plants derived from certified order recorded significant increment in fruit weight as compared with those of all other tested plant

orders. Moreover, no significant differences were detected among them. The results in the first season are similar to those obtained by Vanesbroeck *et al.* (2008).

As regards to the effect of cultivar on fruit weight, significant increment in fruit weight of cv Tamar was detected as compared with those of cv Festival in the first season, while this increment was not significant in the second season. The results coincide with El-Sayed (2000), Mohamed (2003) and Ahmed (2009). However, these results are not confirming those of Aranda *et al*. (2005) and Khanizaded *et al*. (2005).

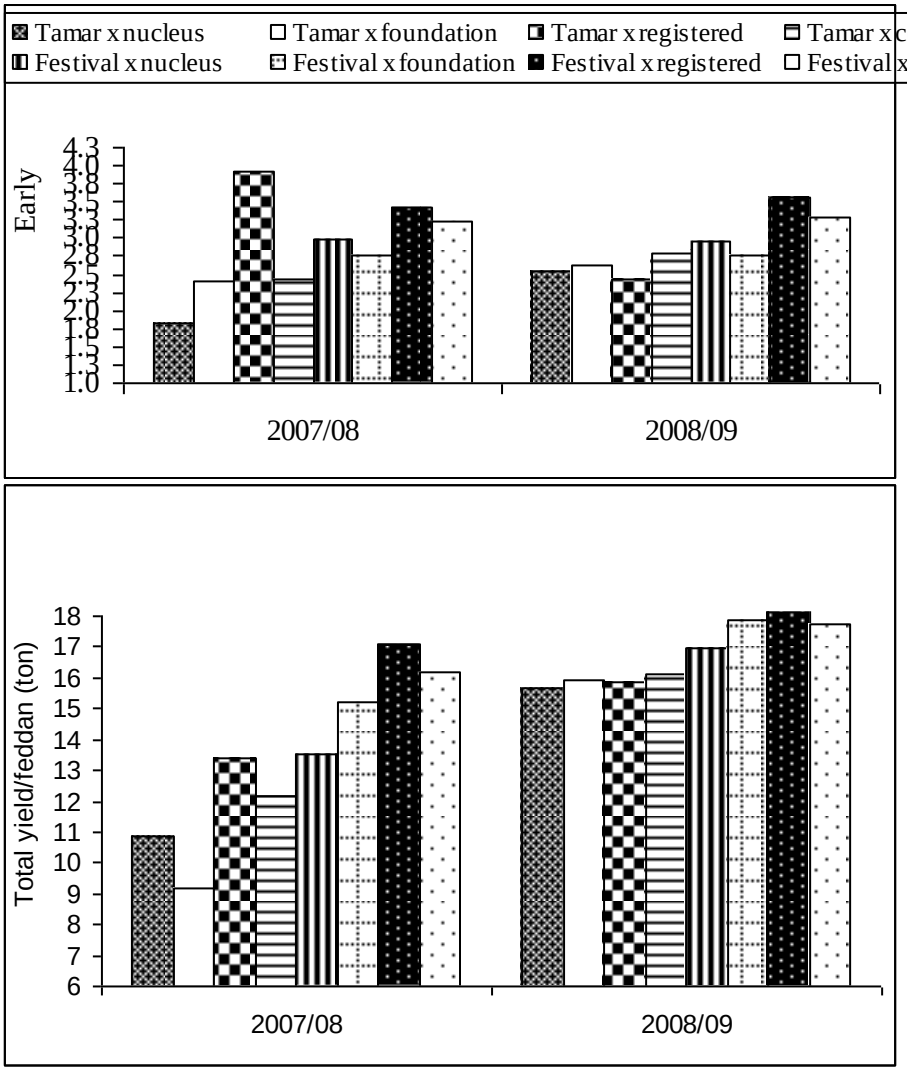

Fig. (1): Effect of plant orders and cultivars on the early and total yield of derived plants during 2007/008 and 2008/2009 seasons.

As for the effect of interaction between mother plant order and cultivar on fruit weight, results in Table (5) show that the highest values were obtained from plants derived from nucleus and foundation order of cv Tamar plants in the two tested seasons in addition to those derived from certified cv Tamar plants, and registered and certified cv Festival in the second season.

3-2- Fruit firmness:

In Table (5) results show that fruits from foundation plant order showed the highest values of firmness in the two tested seasons. On the other hand, the lowest values were detected to plants derived from registered order in the two tested season, with significant differences between it and all other tested orders in the second season.

As for the effect of cultivar on fruit firmness, cv Festival fruits showed significant increment as compared with those of cv Tamar in the two tested seasons. These results agree with those of El-Sayed (2000), Mohamed (2003) and Ahmed (2009).

The interaction between cultivar and plant order had a significant effect as clear from results presented in Table (5). The highest values were obtained from plants derived from nucleus and certified orders of cv Festival in the two tested seasons, in addition to those derived from foundation plants from the same cultivar Festival in the first season. On the contrary, the lowest values of fruit firmness were obtained from plants derived from nucleus order of cv Tamar cultivar in the two tested seasons, in addition to those derived from registered and certified order of cv Tamar plants in the first season.

Table (5): Effect of plant orders, cultivars and their interaction on average fruit weight and fruit firmness of derived plants during 2007/008 and 2008/2009 seasons.

Treatments	Fruit weight (g)		Fruit firmness (g/cm^2)	
	2007/2008	2008/2009	2008/2009	2008/2009
mother order				
Nucleus	29.85a	25.55b	412.5ab	375.0c
Foundation	28.10a	24.31b	427.7a	408.3a
Registered	23.98b	24.81b	402.6b	368.9d
Certified	21.53b	27.85a	415.0ab	395.8b
Cultivars				
Tamar	28.59a	26.12a	391.4b	369.0b
Festival	23.14b	25.14a	437.5a	404.6a
Order x CV				
Tamar x nucleus	33.63a	27.28a	375.0c	325.0g
Tamar x foundation	32.67a	25.65ab	405.3b	416.7b
Tamar x registered	26.07b	23.71b	396.9bc	369.4d
Tamar x certified	25.33b	27.83a	388.36c	366.7f
Festival x nucleus	23.53b	23.82b	450.0a	425.0a
Festival x foundation	22.73b	22.97b	450.0a	400.0c
Festival x registered	22.63b	25.90ab	408.3b	368.3e
Festival x certified	20.33b	27.87a	441.7a	425.0a

Values in same column followed by the same letter do not significantly differ from each other according to Duncan`s multiple range tests at 5 % level.

4- Chemical Compositions of fruits:

4-1- Total soluble solids:

It is clear from Table (6) that both plant order and cultivar affected significantly total soluble solids. Plants derived from nucleus and registered mother plants showed the highest values in the first seasons but those derived from registered plants only gave the highest values in the second season. On the other hand, the lowest values were detected from those derived from certified plants in the two tested seasons in addition to those derived from foundation in the second season only.

As regards to the cultivar effect, cv Tamar fruits showed higher significant values as compared with those of cv Festival in the two tested seasons.

Concerning to the interaction effect between plant orders and cultivar, results showed that those derived from nucleus plants of cv Tamar gave the highest values in the first season, but those derived from registered plants of Festival were the highest in the second season. These findings coincide with those of Aranda *et al.* (2005) and Insfran *et al.* (2006).

4-2- Titratable acidity:-

Plants derived from both of nucleus and foundation mother plants exhibited the highest values of titratable acidity in the first season as well as those derived from foundation plants in the second season (Table 6).

Significant increment in titratable acidity was found in Festival fruits as compared with those cv Tamar in the first season, while in the second season there was no significant effect between the two tested cultivars.

As for the interaction effect between plant order and cultivar on titratable acidity, results showed that the lowest values of titratable acidity were obtained from plants derived from registered plants of Tamar in both seasons, while no significant differences were detected among most of the interactions. These results confirm those of Ahmed (2009).

4-3- Ascorbic acid content:

Regarding the effect of plant order on ascorbic acid content, data in Table (6) showed that the highest values were obtained from fruits of plants derived from nucleus and certified plants in the first seasons. While in the second season fruit of plants derived from foundation plants gave the highest values

As for the effect of cultivar, cv Tamar fruits showed significant increment in ascorbic acid content as compared with those of cv Festival in the two tested seasons. Our results are similar to those of El-Sayed (2000), Mohamed (2003) and Ahmed (2009).

With respect to the interaction effect on ascorbic acid content, data indicate that fruits of plants derived from nucleus and certified plants of Tamar cultivar showed the highest values in the first season, while in the second season a significant increase in ascorbic acid content was detected with the fruits of plants derived from foundation of cv Tamar. Similar findings have been reported by Insfran *et al*. (2006) and Ahmed (2009).

Table (6): Effect of plant orders, cultivars and their interaction on total soluble solids, titratable acidity and ascorbic acid in fruits of derived plants during 2007/008 and 2008/2009 seasons.

Treatments	Total soluble solids (%)		Titratable acidity (mg/100g f.w.)		Ascorbic acids (mg/100g f.w.)	
	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09
mother order						
Nucleus	10.71a	9.83b	0.157ab	0.152b	44.97a	39.97bc
Foundation	10.10b	9.43c	0.167a	0.155a	37.33b	42.33a
Registered	10.32ab	10.50a	0.153b	0.156b	37.28b	38.95c
Certified	9.63c	9.17c	0.153b	0.161b	43.08a	40.28b
Cultivars						
Tamar	10.59a	9.20a	0.151b	0.147a	43.41a	42.66a
Festival	9.79b	10.27b	0.164a	0.165a	37.93b	38.10b
Order x CV						
Tamar x nucleus	11.58a	10.00bc	0.156ab	0.147a	49.50a	42.50b
Tamar x foundation	10.71b	9.27d	0.172a	0.163a	41.49b	45.85a
Tamar x registered	10.63b	9.33d	0.137c	0.130b	24.08c	40.75c
Tamar x certified	9.43c	8.20e	0.142bc	0.148a	48.57a	41.57bc
Festival x nucleus	9.83c	9.67cd	0.160ab	0.158a	40.43b	37.43de
Festival x foundation	9.50c	9.60cd	0.163a	0.148a	33.18c	38.84d
Festival x registered	10.00c	11.67a	0.170a	0.183a	40.48b	37.15e
Festival x certified	9.83c	10.13b	0.163a	0.173a	37.65bc	38.98d

Values in same column followed by the same letter do not significantly differ from each other according to Duncan`s multiple range tests at 5 % level.

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تأثير رتب شتلات الفراولة المختلفة علي إنتاج الشتلات و المحصول وجودة الثمار تحت الأنفاق البلاستيكية

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أجريت هذه الدراسة خلال موسمى ٢٠٠٨/٢٠٠٧ و ٢٠٠٩/٢٠٠٨ فى تجربتين الأولى لبحث تأثير رتب شتلات الفراولة المختلفة (النوية – الأساس – المسجلة – المعتمدة) وكذا الصنف (تمار – فستفال) والتفاعل بينهما علي إنتاج وجودة الشتلات في مرحلة المشتل والثانية لتأثير نفس المعاملات علي الإنتاجية وصفات الجودة في الثمار بنظام الزراعة الطازجة تحت نظام الأقبية البلاستكية واستخدم تصميم القطع المنشقة فى التجربتين.

فى التجربة الأولى أظهرت النتائج بالنسبة لتأثير رتبة الشتلات أن رتبة النوية أعطت أعلى القيم لعدد الشتلات للنبات وعدد الجذور للشتلة وقطر التاج (سمك الشتلة) وان النباتات الناتجة من رتبة الاساس تفوقت في صفات قطر التاج وطول الجذور أما النباتات الناتجة من الرتبة المعتمدة فقد تفوقت أيضاً فى طول الجذور.

بالنسبة لتأثير الصنف فقد زاد عدد الشتلات وعدد الجذور فى الصنف تمار عنه في الصنف فستفال بينما تفوقت النباتات الناتجة من الصنف فستفال فى طول الجذور وطول النبات عن الصنف تمار. وبالنسبة لتأثير التفاعل فقد تم الحصول أعلى عدد للشتلات من الصنف فستفال المنزرع برتبه النويه بينما تفوق الصنف تمار المنزرع برتبه النويه فى عدد الجذور للشتلة وسمك التاج للشتلات.

فى التجربة الثانية توضح النتائج أن النباتات الناتجة من رتبه النوية أظهرت قيم أقل للمحصول الكلى بينما تفوقت النباتات الناتجة من رتبة الأساس فى صفات صلابة الثمار والحموضة الكليه لعصير الثمره أما النباتات الناتجة من الرتبة المسجلة فقد أظهرت تفوقا ملحوظا فى المحصول المبكر والكلى ونسبه المواد الصلبه الذائبه الكليه للعصير.

بالنسبة لتأثير الصنف على المحصول ومكوناته فقد تفوق الصنف فستفال فى المحصول المبكر والكلى وصلابه الثمار والحموضه الكليه عن الصنف تماروأعطى الصنف تمار زيادة فى نسبه المواد الصلبه الذائبه الكليه وحمض الاسكوربك عن الصنف فستفال.

أما بالنسبة لتأثير التفاعل فقد تفوق الصنف فستفال المنزرع بالرتبه المسجلة فى المحصول المبكر والكلى وتفوق الصنف تمار المنزرع برتبة النويه فى متوسط وزن الثمرة. تجمل الدراسة بأنه يوصى بزراعة الصنف فستفال بالرتبة المسجله للحصول علي أعلى محصول مبكر وكلي بالإضافة إلى الحموضة والصلابة العالية بالثمار وذلك للتصدير.