

Influence of Nursery Mother Plants Removal Dates on Number, Quality and Fungal Diseases Severity of Transplants in Some New Strawberry Cultivars

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ABSTRACT

This study was carried out at a private farm at Wardan, Giza Governorate, Egypt, during the two seasons of 2018/2019 and 2019/2020. The aim of this study was to investigate the effect of nursery mother plants removal dates (after 3, 4, 5 months) from planting the nursery in addition to control (without mother plants removal) on transplants quality, production and fungal diseases severity in roots and crown of six strawberry cultivars "Festival, Fortuna, Florida, Eliana, Sensation and Monterey". The experimental design was a split plot design with three replications. The soil type of experimental site was sandy with pH of 6.77 and EC of 0.6Mm. The results indicated that there were significant differences among the tested strawberry cultivars in vegetative growth characteristics (plant length, crown diameter and root length) of their transplant. Festival cultivar gave the highest transplants number while Florida variety seedlings have the highest carbohydrate content. Removing mother plant increased crown diameter of the produced transplants and number of transplants. Delaying mother removal date increased significantly the disease incidence values. Moreover, control treatment (without removal) showed significantly the highest value as compared with the tested treatments. Ealiar removing mother transplant after three months for Festival cultivar give the highest number of transplants. The study recommend removing mothers plants of the strawberry nursery afterthree months from planting of nursery to improve number of transplants, quality and decrease the infection and the severity of the fungi attacking roots and crown which cause root and crown rot diseases.

Keywords: Strawberry- Transplants production- Mother plant removal- Date- Root fungal diseases.

INTRODUCTION

Strawberry propagated plants are vegtatively, occurs through aerial it generation stolon's (runners), which differentiate into daughter plants on the nodes. The total area of strawberry nurseries reached 560 feddans in 2021/2022 season, which produced about 224 millions of Egypt exported around transplants. 70 million of frigo transplants in 2021/2022 season. The propagation process usually starts with virus free stock plants (Super Elite Plants), this order of transplants is used as mother plants for the nursery derived from tissue culture plants. Daughter plants are new leaf rosettes with developing small roots that can develop into mature strawberry plants

(Heide et al., 2013). Strawberry plants consist of a crown (shortened stem) from which all leaves, roots, flowers and runners grow. Strawberry nurseries and transplant quality play a crucial role in strawberry producing industry-serving (Sabt, 2011). In strawberry production, the availability of high quality transplant is one of the most important factors in obtaining good fruit yields. Starting production using healthy plants that have bigger crown size, longer roots and high starch content in crowns resulted in high productivity(Pertuzé, et al., 2006). Also, There are several factors can affect yield andquality of strawberry. Transplants quality is considered one of the mostimportant



factors. In this regard, Attia and Omran (2009) and Cocco et al. (2016) noticed that, starting production with healthy plants that have bigger crown size, longer roots and higher starch concentration gave high productivity. Antonioet al. (2021) mentioned that the productivity and number of fruits increased significantly by 57% with larger crown plants, which also provided precocity of productivity. Previous studies have shown that runner plants quality is a major factor that affects both productivity and fruit quality (Durner et al., 2002, Reekie et al., 2002 and Cobos, 2006).In addition, Czynezyk (2006) mentioned that mother plants for nursery (super elite plants) should be free from strawberry harmful organisms which reduce the quality of nursery plant material; pests, fungi, bacteria and viruses during production of transplants. The Super Elite plants isplanted in the fumigated nursery soil to produce bare root fresh transplants, which have low quality due to contamination by pathogens like Rhizoctonia, Phytophthora and Fusarium (Hancock, 2005).

Defoliation, defined as the partial or total removal of a plant's leaves, is a technique that has been used in several regions of the world, to stimulate photosynthesis and growth of young leaves, promote better use of water and nutrients as well as modify dry matter partitioning between source and sink compartments for plants (Iqbal et al., 2012 and Khan et al., 2023). In this respect, Holzapfel and Alpert (2003) stated that when daughter plants connected to the mother

This study was carried out during the two successive seasons of 2018/2019 and 2019/2020 in a private farmat Wardan, Giza Governorate, Egypt. The purpose of this work was to find out the suitable removal date of mother plants from the strawberry nursery andits effects on transplant production, transplants quality and fungal diseases of some new and

mineral nutrients, and biochemical compounds by vascular transport. Defoliation can also be used in the production of strawberry transplants, to reduce pests and diseases, and to save lower transpiration during transport and planting. Sabt (2011) recommended that continuous defoliation of mother plants is needed to increase number of transplants. In addition, Plant crown diameter and root length increased with mother plant leaf pruning or elimination was performed. Starch content in roots and crowns was enhanced significantly when mother plants were pruned, but increased even more when mother plants were eliminated. Also elimination can help to regulate plant runner production and quality (Lyu et al., 2014).Picio et al. (2014) reported that defoliation can be used to reduce growth of mother plants, without reducing emission and growth of runner tips for transplant production. Shi et al. (2021) showed that, daughter plant production of strawberry plants declines significantly with shorter stolon removal intervals, indicating the need to adjust stolon removal in strawberry nurseries optimal daughter for plant production. Therefore, the objectives of this work

plant, they can also exchange carbon, water,

were to investigate the impact of different mothers' plant removal date on the daughter plant quality and propagation rates in some new and commercial strawberry cultivars, in relation to fungal disease severity in their crown and roots.

MATERIALS AND METHODS

commercialstrawberry cultivars. Super Elite plants as nursery mother plants of Festival, Fortuna, Florida, Eliana, Sensation and Monterey strawberry, were taken out from the cold storage and plantedon the first of April in plastic cups with sizes of 150 cm³,the medium contained peat moss, vermiculite and perlite (1:1:1) in volume, pH was adjust by Calcium carbonate to



6.5.Pots were placed in ascreen-house with a double door (Ahmed, 2015). The plants were transferred to the nursery plots at 1st May in both growing seasons. The soil type was a pure sandy soil with pH of 6.77 and EC of 0.6 Mm.Mother plants were spaced at 1.0 m between plants and 1.5m between rows each replicate contained five rows with 5m in length. The plot area was 37.5 m^2 for each cultivar. Drip irrigation system in the first two months was used with GR 4 L/h, and then micro sprinkler irrigation system (180 L/h) was used. The experimental plots received the normal agricultural practices i.e. flower removal, irrigation, fertilization, runner fixation, disease and pest control according to nursery recommendations of the Egyptian Ministry of Agriculture. The treatments were three dates of mother plants removal and six cultivars evaluated in a split-plot design with three replicates. Cultivars (Festival, Fortuna, Florida, Eliana, Sensation and Monterey) were placed in the main plots, and removal dates (after 3, 4,5 months and without removal (control)) were in the subplots which were 1st August, 1st September, 1st October and without removal.

The following data were recorded:

Representative samples of transplants were taken at digging transplant at end of December 2018 and 2019 before cold storage at 2°C for eight months until next September (planting date) to record the vegetative growth characteristics of transplants i.e., plant height, crown diameter, root length, fresh and dry weight of transplants and number of transplants per

1. Transplant length:

a. Effect of cultivars

Data in **Table** (1) show that transplant length significantly increased in Fortuna, Florida and Eliana cultivarswithout significant differences among them in the both seasons compared with other tested cultivars. These results agree with those feddan was calculated. Total carbohydrates in transplants were determined as the method described in A.O.A.C. (1990).

As for disease assessment, disease severity and infection percentage were estimated in transplants for each cultivar showing various types of rot symptoms i.e. discoloration, a circular black spot, slightly sunken, brown water soaked lesion, salmoncolored, turn dark brown. Samples were surface disinfested using 70% Ethyl alcohol for 2min., washed with sterile water (SW) and dried at room temperature, then cut into small pieces. Sterilized pieces were sown on sterilized PDA medium amended with 0.1% streptomycin sulphate then incubated at $26 \pm$ 2°C for 5 days. All fungal colonies were transferred and purified on PDA medium. Fungal purified were transferred on PDA slant medium and kept at 5°C. All isolated root fungi were identified in Plant Pathology Department, Faulty of Agriculture, Ain Shams University, Egypt. Based on cultural and morphological characteristics, and pathogenicity test were identified according to the methods of Freeman and Katan, (2002).

No. of diseased plants Percentage of diseased plants= **x 100** Total No. of plants

Statistical analysis

All obtained data were subjected to an analysis of variance with SAS statistic package. Means were separated using Duncan's multiple range test(Gomez and Gomez 1984).

RESULTS AND DISCUSSION

ofMarcellini (2019) who stated that cultivars differ in terms of transplant length. The effect of plant vegetative development is closely related to the genotype, and may be to the different genetic constituents of the cultivars.

b. Effect of mother plant removal dates:



As regards to the effect of mother plant removal dates on transplant length, all mother plant removal dates decreased the plant length significantly in the second seasons. The highest plants were obtained from control treatment in both seasons. Such short transplants are needed for high survival percent in the production field than the etulated ones produced from control treatment (Table 1). The results not confirm with these obtained from Wanget al. (2020)who found that seedling heightdid not differ between defoliation treatments. c. Effect of interaction between cultivars and mother plant removal dates:

Data presented in **Table (1)** show that there was no significant effect for interaction on length of transplants in the two seasons. In addition, the maximum values of plant length for transplants was in Eliana cultivar without removal of the mother plants in both growing seasons, these results may be due tothe effect of high transplants density and humidity of the micro climate around plants.

 Table (1). Effect of cultivars, mothers removal dates and their interaction on transplant length(cm),crown diameter (cm) and root length (cm) of strawberry nursery during 2018/2019 and 2019/2020 seasons.

Treatments -		Transplant length (cm)		Crown diameter (cm)		Root length (cm)			
		2018/2019	2018/2019	2018/2019	2018/2019	2018/2019	2018/2019		
				Cultiv	ar				
Festival		13.19 C	13.07 CD	0.91 A	0.72 D	12.18 C	12.38 C		
	Fortuna	16.13 A	15.80 AB	0.84 B	0.83 B	13.74 BC	13.67 BC		
	Florida	16.23 A	15.96 A	0.80 C	0.89 A	13.77 BC	13.80 BC		
	Eliana	16.38 A	16.40 A	0.74 D	0.70 D	14.84 BC	14.66 B		
	Sensation	14.41 B	14.42 BC	0.72 DE	0.84 B	16.94 AB	14.84 B		
	Monterey	12.73 C	12.69 D	0.70 E	0.74 C	20.06 A	19.29 A		
		removal dates							
	after three months	14.64 AB	14.37 BC	0.91 A	0.91 A	15.571 A	14.85 AB		
	after four months	14.22 B	13.96 C	0.85 B	0.86 B	15.039 A	15.19 A		
	after five months	14.74 AB	14.81 B	0.80 C	0.77 C	14.733 A	14.93 AB		
1	Without removal (control)	15.79 A	15.76 A	0.60 D	0.60 D	15.692 A	14.11 B		
			Interaction						
7	after three months	11.55 e	11.33 h	0.92 b	0.94 bc	14.80 ab	13.94 c-f		
liva	after four months	13.54 b-e	13.33 d-h	0.85 de	0.90 de	13.92 b	14.66 cd		
esi	after five months	13.97 b-e	14.03 b-h	0.59 i	0.53 kl	9.47 b	10.38 f		
Ť.	Without removal (control)	13.70 b-e	13.60 c-h	0.54 i	0.52 1	10.49 b	10.55 ef		
а	after three months	17.25 ab	17.25 ab	0.88 b-d	0.91 с-е	12.55 ab	12.27 d-f		
In	after four months	16.25 a-d	15.05 b-g	0.87 ce	0.88 e	12.82 ab	12.83 c-f		
01	after five months	15.05 а-е	15.05 b-g	0.82 ef	0.82 f	13.88 ab	13.88 c-f		
Ŧ	Without removal (control)	16 a-d	15.86 a-e	0.66 h	0.72 h	15.72 ab	15.72 b-d		
а	after three months	16.78 а-с	15.77 а-е	1.03 a	1.03 a	14.22 ab	14.22 c-f		
rid	after four months	14.99 а-е	14.94 b-g	0.93 b	0.89 e	13.22 ab	13.32 c-f		
Iol	after five months	16.94 ab	16.94 ab	1.02 a	0.97 b	13.32 ab	13.32 c-f		
H	Without removal (control)	16.22 a-d	16.22 a-d	0.67 h	0.66 i	14.33 ab	14.33 с-е		
-	after three months	15.67 а-е	15.66 b-f	0.75 g	0.75 g	14.72 ab	14.72 cd		
ana	after four months	15.44 а-е	15.49 b-f	0.75 g	0.76 g	14.27 ab	14.27 с-е		
Eli	after five months	15.77 а-е	15.77 а-е	0.75 g	0.74 gh	14.88 ab	14.88 cd		
	Without removal (control)	19.12 a	18.66 a	0.57 i	0.58 j	15.49 ab	14.77 cd		
nc	after three months	13.50 b-e	13.49 d-h	1.04 a	1.05 a	14.66 ab	14.66 cd		
Sensatic	after four months	12.50 de	12.49 f-h	0.92 bc	0.93 cd	16.55 ab	16.66 bc		
	after five months	15.11 a-e	15.10 b-g	0.86 de	0.83 f	14.60 ab	14.88 cd		
	Without removal (control)	16.57 a-d	16.61 a-c	0.57 i	0.58 j	19.44 ab	13.16 c-f		
Monterey	after three months	13.11 b-e	12.71 e-h	0.82 ef	0.82 f	22.49 a	19.33 ab		
	after four months	12.61 с-е	12.44 f-h	0.82 ef	0.82 f	21.44 a	19.44 ab		
	after five months	11.61 e	11.99 gh	0.78 fg	0.77 g	22.21 a	22.22 a		
	Without removal (control)	13.71 b-e	13.60 c-h	0.57 i	0.56 jk	19.16 ab	16.66 bc		



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

2. Crown diameter:

a. Effect of cultivars:

The results presented in Table (1) show thatFestival cultivar recorded the highest crown diameter in the first tested season. On the other side, Florida cultivar has the largest crown diameter in the second season. These results agree with those of Cocco et al. 2016who reported that greater crown diameter was verified in transplants propagated in Argentina, for both Chile and Chuí cultivars.Initial crown diameter of bare-root transplants is the key consideration for strawberry production. The effect of initial crown diameter was consistent for the three major cultivars in Florida state and has a strong effect on early and total yield of strawberries (Quezada et al., 2015).

b. Effect of mother plant removal dates:

Concerning to the effect of mother removal dates on crown diameter ,data in Table (1) revealed that early removal dates (after 3 months) increased the transplant crown diameter followed by removal of mother plant after 4 then 5 months compared to the control(without removal of mother plants) treatment in both seasons. Our result are in agreement with those of Picio et al. (2014). Differences in crown diameter among the different transplant mother removal dates may be related to the number of transplants produced by mother plant in nurseries. Higher densities can cause competition for primary growthfactors, such as nutrients, light and water which, positively affect transplant growth and show high reserve accumulation and improve early growth(Cocco et al. 2016).

c. Effect of interaction between cultivars and mother plant removal dates:

From the obtained data in Table (1) it was noticed that, the highest values of crown

diameter for transplants were obtained from Florida and Sensation cultivars when removal of mother plants was done after three months in both tested years. This increment could be attributed to the improvement of plant growth and reducing disease incidenceas shown in Table (6), as mentioned by Van and Bosher, (1962), Winks (1965) and Maas (1998).

3. Root length/ transplant:

a. Effect of cultivars:

Data presented in Table (1) clearly show that .Monterey cultivar recorded the highest root length per transplant in the two tested seasons in addition to Sensation cultivar in the first season. These results agree with those of Ahmed (2009) and Attiaand Omran(2009) who found that there were varietal differences in root length of some strawberry cultivars.

b. Effect of mother plant removal dates:

All used mother plants removal dates treatments did not affect significantly root length compared to the control treatment in the first seasons. These results are agree with Lyu et al. (2014) who mentioned that root growth was mainly affected by partial defoliation of old leaves

c. Effect of interaction between cultivars and mother plant removal dates:

As for interaction between cultivars and removal dates of strawberry on root length, there were no significant differences between most of used treatments on root length for transplants in the two seasons. The highest values of root length were for Monetery cultivar under all removal treatments in the both season. On the other side, Festival cultivar gave the lowest values when mother plants were removed after five months.

4. Fresh weight of transplants:

a. Effect of cultivars

In Table (2), data show that Fortuna and



Florida had the highest values of fresh weight without significant difference between them in both seasons, in addition to Sensation and Festival in the first and second seasons respectively. On the other hand, Monterey cultivar showed the lowest values in both tested seasons.

b. Effect of mother plant removal dates:

Results in Table (2) show that the highest values of fresh weight of transplant were recorded by mother plants removal after three and four months from planning without significant differences between them in both seasons. These results agree with Lyu et al. (2014) who indicated that both fresh and dry root weight were significantly reduced by defoliating old leaves of mother plant. While removing of mother plants after five months or those without removing (control) gave the lowest values.

c. Effect of interaction between cultivars and mother plant removal dates:

As shown in Table (2), no clear effect was detected between cultivars and removing dates on fresh weight of transplant.

5. Dry weight of transplant:

a. Effect of cultivars:

Data in Table (2) cleared that the highest significant dry weight of strawberry transplant was produced from Festival followed by Fortuna and Florida cultivars with no significant difference among them in the two studied seasons. On the other hand, no significant differences were recorded among the other tested cultivars.. Similar opinions were reported by Trentin et al. (2021) who reported that Camarosa' had more crowns 'Albion', with higher shoot than dry weight.Differences in root dry mass among the different transplant origins may be related to the number of transplants produced by matrix in plant nurseries. Higher density may cause competition for essential growth factors, such as nutrients, light and water, negatively affecting individual growth and resulting in less reserve accumulation (Cocco et al.,2016).

b. Effect of mother plant removal:

Results in Table (2) revealed that all removal dates of mother plant significantly increase dry weight values as compared with the control. The effect of defoliation on total dry matter mass was higher on once- and twice-defoliated plants with rooted stolons were evualated and dry matter mass of runner tips was not reduced by the use of twice defoliations of plants (Picio et al. 2014).

c. Effect of interaction between cultivars and mother plant removal dates:

The effect of the interaction between cultivars and removal of mother plant dates on dry weight of strawberry was presented in Table (2). Results indicated that transplants produced under all mother plant removal treatments for Fortuna cultivar gave the highest value of dry weight of transplant. However, no clear effect was noticed of the most interaction treatments on dry weight of transplants.

6. Number of transplants/Feddan:

a. Effect of cultivars

It is quite clear from data in Table (3) that number of transplants per feddan for strawberry was significantly affected with cultivars in both seasons. The highest number of transplants was recorded for Festival, Eliana and Monterey cultivarswithout significant difference among themin the both seasons. The results are confirmed with Ahmed (2009) and Attia and Omran (2009) who stated that there were significant differences in number of transplants produced from cv. Tamar plants as compared with cv Festival in the two tested seasons. In addition, Treder, et al. (2014) reported that, the varieties



differed significantly in the efficiency of transplants production, which led to a difference in the number of transplants produced from the mother plant. High or low number of transplants may be due to the differences in the genetic potential of cultivars for runner production (Cocco et al. ,2016). The variation in shoot number in different varieties may be due to the particular varietal character and their growth habits. The differences in the time of runner formation, and transplant production in the various cultivars can be attributed to either a varietal character or genetic make-up of the plants or both influence the plants to react differently under same climatic conditions. Most the cultivars used strawberry showed great variations with respect to number of runners among each other (Kaur et al, 2017).

b. Effect of mother plant removal dates:

Data tabulated in **Table (3)** showed that, there was no significant effect for remval of mother plant on number of transplants per feddan in the both seasons.

c. Effect of interaction between cultivars and mother plant removal dates:

The highest number of transplants (**Table 3**) was produced by combination with Festival cultivar and removal of mother plant after three months in the two tested seasons followed by Monterey cultivar and removal of mother plant after 5 months in the second season.

7. Carbohydrates content: a. Effect of cultivars:

It is clear from **Table (3)** that cultivar affected significantly total carbohydrates content in transplant. Florida cultivar showed significant increment in total carbohydrates as compared with those of other cultivars in the two tested seasons. The starch content was higher in the both crown and roots of Argentinean transplants, differing from the other propagation sites, for both cultivars. Chilean and National transplants propagated in Sao Francisco de Paula presented intermediate and similar values among them for this parameter (COCCO et al., 2016 and Wanget al., 2020).On the other side, Festival and Sensation cultivars showed the lowest values.

b. Effect of mother plant removal dates:

Regarding the effect of mother plant removal dates, results in Table (3) indicated that significant differences were detected among all removal dates. Transplants derived from removal of mother plants after 3 months the highest values of showed total carbohydrates in the two experimental seasons. Such results may be due to that early removing date enable the transplant to store more carbohydrates in their crown and roots because of the crown diameter and root age. On the other hand, the lowest values were detected from those derived from control treatment in the two tested seasons. These findings are coincide with those of Wanget al. (2020)who indicated that the starch concentration in roots was relatively stable, and there was a significant difference among treatments defoliation during the experimental period.

c. Effect of interaction between cultivars and mother plant removal dates.

With respect to the interaction effect on total carbohydrates content, data indicate that transplants derived from Florida cultivar and removal of mother plants after 3 and 4 months showed the highest values in both seasons. The high carbohydrate content in strawberry transplants reserve organs in transplants leading to higher early and total fruit production (COCCO et al. 2016).



Table (2).Effect of cultivars, removal dates and their interaction onFresh weight (g) and dry weig	ht
(g) of strawberry nursery during 2018/2019 and 2019/2020 seasons.	

			• • • • • •	5	• • • • • •	
Treatments -		Fresh weight (g)		Dry w	eight (g)	
		2018/2019 2019/2020		2018/2019	2018/2019	
		26.24 D		ivar	15 (0)	
	Festival	36.34 B	38.35 A	17.46 A	15.62 A	
	Fortuna	<u>37.71 A</u>	<u>37.75 AB</u>	<u>15.80 B</u>	<u>13.77 B</u>	
	<u>Florida</u>	<u>38.01 A</u>	38.01 AB	14.03 BC	12.99 BC	
	Eliana	<u>34.91 C</u>	37.14 BC	14.34 CD	12.27 CD	
	Sensation	37.49 A	<u>37.21 B</u>	13.76 D	11.81 D	
	Monterey	35.10 C	36.30 C	1355 D	11.55 D	
		28 28 4 D	remova	dates	12 51 4	
afi	ter three months	37.27 AB	38.06 A	15.61 A	13.71 A	
af	ter four months	37.39 A	37.38 AB	15.11 AB	13.14 AB	
	ter five months	<u>36.34 BC</u>	37.22 B	14.96 AB	<u>12.85 BC</u>	
Witho	ut removal (control)	35.36 C	<u>3/.18 B</u>	14.28 B	12.30 C	
		20.10	Intera	action	15 70	
	After three months	38.10 a-d	35.07 a-d	15.07 a-d	15.72 a-c	
Festival	After four months	40.66 a	<u>35.82 a-c</u>	15.82 a-c	<u>15.82 a-c</u>	
	After five months	38.080 a-d	36.05 ab	16.05 ab	16.05 ab	
	Without removal (control)	36.567 c-e	34.90 a-e	14.90 a-e	14.90 a-d	
	After three months	38.19 a-d	<u>36.56 a</u>	<u>16.56 a</u>	16.56 a	
Fortuna	After four months	37.16 b-e	33.84 a-f	13.84 a-f	13.85 b-e	
	After five months	<u>38.77 a-c</u>	<u>32.77 d-f</u>	12.77 d-f	12.43 e-h	
	Without removal (control)	36.88 c-e	32.02 ef	12.02 ef	12.16 e-h	
	After three months	<u>39.99</u> ab	33.80 a-f	13.80 a-f	13.80 c-f	
Florida	After four months	37.89 a-d	32.79 d-f	12.79 d-f	12.79 e-h	
	After five months	37.61 b-e	33.74 a-f	13.74 a-f	13.58 d-g	
	Without removal (control)	37.71 b-e	31.78 f	11.78 f	11.78 f-h	
	After three months	37.66 b-e	31.45 f	11.45 f	11.45 h	
Eliana	After four months	37.21 b-e	31.71 f	11.71 f	11.81 f-h	
	After five months	35.99 с-е	31.92 f	11.92 f	12.02 e-h	
	Without removal (control)	37.71 b-e	31.97 ef	11.97 ef	11.97 e-h	
	After three months	38.55 a-d	33.13 b-f	13.13 b-f	13.13 d-h	
Sensation	After four months	36.99 c-e	32.85 c-f	12.85 c-f	12.84 d-h	
	After five months	36.83 c-e	31.91 f	11.91 f	11.66 gh	
	Without removal (control)	36.99 c-e	31.49 f	11.49 f	11.45 h	
	After three months	35.88 de	31.65 f	11.65 f	11.64 gh	
Monterev	After four months	34.88 e	31.65 f	11.65 f	11.65 gh	
	After five months	36.05 с-е	31.39 f	11.39 f	11.39 h	
	Without removal (control)	38.38 a-d	31.52 f	11.52 f	11.52 gh	

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



Table (3).Effect of cultivars, removal dates and their interaction on number of transplant/ feddan (1000 transplant) and carbohydrates content (g/100g dry weight) of strawberry nursery during 2018/2019 and 2019/2020 seasons.

Treatments		Number of transplant/ feddan			Carbohydrates (g/100gdry		
		(1000 transplant)		weight)			
		2018 /20	019	2019/2	020	2018/2019	2019/2020
					Cult	ivar	
	Festival	957.37	Α	1042.30	Α	218.46 E	221.17 E
	Fortuna	549.72	BC	626.27	BC	237.78 C	242.18 C
	Florida	541.80	BC	580.30	BC	289.25 A	299.38 A
	Eliana	761.60	AB	803.82	AC	231.82 D	236.17 D
	Sensation	385.47	С	462.47	С	217.91 E	219.14 F
	Monterey	715.87	AB	752.72	A-C	264.87 B	271.46 B
		Removal dates					
af	ter three months	671.38	Α	716.01	Α	270.30 A	277.73 A
a	ter four months	637.30	Α	697.98	Α	266.71 B	274.63 B
a	fter five months	646.80	Α	728.61	Α	257.49 C	263.49 C
Witho	ut removal (control)	637.30	Α	702.63	Α	178.88 D	177.15 D
					Intera	action	
	After three months	1134.60	а	1112.52	a	245.00 ij	248.27 ј
Festival	After four months	1013.60	bc	1019.20	a-c	234.69 k	238.30 k
restivat	After five months	963.20	b-d	972.52	a-d	232.17 k	236.01 kl
	Without removal (control)	1045.32	b	1064.92	ab	162.00 o	162.11 b
	After three months	709.32	e-i	728.00	a-e	242.89 j	248.06 j
Fortung	After four months	560.00	g-j	564.67	cd	269.22 f	277.58 f
Fortuna	After five months	588.92	f-j	618.80	b-e	263.73 g	271.05 g
	Without removal (control)	560.00	g-j	593.60	c-e	175.26 m	172.01 n
	After three months	524.52	h-j	513.32	de	327.33 a	319.44 b
Florida	After four months	589.87	f-j	61040	b-e	307.17 bc	342.52 a
riorida	After five months	599.20	f-j	615.07	b-e	295.15 d	305.02 d
	Without removal (control)	579.60	f-j	582.40	c-e	227.33 1	230.54 m
	After three months	750.40	d-h	766.27	a-e	258.18 h	264.21 h
Fliana	After four months	799.87	c-f	805.47	a-e	248.14 i	257.01 i
L'halla	After five months	798.92	c-f	835.32	a-e	244.81 ij	250.52 j
	Without removal (control)	785.87	d-g	808.27	a-e	176.10 m	172.96 n
	After three months	431.20	j	438.67	e	244. <u>21</u> j	248.09 j
Sensation	After four months	488.12	ij	473.20	e	233.00 k	236.20 kl
Sensation	After five months	468.52	j	490.00	e	232.01 k	234.12 1
	Without removal (control)	446.12	j	448.00	e	162.44 o	158.14 q
	After three months	884.80	b-e	877.32	a-e	304.18 c	315.23 c
Montorey	After four months	705.60	e-i	714.00	a-e	308.06 b	319.25 b
withterey	After five months	700.00	e-i	1112.52	а	277.06 e	284.24 e
	Without removal (control)	701.87	e-i	701.87	а-е	170.27 n	167.13 0

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

8. Crown and root fungi isolated from different cultivars and different mother removal dates in strawberry transplants in the nursery:

During June, July and August, samples from transplants in six cultivar and three mother plant removal dates were collected. Isolated fungi were identified according to their microscopic characteristics, from the different cultivars, results are presented in **Table (4)** as follows, and the dominant fungus wereRhizoctonia sp., Phytophthora sp. and Fusarium sp.

In *Rhizoctoniasolani* root rot, plants suddenly collapse during nursery stage or early fruiting, the underside of leaves become purplish and numerous side crowns are formed around dead ones (Van Adrichen and Bosher, 1992).



Phytophthorafergaria is a worledwide problem in strawberry and has caused significant recent losses in many countries (Mass, 1998) infected plants are stunted, produce few runners and lose their shin shiny green luster. During hot, dry period diseased plants rapidly wilt and die, they produce few roots and the stele of roots is pink to brick red. The initial infection occurs mainly through the distribution of infected plants or infected soil. *Fusariumoxysporium* is a problem in many countries it is found sporadically elsewhere. Roots become rotted and leaves of infected plants wilt rapidly and crowns discoloration and decay (Winks and Williaims, 1965).

Table (4). Fungal frequency in plants isolated from different cultivars and different mother removal dates	s in
strawberry transplants nursery during 2018/2019 and 2019/2020 seasons.	

Tuesday	Identification of isolated fungi				
1 reatments	2018 /2019	2019/2020			
	Cultivar				
	Rhizoctonia sp.	Rhizoctonia sp.			
Festival	Phytophthora sp.	Phytophthora sp.			
	Fusarium sp.	Fusarium sp.			
	Rhizoctonia sp.	Rhizoctonia sp.			
Fortuna	Phytophthora sp.	Phytophthora sp.			
	Fusarium sp.	Fusarium sp.			
	Rhizoctonia sp.	Rhizoctonia sp.			
Florida	Phytophthora sp.	Phytophthora sp.			
	Fusarium sp.	Fusarium sp.			
	Rhizoctonia sp.	Rhizoctonia sp.			
Enana	Phytophthora sp.	Phytophthora sp.			
Connection	Rhizoctonia sp.	Rhizoctonia sp.			
Sensation	Phytophthora sp.	Phytophthora sp.			
Montorov	Rhizoctonia sp.	Rhizoctonia sp.			
Withterey	Phytophthora sp.	Phytophthora sp.			
	Rem	oval dates			
after 3 months	Phytophthora sp.	Phytophthora sp.			
after 4 months	Phytophthora sp.	Phytophthora sp.			
often 5 menthe	Rhizoctonia sp.	Rhizoctonia sp.			
alter 5 months	Phytophthora sp.	Phytophthora sp.			
	Rhizoctonia sp.	Rhizoctonia sp.			
Without removal (control)	Phytophthora sp.	Phytophthora sp.			
	Fusarium sp.	Fusarium sp.			

Disease incidence and severity percentage:

Results shown in **Table** (5) clearly indicate that strawberry cultivars differed significantly in their disease incidence and disease severity values whereas, Florida cv. detected the highest disease incidence followed by Fortuna and festival cvs, in the two tested years. However, Sensation and Monterey recorded the lowest values in both seasons.

As regards to the effect of mother removal date on disease incidence, results show that delaying removal date increased significantly the disease incidence values. Moreover, control treatment showed significantly the highest disease incidence value as compared with the tested treatments and without significant values as compared with the last removal date (after 5 months) in the first season. As for interaction effect of cultivar and mother removal date on disease incidence, results show that removing of mother plants after 4 or 5 months in Florida recorded the highest values. On the other hand, Eliana and Monterey cvs.recorded the lowest values when mother plants were removed after 3 months from planting.

Concerning the effect of cultivar and mother removal date on disease severity, results presented in Table (5) Indicate clearly that, Festival cultivar has the highest significant values of disease severity. On the other side, Sensation and Monterey cvs.showed the lowest significant values as compared with all tested cultivars in the two tested seasons. Such results are in the same line with those of Ragab, et al. (2017)who found varietal differences in disease severity in some tested strawberry cvs.Moreover,



higher root diseases severity was recorded in Tamarcompared with Yael in both greenhouse and open field plants. Thepercentage of naturally diseased cv. Tamar were 3.6 % and 1.6 % in open field (classic plants) and greenhouse (foundation plants)respectively. While the Yael cultivar recorded 0.8 % and zero ineither classic plants and foundation **Table (5).**Effect of cultivars, removal dates a ones respectively. These results may be due the genetic constituents of each cultivar. Mother plant removal date indicated significant lower values in disease severity as compared with unremoved treatment (control) as clear in **Table (5).** In addition, the lowest values of disease severity were obtained when mother were removed after 3 months.

 Table (5).Effect of cultivars, removal dates and their interaction onDisease incidence and Disease severity % of strawberry nursery during 2018/2019 and 2019/2020 seasons.

Treatments –		Disease i	incidence	Disease severity %		
		2018/2019	2019/2020	2018/2019	2019/2020	
		Cultivar				
	Festival	1.98 B	2.18 C	49.43 A	50.91 A	
	Fortuna	2.20 B	2.73 B	41.15 B	37.82 B	
	Florida	2.89 A	3.11 A	19.02 C	26.87 C	
	Eliana	1.15 C	2.43 BC	18.43 C	18.69 D	
	Sensation	1.29 C	1.31 D	11.44 D	15.23 E	
	Monterey	1.50 C	2.08 C	8.84 E	8.47 F	
		Removal dates				
af	ter three months	1.34 C	1.46 C	6.91 D	5.24 C	
a	fter five months	1.73 B	2.31 B	13.66 C	15.69 B	
a	fter five months	2.17 A	2.53 B	37.78 B	41.53 A	
Witho	out removal (control)	2.11 A	2.94 A	40.53 A	42.84 A	
			Intera	iction		
	After three months	1.73 d-h	1.33 ij	15.83 ef	16.8 f	
Festival	After four months	1.73 d-h	1.73 g-j	35.83 c	35.1 d	
1 obu (ui	After five months	1.60 f-h	2.23 e-i	72.2 a	76.13 a	
	Without removal (control)	2.87 ab	3.43 ab	73.83 a	75.6 a	
	After three months	2.50 bc	2.43 c-h	16.13 ef	2.4 g	
Fortuna	After four months	2.27 cd	2.83 a-f	22.7 d	16.83 f	
Tortunu	After five months	2.37 bc	3.17 a-e	63.53 b	65.73 b	
	Without removal (control)	1.67 e-h	2.47 b-h	62.23 b	66.3 b	
	After three months	2.90 ab	3.17 a-e	2.5 g	3.53 g	
Florida	After four months	3.27 a	3.53 a	2.47 g	18.2 7f	
Tioriaa	After five months	3.17 a	3.33 a-c	33.8 c	42.5 c	
	Without removal (control)	2.21 c-e	2.40 c-h	37.3 c	43.17 c	
	After three months	0.30 i	0.30 k	3.57 g	4.03 g	
Fliana	After four months	1.30 h	3.27 a-d	16.87 ef	19.57 f	
Linana	After five months	1.50 gh	2.60 a-g	19.63 de	18.93 f	
	Without removal (control)	1.50 gh	3.57 a	33.67 c	32.23 de	
	After three months	0.30 i	0.30 k	1.87 g	2.73 g	
Sensation	After four months	0.27 i	0.30 k	1.9 g	2.9 g	
Scusation	After five months	2.17 c-f	1.53 h-j	19.7 de	28.9 e	
	Without removal (control)	2.43 bc	3.10 a-f	22.3 d	26.37 e	
	After three months	0.30 i	1.20 jk	1.57 g	1.97 g	
Montorov	After four months	1.53 gh	2.17 f-i	2.17 g	1.5 g	
withterey	After five months	2.20 с-е	2.30 d-h	17.8 ef	17 f	
	Without removal (control)	1.97 c-g	2.67 a-g	13.8 3f	13.4 f	

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



As for the effect of the interaction between cultivar and date of mother removal on disease severity, the highest values were obtained from Festival un-removed treatment as well as those when festival mothers were removed after 5 months

On the contrarily the lowest values were recorded when mothers were removed after 3 months in Florida, Eliana, Sensation and Monterey cvs. in addition to those removed after five months in Sensation and Monterey cvs. Increasing the disease severity with delaying mother plant removal time as well as control treatment may be due to increasing the infection percent and distributing the pathogens from the old roots and crown of the mothers to the new roots of the daughter plants.

CONCLUSION

The current study recommend to remove all mother plants of the strawberry nursery after threemonths from planting of nursery used in frigo plantation to improve transplants number and quality as well as decrease the infection and the severity of the fungi attacking roots and crown.Removing motherplant after three months for Festival cultivar give the highest number of transplants

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تأثير مواعيد إزالة أمهات المشتل على عدد وجودة الشتلات وشدة الإصابة بالأمراض الفطرية لبعض أصناف الفراولة الجديدة رضا السيد احمد¹ - أشرف أيوب عبد الشافى² - أحمد بندق³

- ١. قسم بحوث الزراعات المحمية معهد بحوث البساتين مركز البحوث الزراعية الجيزة مصر
- ٢. قسم بحوث البطاطس والخضر خضرية التكاثر معهد بحوث البساتين مركز البحوث الزراعية الجيزة مصر
 - ۳. قسم أمراض النبات كلية الزراعة جامعة عين شمس-مصر.

أجريت هذه الدراسة خلال موسمي 2019/2018 و 2020/2019 في مزرعة خاصة ب قرية وردان – محافظة الجيزة، هدفت هذه الدراسة لمعرفة تأثير موعد أزاله أمهات المشتل بعد 3و4 و 5 أشهر من زراعة المشتل بالإضافة الى معاملة المقارنة (بدون إزالة أمهات المشتل) على انتاج الشتلات وجو دتها والإصابة بالأمراض الفطرية لستة أصناف من الفراولة (فيستفال، فورتونا، فلوريدا، اليانا، سينسيشن، مونتيرى) في تصميم القطع الهنشقة مرة واحدة فى ثلاث مكررات. أشارت النتائج إلى وجود دنها والإصابة بالأمراض الفطرية لستة أصناف من الفراولة (فيستفال، فورتونا، فلوريدا، اليانا، سينسيشن، مونتيرى) في تصميم القطع الهنشقة مرة واحدة فى ثلاث مكررات. أشارت النتائج إلى وجود فروق معنوية بين أصناف الفراولة تحت الدراسة في صفات النمو الخضري للشتلات (طول ال شتلة، قطر التائج إلى وجود فروق معنوية بين أصناف الفراولة تحت الدراسة في صفات النمو الخضري للشتلات (طول ال شتلة، قطر التائية إلى وجود فروق معنوية بين أصناف الفراولة تحت الدراسة في صفات النمو الخضري للشتلات (طول ال شتلة، قطر التائج إلى وجود فروق معنوية بين أصناف الفراولة تحت الدراسة في صفات النمو الخضري الشتلات). حيث اعطى الصنف مونتيرى اعلى كمية كربو هيدرات ، ومن ناحية أخرى سجل الصنف فستيفال التاجو طول الجذر للشتلات. وأدت إزالة النباتلت الأم في زيادة قطر التاجللشتلة الناتجة ومحتواها من الكربو هيدرات الكلية كما أدى تأخير إزالة المهات إلى في زيادة معنوية في قيم الإصابة بفطريات الريزوكتونيا الفيتوفثورا والفيوزاريوم ، كما أظهرت معاملة المقارنة أمهات مناز الموارنة الموارية المياتين عد وجودة الشتلات الناتجة وتقليل الإصابة أمهات الميزوكتونيا الفيتوفثورا والفيوزاريوم ، كما أظهرت معاملة أمهات مشارنة أمهات الفراولة بعد ثلاثة أشهر من بداية زرائة الامهات إلى المقتلات المنتلة المراسة للإولية ويوليون الفيروني من المواريوم أله وتقليل معاملة أمهات المقتروكتونيا الفيتوفثورا والفيرانية ألهرت معاملة أمهات معاملة ألهران الموارنة ألهرت الخليبة ألهران المانتية وروتونيا الفيتوفتورا والميون إلى التي ألهران المرى ول ألهمات إلى ألمواري ألهمات المقارية ألهمات إلى ألهمات إلهمات ألموارنة ألهمات المواريوم ألهم ألهمات ألهمات ألهمات المقارية ألهمان الموارية ألهم ورسمي ألهم ألهمات ألمواري ألهم ألهم ألهم ألهما ألهمان المواريوم ألهم ألهم ألهمات ألهم من بداية أل