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COMPARATIVE STUDY ON FRESH TRANSPLANT PRODUCTION IN THE MAJOR STRAWBERRY GROWING AREAS OF EGYPT

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ABSTRACT

This study was carried out during 2002 and 2003 years in sandy soils at three different major strawberry production areas i.e. Ismailia (East Delta), Qaluobia (Middle Delta) and Nobaria (West Delta) to compare runner formation and fresh transplant production under four different nursery planting dates i.e. April 1st, 15th ,May 1st and 15th. Camarosa cultivar was used. Data were recorded on number of main runners, number of fresh transplants dug in September, crown diameter, number of roots, root length, and carbohydrates content in the crowns of transplant. Results indicate that, there were significant increases in number of main runners, number of fresh transplants, number of roots, root length and total carbohydrates in crowns in Ismailia (East Delta) location as compared with other tested locations. On the other hand, Nobaria location showed the lowest values for the above mentioned studied characters. As for nursery planting date, planting nursery mother plants on April 1st or 15th resulted in significant increments in number of runners and marketable fresh transplants as well as number and length of roots and total carbohydrates in crown. On the other side, plants planted in mid May gave the highest values of crown diameter.The study conclude that early establishment of strawberry nursery (first or mid April) is preferable to increase number and quality of fresh transplants. Moreover, Ismailia area (East Delta) was the best for transplant production as compared with the other tested locations.

INTRODUCTION

Due to the expansion of strawberry nursery cultivation, transplant production has become an important industry in Egypt. Increasing the production of high quality transplants per feddan (4200 m^2) is very desirable by cold-stored (Frigo) strawberry growers. Transplant quality can have a major effect on the productivity of strawberry. Bare-root transplants are produced in open nurseries where daughter plants remain attached to the mother plant and allow to root into the soil. According to latimer (1998), the goal of transplants production is to produce plants that 1) adapt rapidly to field environment, 2) establish and resume active growth soon after transplanting and 3) produce acceptable early and total yield. Several factors may all be contributing factors to the transplant success in the fruiting fields, i.e., transplant size (Chandler *et al.* 1989, Kirschbaum *et al*. 1998; Latimar 1998; NeSmith and Duval, 1998; Ragab *et al*. 2000), transplant age (Vavrina, 1998; Ragab *et al*. 2002), transplant root structure (Nicola, 1998) and carbohydrate content, (Schupp and Hennion. 1997 and Palha *et al*., 2002).

Turemis *et al.* (1997) mentioned that there was a negative correlation between quality and number of runner plants per unit area. Therefore, the

study aimed to investigate the runner formation and transplant production in the major strawberry growing areas in Egypt as affected by different nursery planting dates.

MATERIAL AND METHODS

This study was carried out during 2001/2002 and 2002/2003 seasons at three major strawberry growing areas, i.e, Ismailia (East Delta), Qalubia (Middle Delta) and Nobaria (West Delta) under four different nursery planting dates,i.e, April 1st ,15th, May 1st and 15th. Camarosa cultivar was used. The sandy soil of the nurseries was fumigated with methyl bromide 15 days before planting.

The Super Elite transplants were dipped in 0.1% Benlate solution for 20 minutes then planted at 1.5m x 1.5m in plots of 25 m^2. Split plot design with four replicates was used.

Flowers were continuously removed until plants stopped flowering (after one month) and started runnering. All agricultural partices for strawberry nurseries, i.e., irrigation, fertilization and pest control were carried out as recommended. After two months from planting date, number of main runners/ plant was recorded In mid September, data were recorded on the following: -

1- Soil analysis:

Particle size distribution of the studied soils, the ionic content of soil paste extracts and the cation exchange capacity, organic carbon, and $CaCO_3$ % were determined according to the standard methods mentioned Jackson (1967). Results are shown in Table (A).

Table (A): Physical and chemical analysis of the used soils.

Component	El-Kaluobia		El-Behiara		Ismalia	
	Depth		Depth		Depth	
	0-30	30-60	0-30	30-60	0-30	30-60
Sand (%)	26	26	77	0	80.0	97.7
Silt (%)	28	24	11	11	1.2	1.8
Clay (%)	46	50	12	9	.5	0.5
Soil texture	Clay	Clay	Sandy	Sandy	Sandy	Sandy
PH	7.51	7.80	7.80	8.13	7.4	7.3
EC (m mhos/cm)	1.60	0.94	1.06	0.61	6.8	1.31
Anions (me.q/liter)						
CO_3	0	0	0	0	0	0
HCO_3	4.80	3.00	5.40	3.60	3.9	3.2
Cl	11.00	11.50	10.00	11.50	17.9	17.1
SO_4	0.20	0.90	0.60	0.90	35.4	34.5
Cations (me.q/liter)						
Na^+	7.53	4.91	7.19	2.97	10.9	10.5
K^+	0.27	0.07	0.17	0.94	3.2	3.0
Ca^{++}	5.20	3.31	1.86	1.96	2.51	2.45
Mg^{++}	3.00	1.18	1.3	0.17	14.9	15.1

Table (B): Average temperature and relative humidity during 2002 and 2003 seasons under El-Behiara, Ismalia and Kaluobia conditions.

Month	El-Behiara.						Ismailia	
	2002			2003	2003		2002	
	Max. temperature (°C)	Min. temperature (°C)	Relative humidity	Max. temperature (°C)	Min. temperature (°C)	Relative humidity	Max. temperature (°C)	Min. temperature (°C)
Jan.	20.50	9.10	51.0	21.50	9.80	51.0	16.00	6.60
Feb.	18.90	8.00	51.5	19.00	8.00	51.0	22.30	9.80
Mar.	19.90	9.40	52.0	10.10	9.30	52.0	16.20	11.80
Apr.	24.90	13.70	49.5	25.80	13.20	49.5	18.50	8.60
May	28.10	15.10	48.5	27.10	15.00	48.0	25.50	16.50
Jun.	30.20	19.00	48.5	31.10	19.20	48.5	28.75	19.80
Jul.	34.50	23.10	60.0	32.80	23.30	60.0	35.50	23.40
Aug.	33.60	23.40	56.0	33.40	22.70	56.0	29.50	22.80
Sep.	33.10	21.20	54.0	32.30	20.30	54.0	29.30	21.70
Oct.	29.30	18.20	54.0	31.70	18.10	53.5	22.00	18.10
Nov.	26.20	12.20	53.5	25.30	11.90	53.0	18.00	12.70
Dec.	21.20	10.60	53.0	20.70	10.20	52.0	16.00	9.60

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2- Number of fresh transplants/plant:-

All harvested transplants from the inner two rows were counted and number of transplants/mother plant was calculated .

3- Crown diameter:

It was measured in cm by verniar caliber in twenty random transplants in each replicate.

4- Carbohydrates content:-

Total carbohydrates content in crowns of fresh transplants was determined according the method described by Shaffer and Hartmann (1921).

Statistical analysis:

The recorded data were statically analyzed according to Duncan·s multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

1- Number of runners and fresh marketable transplants

Results in Tables (1 & 2) show that Ismailia location showed significant increments in number of main runners as well as number of fresh marketable transplants. On the other hand, Nobaria location showed the lowest values. As for the effect of nursery planting dates, results show that the highest values were recorded from plants planted in mid April or first of May. Concerning the effect of interaction, results show that Ismailia location planted in mid April or first of May showed the highest number of runners while those planted early April 1st at Qaluobia and Nobaria showed the

lowest values. As for fresh transplants production, Ismailia gave the highest number of fresh marketable transplants On the other side , those planted at Nobaria in the last planting date showed the lowest values .

Regarding the effect of planting on number of fresh transplants, results showed that the highest values were detected to plants planted April 15 and first of May . Results of interaction show that the highest values were recorded to plants of Ismailia planted on April 15th May 1st or May 15th . The results are similar to those of Turemis *et al*. (1997), also results confirm those of Vavrina, (1998) and Ragab *et al*. (2002).

Table (1): Effect of location and nursery planting date on number of main runners after two months.

Locations	Nursery planting dates									
	1st April		15 st April		1st May		15 th May		Mean	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Ismailia	7.3c	6.9c	9.6a	9.2a	9.2ab	9.1a	8.9ab	8.8b	8.8A	8.5A
Kaluobia	5.9d	5.8d	7.3c	7.5c	7.5c	7.9c	5.9d	6.2d	6.7B	6.9B
Nobaria	5.1d	5.4d	4.4e	4.9e	4.2e	4.4e	4.1e	4.1e	4.4C	4.7C
Mean	6.1B	6.0B	7.1A	7.2A	6.9A	7.1A	6.2B	6.4B		

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

Table (2): Effect of location and nursery planting date on number of fresh marketable transplants/plant.

Locations	Nursery planting dates									
	1st April		15 st April		1st May		15 th May		Mean	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Ismailia	46.9bc	48.2bc	51.9b	56.2b	63.8a	66.6a	60.4a	62.0a	55.8A	58.3A
Kaluobia	43.2c	44.1c	45.2c	46.9bc	44.7c	45.0c	40.3d	38.5d	43.4B	43.6B
Nobaria	40.2d	42.0cd	44.6c	45.2c	39.8d	40.6d	33.6e	35.1e	39.6C	40.7B
Mean	43.4B	44.8B	47.2A	49.4A	49.4A	50.7A	44.8B	45.2B		

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

2- Crown diameter:-

Crown diameter increased as delaying nursery planting date Table(3) whereas, plants established in April 1st produced transplants with the highest crown diameter.

Table (3): Effect of location and nursery planting date on crown diameter of transplants (cm.)

Locations	Nursery planting dates									
	1st April		15 st April		1st May		15 th May		Mean	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Ismailia	1.53a	1.36b	1.25c	1.13cd	0.98d	0.97d	0.83d	0.86d	1.15C	1.08B
Kaluobia	1.47ab	1.63a	1.34b	1.30b	1.21c	1.13cd	1.12cd	1.29b	1.29B	1.34A
Nobaria	1.57a	1.61a	1.43ab	1.31b	1.44ab	1.26c	1.25c	1.10cd	1.42A	1.32A
Mean	1.52A	1.52A	1.34B	1.25B	1.21BC	1.12C	1.07C	1.08C		

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

On the other hand, the smallest transplants were obtained from those planted in the latest planting date, i.e 15th May. Such results are similar to the findings of Chandler *et al.* (1989).

3- Carbohydrates content in crown (g/ 100 g) :-

Results in Table (4) show that carbohydrates content of crowns increased significantly in Ismailia location as compared with Qaluobia as well as Nobaria . Nursery planting date affected significantly crown carbohydrate , content of transplants whereas, delaying nursery planting date increased carbohydrates content in the crowns . On the other hand , it decreased in early plantings . as for the interaction between location and planting date, the highest values were detected from plants of Ismailia location when planted on July 15. These results agree with those of Schupp and Hennion (1997) and Palha *et al*. (2002).

Table (4): Effect of location and nursery planting date on carbohydrates content in crown (g./100g).

Locations	Nursery planting dates									
	1st April		15 st April		1st May		15 th May		Mean	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Ismailia	3.36d	3.49d	4.21c	4.56b	4.93b	5.26a	5.39a	5.83a	4.47A	4.79A
Kaluobia	3.10e	3.76d	3.69d	3.45d	3.92c	4.01c	4.63b	4.66b	3.84B	3.97B
Nobaria	3.69d	3.28e	3.81d	3.77d	4.21c	4.08c	4.86b	4.92b	4.14B	4.01B
Mean	3.38D	3.51D	3.90C	3.93C	4.35B	4.45B	4.96A	5.14A		

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

4- Number of roots / transplants :-

It is clear from data presented in Table (5) that Ismailia plants produced significantly higher number of roots compared with of Qalubia as well as Nobaria with out significant difference between them. Results show also that number of roots increased in early planting date while it decreased in late planting Results of interaction show that early planting of Ismailia location showed the highest number of transplant roots . On the other hand, late plantings of Qaluobia and Ismailia showed the lowest values.

Table (5): Effect of location and nursery planting date on number of roots/transplant.

Locations	Nursery planting dates									
	1st April		15 st April		1st May		15 th May		Mean	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Ismailia	33.16a	33.19a	28.61b	26.14b	22.92c	25.19b	18.70d	16.50e	25.85A	25.26A
Kaluobia	26.91b	22.14c	18.16d	20.40c	15.19e	17.21d	11.40f	10.90f	17.92B	17.66B
Nobaria	25.21b	23.16c	19.70d	16.8e	19.01d	14.60e	10.20f	9.96f	18.53B	16.13B
Mean	28.43A	26.16A	22.16B	2112B	19.04C	19.00C	13.43D	12.45D		

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

5- Root length (cm) :-

Data in Table (6) show that the highest values of root length was found in Ismaailia transplants. On the other hand, the lowest values were detected to those of Nobaria location. Qaluobia plants showed midium values. As for the effect of planting date, there was significant decremts in root length with delaying nursery planting date whereas, earlyplanting date showed the highest values of root length while the latest date gave the lowest values. These increments in number of transplants, number of roots, root length and crown carbohydrates content in transplants produced in Ismalia location could be due to the suitable microclimet conditions which affected positively transplant growth. Our results are in agreement with those of Nicola (1998).

Table (6): Effect of location and nursery planting date on root length (cm).

Locations	Nursery planting dates									
	1st April		15 st April		1st May		15 th May		Mean	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Ismailia	19.6a	15.9ab	17.2ab	15.1b	13.4c	11.2c	10.8cd	12.5c	15.3A	13.7A
Kaluobia	13.8c	10.7cd	16.2ab	9.4cd	11.2c	12.3c	9.6cd	8.7d	12.8B	10.3B
Nobaria	11.30c	9.2cd	9.8cd	10.1cd	8.6d	8.4d	8.2d	6.4e	9.5C	8.5C
Mean	14.9A	11.9B	14.4A	11.5B	11.1B	10.6B	9.5C	9.2C		

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

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دراسة مقارنة على إنتاج الشتلات الطازجة في مناطق زراعة الفراولة الرئيسية في مصر

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**** قسم التكاثر الخضري والبطاطس- شعبة بحوث الخضر- معهد بحوث البساتين - الجيزة**

أجريت هذه الدراسة خلال عامى ٢٠٠٢و ٢٠٠٣ في تربة رملية في الثلاثة مناطق الرئيسية لإنتاج الفراولة في مصر وهى الإسماعيلية (شرق الدلتا)و القليوبية (وسط الدلتا) والنوبارية (غرب الدلتا) لمقارنة تكوين المدادات وإنتاج الشتلات في مشاتل الفراولة صنف كماروزا في تلك المناطق فى أربعة مواعيد زراعة مختلفة للمشتل وهى ١ أبريل ، ١٥ أبريل ، ١ مايو ،١٥ مايو. وسجلت القراءات على عدد المدادات الرئيسية وعدد الشتلات الطازجة التي تقلع في سبتمبر وقطر الشتلات وعدد وطول الجذور ومحتوى التيجان من الكربوهيدرات.

توضح النتائج أن هناك زيادة معنوية فى عدد المدادات الرئيسية وعدد الشتلات الطازجة وعدد وطول الجذور و الكربوهيدرات الكلية فى الشتلات الناتجة من منطقة الإسماعيلية عند مقارنتها بمثيلتها في المناطق الأخرى ومن ناحية أخرى كانت النوبارية هي الأقل في الصفات المدروسة أما بالنسبة لمواعيد زراعة المشتل فإن الزراعة المبكرة في أول أو منتصف أبريل أدت إلى زيادة عدد المدادات وعدد الشتلات الطازجة القابلة للتسويق وكذا عدد وطول الجذور ومحتوى التيجان من الكربوهيدرات أما النباتات التي زرعت في مايو فقد أعطت شتلات أكثر سمكاً.

وتجمل الدراسة انه بفضل زراعة مشاتل الفراولة لإنتاج الشتلات الطازجة مبكراً في أول أو منتصف إبريل لزيارة عدد وجودة الشتلات وانه تفضل منطقة الإسماعيلية لإنشاء مشاتل الفراولة مقارنة بمنطقتي غرب ووسط الدلتا وقد يرجع ذلك لمناخ الإسماعيلية المناسب الذي قد يرجع إلى زيادة الرطوبة الجوية بالإسماعيلية عن القليوبية والنوبارية خلال شهري يونيو ويوليو حيث خروج المدادات فيهما.