

**EFFECT OF PLANTING DATE AND SHADING
NURSERY ON THREE STRAWBERRY CULTIVARS
2. EARLY AND TOTAL YIELD**

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ABSTRACT: The transplants of three strawberry cvs were shaded at the nursery for 0, 60, 75 and 90 days using shading net. The transplants were, then, transplanted at three planting dates (Sept. 1st, Sept 15th and Oct. 1st). This experiment aimed to investigate the effect of shading and planting date on both early and total yield and their components of the studied cvs.

Sweet Charlie cv produced a considerable high early yield and its components, but cv Camarosa had the highest fruit wt. Sept. 15th being the suitable planting date for producing higher early yield and enhancing its components. In addition, the shading in the nursery promoted the plants to produce more early yield than the unshaded one, and being highest with 60 days shading in the 1st season, and with 90 and 75 days shading, in the 2nd early period, in the 2nd season. But it had insignificant effect on average fruit weight. Moreover, early yield and its components were significantly affected by the interaction among the three factors.

The early yield in the 2nd early period (from Jan. till the end of Feb.), generally, was higher than that of the 1st early period (from Nov. till the end of Dec). For the total yield, the cv Camarosa scored the highest significant values of both the fruit wt. and total yield / plot. Fruit wt. was maximum with Oct. 1, but fruit No. / plot was at the highest value with Sept. 1st. Whereas, Sept. 15th gave the highest significant total yield, in the first season. Meantime, shading for 90 days caused significant increase of total fruit No. and total yield per plot and per feddan.

INTRODUCTION

Since strawberry (*Fragaria x ananassa* Duch.) is a short-day

plant, flowering initiation and early fruiting may be achieved by shading or low light intensity. Jurik *et al.* (1979), on strawberry,

reported that, the plants stressed by low irradiance and those under shortened days are both responding to the total quanta received during the light period.

Early fruiting of strawberry, which considered as a very important target for exporting this crop, and total yield received a little attention, regarding the effect of shade on the flowering of this plant. It could be manipulated through adjusting the planting date or through modifying of this factor; i.e., using low light intensity to initiate the flowering buds. Flowering of the plant, that classified as short-day one was reported by several authors; Ferre and Stang (1988) and Chandler *et al.* (1992), mentioned that subjecting strawberry plants to 60% shade from 1 July to 31 Aug. produced higher total yield per plant than the unshaded ones.

Chio *et al.* (1992) reported that shading or shading + short day enhanced strawberry flower differentiation at the seedling stage and flowering was an average 10 days earlier when plants were shaded and 21 days earlier with shading + short day than the unshaded plants. Ra *et al.* (1994), found that the shading accelerated strawberry flower bud differ-

entiation by four days. Moreover, number of fruits, fruit weight and total yield were at the highest values with shading + short day. Martin (1985), reported that a strong shade for strawberry reduced flowering, but cultivars significantly differed in response to shade. Awang and Atherton (1995), mentioned that shading depressed the strawberry fruit dry weight but not F.Wt. Fruit number was reduced under shade conditions. Svenson (1995) reported that shaded strawberry plants under 60% gave larger flowering than 80% shade. Hansen (1996) reported that a reduction of light by 50% had no effect on strawberry fruit development.

For the effect of planting date on yield and early yield of strawberry. Puffer *et al.* (1968), reported that there were significant differences between three digging dates and the yield of late date gave the highest yield. Badiyala and Bhutani (1990) mentioned that planting strawberry plant at Sept.30th gave the highest yield. Chercuitte *et al.* (1991), reported that the strawberry marketable and total yield/plant were lower for June 16th than the other planting dates (May15th and July15th). Hansen (1994) reported that planting strawberry on July 25th or

Aug 15th had significant differences in yield and berry size under early planting. Maroto *et al.* (1993) reported that early and total marketable yield of strawberry were greater with summer planting date than with autumn one for all cultivars. Albergts and Chandler (1996) mentioned that planting date Sept. 21th and 5 and Oct. 19th had a significant effect on strawberry yield cv Seascap through Jan which reduced 2 weeks on the 1st planting date and by 4 weeks on the 2nd planting date. Sweet Charlie cv. had a little effect on the early yield and the average fruit weight increased with later planting. They also concluded that planting dates affected fruit yield and quality, which were the highest for the last planting date.

Therefore, the present investigation aimed to study the effect of shading the nursery of some strawberry cultivars (Camarosa, Sweet Charlie and Rosalinda) and the behaviour of those shaded transplants in the open field. Also to study the effect of planting date on the yield and its components of those shaded cultivars.

MATERIALS AND METHODS

The present investigation was carried out on three strawberry cultivars, during 1999/2000 and

2000/2001 growing seasons, at south Tahreer, Behera Governorate. This study aimed to investigate the response of strawberry cultivars to shading at the nursery and planting dates on the early and total yield at the field. The used strawberry cultivars were Camarosa, Sweet Charlie and Rosalinda.

Super Elite mother plants of the three studied cultivars were shaded at the nursery using shading net which gave a reduction in light intensity by 63% to get the seedlings which were transplanted at three planting dates.

Soil preparation took place in July, every season, basic fertilizers were broad casted before tillage prior to planting. The kinds and amounts of fertilizers per feddan were:

1. Farm yard manure (40 m³),
2. Calcium superphosphate (15.5% P₂O₅); 100kg,
3. Sulphur 250 kg,
4. Amonium sulphate (20.6% N); 100kg,
5. Potassium sulphate (42% K₂O) 100kg, and
6. Magnesium sulphate 50 kg.

The raised beds top surface was 1.2m width and 40cm high, then they were fumigated with

methylbromid at the rate of 70gm/m² soil, two weeks before planting. Drip irrigation system was positioned. Fresh transplants were planted in rows on the beds at 30 cm between the rows and 25 cm between plants in the row. The beds were mulched by white plastic sheets when the transplants had 2-3 new leaves. Also tunnels were covered with white plastic sheets.

The experiment included the combination treatments among three planting dates; i.e., Sept.1st, Sept.15th and Oct.1st; three cultivars; i.e, Camarosa, Sweet Charlie and Rosalinda; and two shading treatments(60days shading and unshading), in the first season, or four shading treatments (60,75 and 90 days shading besides the unshaded one),in the second season.

The used experiment design was a split-split plot in randomized complete blocks with three replications. Each main plot contained three planting dates, cultivars were arranged at random in sub-plots and the shading treatments were distributed in sub-sub plots.

The sub-sub plot area was 4.2m² (1/1000 feddan) that containing 48 plants each. Herein one feddan

equals 1000 plots. That means, one kg/plot equals one ton/feddan.

The plants were fertilized with N, P and K fertilizers at the rate of 150,60, and 200 kg/feddan, respectively, during the growth season. In addition Ca (chelated calcium), Mg (magnesium sulphate) and micronutrients were applied as foliar application. Fungicides and insecticides were applied during the growth season.

Date Recorded

1. Early Yield and Its Components

Fruits of each sub-sub plot were harvested at mature red-ripe stage, then counted and weighed at each harvest in order to determine the total early yield/plot and its components (from November till the end of February). The following early yield traits were recorded :

- i.a. Average fruit weight (gm),
- b. Fruit number/plot, and
- c. Total early yield/plot (kg).

2.Early Yield of The Two Early Periods and Its Components.

The early yield was divided into two early periods, i.e., the first one was from November till the end of December, and the second was from January till the end of

February, according to the market price during these two periods*.

The following early yield traits were recorded at each period separately.

- a. Average fruit weight (gm),
- b. Fruit number/plot, and
- c. Total early yield/plot (kg).

3. Total Yield and Its Components

All harvested fruits of each sub-sub plot in different harvestings all over the season were counted, and weighed in order to obtain:

- a. Average fruit weight (gm),
- b. Fruit number/plot, and
- c. Total early yield/plot (kg).

Statistical Analysis

The recorded data were analyzed for each season separately. Analysis of variance and L.S.D. were done according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Strawberry is considered a short day plant and also needs a low temperature during the plant growth to initiate the flower buds. Moreover, the cultivars differed, in this respect, in their response to day length and to the low temperature needed (Darrow, 1937). Such

two factors, may be fulfilled by reducing the light intensity during growth at the transplants in the nursery, and also by adjusting the planting date in the field, to get early flowering and subsequently early yield. Therefore, the results of the present study, on the aforementioned two modified factors, will be discussed under the following topics.

1. Early Yield and Its Components (Total)

a. Main effect

Results in Table 1 show a significant difference among each of the studied cultivars, planting dates and shading days in the nursery on average fruit weight, fruit number/plot and early yield, in the two growing seasons.

Regarding to cultivar effect, the data (Table 1) show that the highest fruit weight, in the two seasons, was observed for the cvs Camarosa and Sweet Charlie, with insignificance between them in the first season. While, cv Rosalinda gave the lowest significant fruit weight. Early fruit number/plot was significantly higher for the cvs Sweet Charlie and Rosalinda than Camarosa. For early yield, cv Sweet Charlie had the highest

*Ministry of Agriculture and land reclamation; ATUT. 1999
strawberry Export Market Analysis and Potential.

Table 1: Average effect of the cultivar, planting date and shading the nursery on strawberry total early yield /plot and its components

Treatments	1999/2000			2000/2001		
	Fruit wt. (gm)	Fruit No.	Early yield (kg)	Fruit wt. (gm)	Fruit No.	Early yield (kg)
Effect of the cultivar						
Camarosa	12.82	389.10	4.990	13.37	322.28	4.310
Sweet Charlie	11.25	1131.10	12.721	11.60	1551.17	12.192
Rosalinda	8.15	1140.90	9.304	9.78	1031.17	10.080
LSD at 0.05	2.09	222.90	1.660	1.40	119.37	1.260
Effect of the planting date						
Sept. 1st	8.59	960.5	8.250	9.73	868.25	8.450
Sept. 15th	10.74	979.67	10.521	11.04	879.14	9.702
Oct. 1st	12.03	720.94	8.670	12.84	657.22	8.441
LSD at 0.05	3.52	104.94	0.810	1.27	136.87	0.880
Effect of the shading days						
Unshaded	10.01	781.52	7.821	10.06	743.74	7.481
60 days shading	10.55	992.56	10.472	11.14	771.59	8.593
75 days shading				11.63	830.85	9.663
90 days shading				11.31	859.92	9.724
LSD at 0.05	NS	99.8	0.90	NS	99.31	0.920

NS, insignificant at the 0.05 level of probability.

significant early yield followed, significantly, by *cv* Rosalinda, but *cv* Camarosa was the poorest one, in this respect, in the two seasons (Table 1). These results indicate that *cv* Sweet Charlie produced a considerable high early yield and its components, but *cv* Camarosa gave the lowest early yield and fruit number, and had the highest fruit weight. In this respect, Albergets and Chandler (1996) came to similar conclusion.

For planting date (Table 1), October 1st followed by September 15th were more suitable planting dates for obtaining high fruit weight, with insignificant difference between the two planting dates, in the first season only. Whereas, planting on September 1st gave the lowest early fruit weight. Results indicate, also, that fruit number, fruit weight and early yield favoured September 15, which was not significantly higher than September 1 for fruit number and significantly higher than the other two planting dates for early yield. In general, planting strawberry on September 15 being the suitable planting date for getting early yield and enhancing its components. Similar finding were reported by Puffer *et al.* (1968), Chercuitte *et al.* (1991), Badiyala and Bhutani (1990)

Hansen (1994), Maroto *et al.* (1993) and Albergets and Chandler (1996).

For shading effect, it is clear from data in Table 2 that shading in the nursery had insignificant effect on average fruit weight, in the two seasons. On the other hand, it had significant effect on the fruit number and early yield. In the first season, shading the transplants in the nursery for 60 days significantly promoted the plants to give early fruit number and yield more than that of the unshaded ones. In second season, shading the transplants gradually increased both the fruit number and early yield, but such increment was significant only with 90 days shading for fruit number. Regarding early yield, all shading treatments gave significant higher early yield than the unshaded ones, with insignificant difference between 75 and 90 days shading. However, 90 days shading gave early yield significantly higher than 60 days shading. In this respect, shading the transplants in the nursery had a considerable effect on the behaviour of the plants in the field. So, it produced more early yield than the control (unshaded transplants). Obtained results were similar to those reported by Ferre and Stang

Table 2 : Effect of the interaction of the planting date x cultivar x shading the nursery on strawberry total early yield/plot and its components

Treatments	Fruit wt. (gm)			Fruit No.			Early yield (kg)		
	Camarosa	Sweet Charlie	Rosalinda	Camarosa	Sweet Charlie	Rosalinda	Camarosa	Sweet Charlie	Rosalinda
First season (1999/2000)									
D1 Unshaded	10.26	11.30	6.55	353.67	898.00	1343.00	3.630	10.150	8.800
60 days shading	11.16	10.78	6.03	358.67	1252.67	1557.00	4.001	13.498	9.389
D2 Unshaded	13.17	10.94	8.07	325.00	1140.00	1064.00	4.279	12.470	8.580
60 days shading	14.27	11.24	10.14	52.00	1303.33	1473.67	8.161	14.649	14.948
D3 Unshaded	14.29	11.53	11.73	828.00	1019.33	562.67	4.687	11.750	6.600
60 days shading	12.99	11.76	12.09	397.33	1173.33	845.00	5.160	13.800	10.220
Second season (2000/2001)									
D1 Unshaded	14.73	11.34	6.82	220.00	969.00	1510.33	3.241	10.729	10.300
60 days shading	11.70	10.57	10.68	337.67	1041.33	847.67	3.944	11.010	9.050
75 days shading	10.99	10.58	10.16	275.67	1085.00	1031.33	3.029	11.479	10.480
90 days shading	12.36	11.17	6.87	281.67	1183.33	1636.00	3.481	13.220	11.243
D2 Unshaded	13.36	10.91	7.67	247.00	1080.00	1036.00	3.452	11.779	7.970
60 days shading	13.98	11.28	8.54	363.33	1099.00	1405.67	4.750	12.400	12.010
75 days shading	13.07	12.10	10.50	462.00	1215.33	1161.33	6.319	14.710	12.190
90 days shading	13.68	12.58	11.79	342.67	1125.67	1011.67	4.701	14.159	11.923
D3 Unshaded	13.72	11.77	10.95	289.67	915.00	426.67	4.333	10.770	4.670
60 days shading	14.96	12.21	13.43	319.33	728.33	802.00	4.449	8.890	10.770
75 days shading	13.92	12.52	12.67	344.00	1054.67	848.33	4.790	13.200	10.748
90 days shading	13.82	12.38	14.55	384.33	1117.33	657.00	5.310	13.829	9.558
LSD at 0.05 level for comparing :				1999/2000			2000/2001		
				F.wt.	F.No.	Yield	F.wt.	F.No.	Yield
any two means of the interaction				3.63	172.80	2.77	4.78	171.59	2.78
any two planting dates x shade interaction									
means under the same cultivar				3.22	123.42	2.04	3.6	146.94	2.061
D1,D2,D3 = Planting dates ; D1, Sept. 1 ; D2, Sept. 15 ; D3, Oct. 1.									

(1988), Chandler *et al.* (1992), Choi *et al.* (1992), Ra *et al.* (1994) and Svenson (1995) on strawberry.

b. Interaction effect

Since the first order interactions and the second order interactions (planting date x cultivar x shading) were significant, the second order interaction will be presented and discussed here; that is to highlight on the response of each cultivar to planting date and shading, to get information about the suitable treatments for each cultivar.

Data in Table 2 show significant effect of the interaction among the studied three factors on average fruit weight, fruit number /plot and early yield /plot. For comparing planting date and shading under the same cultivar, results in Table 2 show that, cv Camarosa gave the highest significant fruit weight with Sept. 15th x 60 days shading and with Oct. 1st x unshaded, and with Sept. 1st or Oct. 1st x unshaded treatments in the 1st and 2nd seasons, respectively. However the lowest one was obtained with Sept. 1st x unshaded, in the 1st season, and Sept. 1st x 60 or 75 days shading, in the 2nd season. The rest interaction treatments cases did not differ from those that gave the highest fruit weight.

For early fruit number and early yield, cv Camarosa showed the highest significant values in both the traits with Sept. 15th x 60 days shading, in the first season. In the 2nd season, cv Camarosa gave the highest significant fruit number and early yield with Sept. 15 x 75 days and Oct. 1st x 90 days shading. This early yield reached 8.161; 6.319 and 5.310 tons/feddan in the 1st and 2nd seasons, respectively. Such an early yield considered of a great value, since the cultivar is very late because the cultivar early average yield was 4.990 and 4.310 tons/feddan, in the two seasons, respectively (Table 2).

For cv Sweet Charlie, fruit weight was not affected by planting date x shading treatments. For fruit number and early yield (Table 2), the highest significant values of both the traits were obtained with Sept. 15th x 60 days shading followed by Oct. 1st or Sept. 1st x 60 days shading, in the first season. Data also reveal that, Sept. 15th x 75 or 90 days shading, followed insignificantly with Sept. 1st x 90 days and Oct. 1st x 90 or 75 days shading gave the highest values of both the traits. These treatments gave 14.649, 13.800, 13.498 and 14.710, 14.159, 13.220, 13.829 and 13.200 tons /fed., respectively with the aforemen-

tioned treatments and being higher than the cultivar average (12.721 in the 1st season and 12.192 tons/fed., in the second season).

For cv Rosalinda (Table 2), it showed the largest fruit weight with Oct. 1st x 60 days shading or unshaded one, in the 1st season, and with Oct. 1st x 90, 75 or 60 days shading, in the 2nd season, compared with any planting date x unshaded treatments. For fruit number and early yield, the highest values were obtained with Sept. 15 or Oct. 1st x 60 days shading, in the 1st season, although the later one had lower fruit number, and with Sept. 15th x 75 or 60 days shading and with Sept. 1st x 90 days shading, when all were compared with planting date x unshaded one. These treatments in the two seasons valued, 14.948, 10.220, 12.190, 12.010 and 11.243 tons/fed., respectively, compared with any planting date x unshaded treatments, or with the cultivar average (9.30 in the 1st season and 10.080 tons/fed., in the 2nd one).

2. Early Yield of The Two Early Periods and Its Components

The early yield was divided into two early periods; i.e. the 1st one was from November till the end of December, and the 2nd was from

January till the end of February, according to the market price.

a. Main effect

Data in Tables 3 and 4, generally, show that the early yield in the 2nd period was higher than that of the 1st One. Results also show that there were significant differences among the three cultivars in fruit weight, fruit number/plot and early yield / plot, in the two seasons and/also in the two early periods. Regarding to average fruit weight, the cvs Camarosa and Sweet Charlie gave larger fruits significantly higher than that of Rosalinda cv in the two early periods in the two seasons. However, Camarosa had significantly larger fruit weight than cv Sweet Charlie in the second period in the second season. For fruit number and early yield in the two periods in both seasons (Tables 3, 4), cv Sweet Charlie gave the significantly highest values of both the traits, followed by cv Rosalinda, while cv Camarosa was significantly the lowest one in this respect.

For planting date (Tables 3,4), results of the 1st period showed insignificant effect on the early yield and its components, except that for early yield /plot, which showed significant advantage for

Table 3: Effect of the cultivar, planting date and shading the nursery on strawberry early yield / plot and its components in the first early period

Treatments	1999/2000			2000/2001		
	Fruit wt. (gm)	Fruit No.	Early yield (kg)	Fruit wt. (gm)	Fruit No.	Early yield (kg)
Effect of the cultivar						
Camarosa	13.27	169.50	2.250	13.48	151.53	2.042
Sweet Charlie	12.85	426.00	5.462	13.11	392.08	5.141
Rosalinda	9.08	461.80	4.191	10.83	373.75	4.049
LSD at 0.05	1.46	236.30	1.380	0.93	131.95	1.000
Effect of the planting date						
Sept. 1st	9.66	389.4	3.760	11.29	377.56	3.891
Sept. 15th	11.78	385.4	4.541	12.49	334.00	4.170
Oct. 1st	12.61	282.5	3.562	13.40	238.00	3.190
LSD at 0.05	NS	NS	NS	NS	NS	0.910
Effect of the shading days						
Unshaded	10.98	307.7	3.380	11.46	280.19	3.210
60 days shading	11.46	397.2	4.551	12.60	284.15	3.579
75 days shading				12.79	319.74	4.091
90 days shading				12.20	338.00	4.123
LSD at 0.05	NS	51.77	0.80	NS	57.28	0.680

NS, insignificant at the 0.05 level of probability.

Table 4: Effect of the cultivar, planting date and shading the nursery on strawberry early yield / plot and its components in the second early period

Treatments	1999/2000			2000/2001		
	Fruit wt. (gm)	Fruit No.	Early yield (kg)	Fruit wt. (gm)	Fruit No.	Early yield (kg)
Effect of the cultivar						
Camarosa	12.48	219.60	2.740	13.28	170.75	2.268
Sweet Charlie	10.29	705.10	7.259	10.69	659.89	7.052
Rosalinda	7.53	679.10	5.113	9.17	657.42	6.031
LSD at 0.05	3.54	223.10	1.730	1.91	106.03	1.020
Effect of the planting date						
Sept. 1st	7.86	571.1	4.490	8.71	523.60	4.559
Sept. 15th	10.06	594.27	5.980	9.60	545.19	5.232
Oct. 1st	11.65	438.44	5.108	12.51	419.82	5.251
LSD at 0.05	2.3	131.7	0.93	1.86	103.3	0.630
Effect of the shading days						
Unshade	9.42	471.52	4.441	9.21	463.55	4.271
60 days shade	9.96	594.76	5.921	10.29	487.44	5.014
75 days shade				10.90	511.11	5.572
90 days shade				10.73	521.96	5.601
LSD at 0.05	NS	96.1	0.96	1.51	NS	0.75

NS, insignificant at the 0.05 level of probability.

Sept. 15th followed, insignificantly, by Sept. 1st and significantly by Oct. 1st planting dates. In the second period (Table 4), planting date had significant effect on the early yield traits in the two seasons. The largest fruit size was observed with Oct. 1st planting date, while fruit number and early yield in this period reflected the highest values on Sept. 15th followed, insignificantly, by Oct. 1st and, significantly, by Sept. 1st planting dates.

Regarding the effect of shading days (Tables 3,4), it had insignificant effect on fruit weight in the two early periods in the two seasons, except that in the 2nd early period in the 2nd season, which showed advantage for shading treatment over unshaded one. That was significant only for 75 or 90 days shading over the unshaded one. While fruit number and early yield, in the 1st and 2nd early periods, 60 days shading gave the highest significant values of the traits, in the 1st season, compared with unshaded ones. However, in the second season, there were insignificant differences between unshaded and 60 days shading treatments in the two early periods except early yield in the 2nd period. In this season, the highest significant values of the

two traits were obtained with 90 days and 75 days in the 1st early period, with insignificance differences between them. In the 2nd early period (Table 4), the highest early yield values were obtained with all shading treatments compared with unshaded one, and being the highest with 90 and 75 days shading. In this respect, Jurk *et al.* (1979), Ferre and Stang (1988), Chandler *et al.* (1992), Choi *et al.* (1993), Ra *et al.* (1994), Svenson (1995) and Hansen (1996), came to similar findings on strawberry and Martin (1985) on Sweet potato.

b. Interaction effect

Results in Tables 5 and 6 show significant effect of the interactions among planting date, cultivar and shading the nursery on the early yield traits of the strawberry during the 1st and the 2nd early periods in the two growing seasons.

Regarding the effect of interaction between planting date and shading the nursery on the same cultivar, the results show that average fruit weight of cv Camarosa was, mostly, not affected by the interaction of planting date x shading in both of the growing seasons and early periods. Meanwhile, few cases showed significant low and high

Table 5 : Effect of the interaction of the planting date x cultivar x shading the nursery on strawberry early yield / plot and its components in the first early period

Treatments	Fruit wt. (gm)			Fruit No.			Early yield /plot(kg)		
	Camarosa	Sweet Charlie	Rosalinda	Camarosa	Sweet Charlie	Rosalinda	Camarosa	Sweet Charlie	Rosalinda
First season (1999/2000)									
D1 Unshaded	12.68	14.63	7.01	99.33	238.00	642.33	1.260	4.139	4.300
60 days shading	11.02	12.37	7.29	128.00	507.67	676.33	1.411	6.280	4.459
D2 Unshaded	13.99	12.34	9.06	135.00	477.33	390.33	1.889	5.889	3.538
60 days shading	13.89	12.27	10.92	271.33	464.33	574.00	3.770	6.160	6.270
D3 Unshaded	13.64	12.35	14.46	149.67	387.00	205.33	2.041	4.780	2.970
60 days shading	13.53	12.62	10.75	233.67	436.67	282.67	3.162	5.509	3.040
Second season (2000/2001)									
D1 Unshaded	14.74	14.68	8.41	72.67	301.00	586.00	1.071	4.420	4.928
60 days shading	11.34	12.50	11.83	138.67	456.67	253.67	1.572	5.710	3.000
75 days shading	13.17	11.84	12.76	98.67	518.67	427.00	1.299	6.139	5.450
90 days shading	12.32	12.77	8.23	100.67	462.00	724.00	1.240	5.900	5.960
D2 Unshaded	15.20	12.30	8.66	105.33	451.33	379.00	1.601	5.549	3.283
60 days shading	12.45	13.28	11.55	175.33	353.00	465.00	2.182	4.688	5.370
75 days shading	13.43	14.34	11.21	220.33	429.00	453.33	2.959	6.150	5.080
90 days shading	13.06	15.22	12.12	224.33	388.33	363.00	2.930	5.910	4.400
D3 Unshaded	14.20	12.54	12.01	132.83	346.00	148.00	1.879	4.338	1.778
60 days shading	14.53	13.13	13.71	188.67	268.00	252.33	2.741	3.520	3.460
75 days shading	12.92	12.76	14.11	176.67	301.67	256.67	2.283	3.849	3.622
90 days shading	14.55	13.22	14.56	189.67	419.00	171.00	2.759	5.540	2.490
LSD at 0.05 level for comparing :				1999/2000			2000/2001		
				F.wt.	F.No.	Yield	F.wt.	F.No.	Yield
any two means of the interaction				3.60	89.63	1.79	3.60	131.81	2.05
any two planting date x shade interaction									
means under the same cultivar				2.84	59.29	1.22	3.16	88.84	1.07

D1,D2,D3 = Planting dates ; D1. Sept. 1 ; D2 .Sept. 15 ; D3 , Oct. 1 .

Table 6: Effect of the interaction of the planting date x cultivar x shading the nursery on strawberry early yield / plot and its components in the second early period

Treatment	Fruit wt. (gm)			Fruit No.			Early yield (kg)		
	Camarosa	Sweet Charlie	Rosalinda	Camarosa	Sweet Charlie	Rosalinda	Camarosa	Sweet Charlie	Rosalinda
First season (1999/2000)									
D1 Unshaded	9.12	9.77	6.14	254.34	615.00	700.67	2.370	6.011	4.500
60 days shading	11.23	9.69	5.06	230.67	745.00	880.67	2.590	7.218	4.930
D2 Unshaded	12.58	9.93	7.48	190.00	662.67	673.67	2.390	6.581	5.042
60 days shading	14.60	10.12	9.64	300.67	839.00	899.67	4.391	8.489	8.670
D3 Unshaded	14.84	10.02	10.16	178.33	632.33	357.34	2.646	6.970	3.630
60 days shading	12.21	11.25	12.77	163.66	736.66	562.33	1.998	8.291	7.180
Second season (2000/2001)									
D1 Unshaded	14.73	9.53	5.81	147.33	668.00	924.33	2.170	6.369	5.372
60 days shading	11.92	9.07	10.19	199.00	584.66	594.00	2.372	5.300	6.050
75 days shading	9.77	9.43	8.32	177.00	566.33	604.33	1.730	5.340	5.030
90 days shading	12.38	10.15	5.79	181.00	721.33	912.00	2.241	7.320	5.283
D2 Unshaded	13.07	9.91	7.13	141.67	628.67	657.00	1.851	6.230	4.687
60 days shading	13.66	10.34	7.06	188.00	746.00	940.67	2.568	7.712	6.640
75 days shading	13.90	10.89	10.14	241.67	786.33	708.00	3.360	8.560	7.110
90 days shading	14.97	11.19	11.60	118.34	737.34	648.67	1.771	8.249	7.523
D3 Unshaded	15.60	11.30	10.38	157.34	569.00	278.67	2.454	6.432	2.892
60 days shading	13.07	11.67	12.61	130.66	460.33	579.67	1.708	5.370	7.310
75 days shading	14.98	12.42	12.04	167.33	753.00	591.67	2.507	9.351	7.126
90 days shading	13.10	11.87	14.54	194.66	698.33	486.00	2.551	8.289	7.068
LSD at 0.05 level for comparing :				1999/2000			2000/2001		
				F.wt.	F.No.	Yield	F.wt.	F.No.	Yield
any two means of the interaction				3.43	123.96	2.70	4.03	146.94	2.06
any two planting date x shade interaction									
means under the same cultivar				3.30	72.28	1.70	2.50	90.03	1.08
D1, D2, D3 = Planting dates ; D1. Sept. 1 ; D2. Sept. 15 ; D3, Oct. 1 .									

values of fruit weight. The significant lowest fruit size was obtained with the Sept. 1st x unshaded or 60 days shading in the 1st season, and with the Sept. 1st x 60 days shading in the 2nd season, both were in the two early periods (Table 5,6). While, the heaviest one was observed with the Sept. 15th x unshaded or 60 days shading in the 1st early period and with the Oct. 1st x unshaded or Sept. 15th x 60 days shading in the 2nd one, in the 1st season, and with Sept. 15th or Sept. 1st x unshaded in the 1st early period and with Oct. 1st x unshaded or 75 days shading or with Sept. 15th x 90 days shading in the 2nd early period, both were in the second season.

For fruit number and early yield in two early periods, results in Tables 5 and 6 revealed that shading the nursery had significant effect on the two early periods of cv Camarosa under planting dates in the two growing seasons. In the 1st early period (Table 5), it was reached its maximum effect with the Sept. 15th or Oct. 1st x 60 days shading, and with Sept. 15th x 75 or 90 days shading, in the 1st and 2nd seasons, respectively, which valued 3.770, 3.162, 2.959 and 2.930 total early yield ton/fed., respectively with those treatments.

In the 2nd early period (Table 6), the early yield was at the highest value with the Sept. 15th x 60 days shading and with Sept. 15th x 75 days shading in the two seasons, respectively, which valued 4.391 and 3.360 tons/feddan. Such values could be considered of fruitful one, since the cv Camarosa average was 2.250 and 2.042 in the first period and 2.740 and 2.268 ton/fed. in the two seasons, respectively.

For cv Sweet Charlie (Tables 5, 6), average fruit weight was not affected by planting date x shading days of the nursery. However there were two cases, only, showing significant high values, those were with Sept. 1st x unshaded and Sept. 15th x 90 days shading in the 1st early period in the 1st season, and with Oct. 1st x 75 days shading in the 2nd early period in the second season. For fruit number and early yield in the two early period (Tables 5,6), results showed significant effect of shading days of the nursery on early fruits of strawberry. It also revealed that, the value of the early yield in 1st early period (Table 5), for Sweet Charlie, was obtained with the Sept. 1st or 15th x 60 days shading in the 1st season and with Sept. 15th or 1st x 75 days in the 2nd

Table 7 : Average effect of the cultivar, planting date and shading the nursery on strawberry total yield /plot and its components

Treatments	1999/2000			2000/2001		
	Fruit wt. (gm)	Fruit No.	Total yield (kg)	Fruit wt. (gm)	Fruit No.	Total yield (kg)
Effect of the cultivar						
Camarosa	10.43	2952.30	30.792	10.93	2293.60	25.069
Sweet Charlie	8.09	2896.90	23.436	8.28	2577.00	21.338
Rosalinda	7.00	2871.00	20.097	7.60	2720.70	20.672
LSD at 0.05	0.32	NS	1.620	0.43	275.56	2.050
Effect of the planting date						
Sept.1	7.48	3194.4	23.894	8.30	2813.60	23.350
Sept.15	8.88	2879.8	25.572	8.89	2521.20	22.410
Oct.1	9.75	2646.1	24.211	9.62	2256.50	21.710
LSD at 0.05	0.5	355.79	1.080	0.8	NS	NS
Effect of the shading days						
Unshaded	8.54	2801	23.921	8.87	2592.10	22.759
60 days shading	8.47	3012.5	25.512	8.91	2376.10	21.171
75 days shading				8.99	2492.00	22.403
90 days shading				8.98	2661.80	23.900
LSD at 0.05	NS	NS	NS	NS	235.04	1.91

NS, insignificant at the 0.05 level of probability.

Table 8: Effect of the interaction of the planting date x cultivar x shading the nursery on strawberry on strawberry total yield/plot and its components

Treatments	Fruit wt. (gm)			Fruit No.			Early yield (kg)		
	Camarosa	Sweet Charlie	Rosalinda	Camarosa	Sweet Charlie	Rosalinda	Camarosa	Sweet Charlie	Rosalinda
First season (1999/2000)									
D1 Unshaded	8.77	7.50	6.53	3418.10	3244.62	2970.30	29.977	24.335	19.396
60 days shading	9.50	7.63	6.15	3003.70	3002.88	3526.77	28.535	22.912	21.690
D2 Unshaded	10.49	8.81	8.05	3024.83	2647.98	2252.67	31.730	23.329	18.134
60 days shading	10.86	8.05	7.07	2964.00	3155.49	3233.87	32.189	25.402	22.869
D3 Unshaded	11.48	8.33	7.48	2590.02	2435.67	2624.79	29.733	20.289	19.633
60 days shading	11.43	8.06	8.11	2713.15	2895.00	2617.67	31.011	23.334	21.229
Second season (2000/2001)									
D1 Unshaded	10.49	7.48	6.68	2492.67	3627.67	3625.67	26.148	27.135	24.219
60 days shading	10.06	7.42	7.06	2243.00	2325.33	3135.00	22.565	17.254	22.133
75 days shading	10.48	7.22	7.27	2163.67	2680.67	2584.33	22.675	19.354	18.788
90 days shading	10.54	6.75	6.75	2344.33	2812.00	3788.33	24.709	18.981	25.571
D2 Unshaded	10.53	8.72	7.94	2427.67	2536.00	2204.33	25.563	22.114	17.502
60 days shading	10.85	8.45	7.01	2015.67	2401.33	2841.67	21.870	20.291	19.920
75 days shading	10.52	8.65	7.20	2489.33	2966.67	2563.67	26.188	25.662	18.458
90 days shading	10.74	8.51	7.60	2393.00	2700.00	2715.33	25.701	22.977	20.637
D3 Unshaded	11.92	8.45	7.62	2251.67	2181.67	1981.33	26.839	18.453	15.098
60 days shading	12.21	8.31	8.72	2213.67	1762.00	2447.00	27.029	14.642	21.338
75 days shading	11.70	9.01	8.65	2401.33	2493.67	2144.67	28.096	22.468	18.551
90 days shading	11.14	8.99	8.71	2086.67	2436.67	2677.33	23.246	21.906	23.320
LSD at 0.05 level for comparing :				1999/2000			2000/2001		
	F.wt.	F.No.	Yield	F.wt.	F.No.	Yield	F.wt.	F.No.	Yield
any two means of the interaction.	NS	NS	4.21	1.30	703.40	5.70			
any two planting date x shading interaction means under the same cultivar.	NS	NS	2.43	0.74	406.10	3.3			
NS, insignificant at the 0.05 level of probability.									

season. Moreover, in the *2nd* early period (Table 6), the highest values were obtained with Sept. 15th or Oct. 1st x 60 days shading, and with Oct. 1st x 75 days shading and Sept. 15th x 75 or 90 shading days in the *1st* and *2nd* seasons, respectively. Such treatments valued 6.280, 6.160, 6.150, 6.139, 8.489, 8.291, 9.351, 8.560 and 8.249 tons/ feddan, respectively, which could be taken in consideration if compared with the cultivar average; i.e., 5.460 and 5.141 in the *1st* period and 7.260 and 7.052 ton/fed. in the *2nd* period in the *1st* and *2nd* seasons, respectively (Tables 3,4).

For *cv* Rosalinda (Tables 5,6) results showed an increase of fruit weight with shading of the nursery in the two early periods in the two seasons, except that of Oct. 1st x unshaded in the early period in the *1st* season. Meanwhile, the highest significant fruit weight was obtained with Oct., 1st x 90 or 75 days shading in the *1st* early period in the *2nd* season, and with Oct. 1st x 60 days shading and Oct. 1st x 90 days shading in the *2nd* early period in the first and second seasons, respectively. For both the fruit number and early yield in the two early periods. The results indicated significant increase of both the traits in *cv* Rosalinda with

shading days in the nursery. Such increment was significantly high with Sept. 15th x 60 days shading in the *1st* season in the two early periods, which valued 6.270 and 8.670 tons /feddan, respectively with the *1st* and the *2nd* early periods. In the *2nd* season, the highest early yield in the *1st* early period was obtained with Sept. 1st x 90 or 75 days shading and with Sept. 15th x 60 or 75 days shading, which valued 5.960, 5.450, 5.370 and 5.080 ton/fed., respectively; and it was, in the *2nd* early period, with the Sept. 15th x90 or 75 days shading and with Oct. 1st x the three shading treatments, which valued 7.523, 7.110, 7.310, 7.126 and 7.068 ton/fed. early yield, respectively. Those early yield values were higher, also, than the cultivar average (Tables 3,4); i.e., 4.191 and 5.113 tons/fed., in the first season, and 4.049 and 6.031 ton/fed., in the second season. These means were in the *1st* and *2nd* periods, respectively.

3. Total Yield and Its Components

a. Main effect

Results in Table 7 show significant differences in the total yield and its components of the studied three cultivars, except that for fruit number /plot in the *1st*

season. The cultivar Camarosa scored the highest significant values of both the fruit weight and total yield over the harvest season, followed, significantly, by cvs Sweet Charlie and Rosalinda in the two growing seasons.

For the average effect of the planting date (Table 7), the data reflected significant effect on all yield traits, in the first season, and average fruit weight only in the second season. It also shows that, fruit weight had the largest size with Oct. 1st planting date, in the two seasons, and it was vice versa for fruit number /plot, i.e., fruit number /plot was at maximum value with Sept. 1st planting date. For total yield /plot, planting strawberry on Sept. 15th gave the highest significant yield in the first season, which was followed by Oct. 1st and Sept. 1st plantations in the 1st season.

Regarding to the effect of shading the nursery on all yield traits (Table 7), the data show that, shading days in the nursery did not affect all strawberry yield traits. Such a result was also obtained in the 2nd season, where there was insignificant difference among unshaded treatment, 60 days and 75 days shading for total yield. While shading the nursery for 90

days caused significant increase of both the fruit number and total yield when compared with 60 days shading, only. On the other hand, shading treatments had insignificant effect on fruit weight in the second season. Obtained results are confirmed with those of Ferre and Stang (1988) Chandler *et al* (1992), Awang and Atherton (1995) and Svenson (1995) on strawberry.

b. Interaction effect

Present results (Table 8) reflect significant effect of the planting date x cultivar x shading the nursery on strawberry total yield and its components in the two growing seasons. The results regarding the effect of planting date x shading the nursery on each cultivar separately show that, cv Camarosa fruit weight and fruit number /plot were not affected by the interaction of planting date x shading the nursery treatments, in the 1st season, while total yield was significantly improved with Sept. 15th plantation, with unshading and shading the nursery, and being the highest with 60 days shading, in the 1st season. In the 2nd season (Table 8), Camarosa cv was significantly affected by planting date x shading, and the total yield and its components scored the highest values with Oct.

1st x 75, 60 days shading or unshaded; Sept. 1st x unshaded and Sept. 15th x 75 days shading, with insignificance among these treatments.

For *cv* Sweet Charlie total yield traits (Table 8), fruit weight and fruit number/plot were not affected by planting date x shading treatments, but the cultivar total yield scored significant high values with Sept. 15th x 60 days shading, Sept. 1st x unshaded, Oct. 1st x 60 days shading and Sept. 15th x unshaded, with insignificance among those treatments, in the 1st season. In the 2nd season, fruit weight had the highest significant value with Oct. 1st x 75 days shading and the lowest one was obtained with Sept. 1st x 90 days shading. However both fruit number and total yield were significantly higher with Sept. 1st x unshaded and Sept. 15th x 75 days shading than the rest of the treatments, with insignificance between them.

As for *cv* Rosalinda (Table 8), it was not affected by planting date x shading treatments, regarding fruit weight and fruit number, in the 1st season. Meanwhile, the total yield significantly responded to those treatments. The highest total yield was obtained with Sept. 15th

x 60 days shading, which was higher, only, than that with Sept. 15th x unshaded treatment. Whereas, in the 2nd season, fruit weight was significantly increased with Oct. 1st plantation x all shading days in the nursery. However the fruit number and the total yield of the cultivar, Rosalinda, scored the highest significant values with Sept. 1st x 90 days shading or unshaded one and with Oct. 1st x 90 days shading with insignificance between the both.

Generally, it could be concluded that, of the three studied cultivars, *cv* Camarosa had higher productivity (total yield) than *cv* Sweet Charlie, which, in turn, was more productive than *cv* Rosalinda, in this respect, similar trend was obtained by Fenandez *et al.*, (2002). The yield of those cultivars could be improved with the combination of Sept. 15th or Oct. 1st planting dates x 75 or 90 days shading for Camarosa *cv*, with Sept. 1st x unshaded and Sept. 15th x 75 days shading for Sweet Charlie *cv* and with Sept. 1st x 90 days or unshaded for Rosalinda *cv*. On the other hand, *cv* Camarosa was the poorest one regarding the early yield, while *cv* Sweet Charlie was the best in this respect. However, this early yield in the 1st and the 2nd early

period could be improved by planting the transplants on Sept. 15th and shading the nursery for 75 days. This treatment could improve the early yield by 46.6, 20.7 and 20.9% of the Camarosa, Sweet Charlie and Rosalinda, over the cultivars averages, respectively in the 2nd season. Moreover, in the 1st and 2nd early periods, the improvement reached 44.9 and 48.1% for Camarosa, 19.6 and 21.1% for Sweet Charlie, and 25.5 and 17.9 for Rosalinda, respectively.

REFERENCES

- Albregts E.E. and C. K. Chandler. 1996. Effect of transplants chilling and planting dates on fruiting response of 4 strawberry clones. Hort. Abstr. (66): 6.
- Awang Y.G. and Y.G. Atherton. 1995. Growth and fruiting responses of strawberry plants grown on rockwool to shading and salinity. Scientia Horticulturae (62) No. 1/2, 25-31.
- Badiyala, S. D., and V. P. Bhutani 1990. Effect of planting dates and spacing on yield and quality of strawberry cv. Tioga. South Indian Horticulture 38: 295-296.
- Chandler, C. K., D. Miller and D. C. Ferre. 1992. Shade during July and August reduce growth but not fruiting at strawberry plants. Hort. Sci. 27 (9): 1044.
- Chercuitte L., J. A. Sullivan, Y. D. Desiardins, and R. Bedard. 1991. Yield potential and vegetative growth of summer planted strawberry. J. Amer. Soc. Hort. Sci. 116 (6): 930-936.
- Choi, K. S., J. T. Suh, S.Y. Ryu and K. H. Jhee, 1992. Studies on strawberry forcing culture at low land by acceleration of flower but differentiation at high land. Rural Development Administration, Horticulture, 34:(1) 5-12.
- Darrow, G.M. 1937. Interaction of temperature and photoperiodism in the production of fruit buds and runners in the strawberry. Amer. Soc. Sci. Proc. 1936 : 360-363.
- Fenandez, Gina E., Laura M. Butler and J. L. Frank 2002. Strawberry growth and development in an annual plastic-culture system. Hort. Sci. 36 (7) : 1219-1223.
- Ferre, D.C. and E. J. Stang 1988. Seasonal plant shading, growth and fruiting in (Eerligow)

تأثير التظليل في المشتل وميعاد الزراعة علي ثلاثة أصناف من الفراولة ٢ - المحصول المبكر والمحصول الكلي

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في هذه الدراسة ، تم تظليل ثلاثة أصناف من الفراولة في المشتل لمدة صفر ، ٦٠ ، ٧٥ ، ٩٠ يوماً باستخدام شباك التظليل ، وبعد ذلك تم زراعة الشتلات التي ظلت في ثلاثة مواعيد للزراعة هي : أول سبتمبر ، و١٥ سبتمبر ، وأول أكتوبر . لدراسة تأثير كل من التظليل ومواعيد الزراعة علي المحصول المبكر والمحصول الكلي ومكوناته .

وأوضحت النتائج تفوق الصنف سويت شارلي في المحصول المبكر ومكوناته ، بينما سجل الصنف كماروزا أعلى متوسط لوزن الثمرة . وأظهرت النتائج أن ١٥ سبتمبر كان أنسب ميعاد لإنتاج أعلى محصول مبكر وزيادة مكوناته (وزن للثمرة وعدد الثمار للقطعة للتجريبية) . وبالإضافة إلي ذلك ، فقد أدى تظليل الشتلات إلي دفع النباتات لإنتاج محصول مبكر أعلى من الغير مظلله ، وتبين أن أفضل فترات التظليل هي ٦٠ يوماً في الموسم الأول و ٩٠ ، ٧٥ يوماً في فترة التبريد الثانية في الموسم الثاني ، علي حين أنه لم يكن للتظليل أي تأثير معنوي علي متوسط وزن الثمرة

كما أوضحت النتائج أن المحصول المبكر ومكوناته قد تأثر معنوياً بمعاملات التفاعل الثلاثي . وبصفة عامة ، كان المحصول المبكر عاليًا في فترة التبريد الثانية (من يناير حتى نهاية فبراير) عنه في فترة التبريد الأولي (من نوفمبر وحتى نهاية ديسمبر) . وبالنسبة للمحصول الكلي ، فقد سجل الصنف كماروزا أعلى زيادة معنوية في قيم كل من متوسط وزن الثمرة ، والمحصول الكلي للقطعة للتجريبية . وكان وزن الثمرة أعلى ما يمكن مع ميعاد الزراعة أول أكتوبر ، كما كان عدد الثمار للقطعة التجريبية عند أكبر قيمة له مع أول سبتمبر ، وسجلت أعلى قيمة معنوية للمحصول الكلي في السنة الأولي مع ميعاد الزراعة ١٥ سبتمبر . كما أدى التظليل في المشتل لمدة ٩٠ يوماً إلي زيادة معنوية في كل من عدد الثمار والمحصول الكلي للقطعة التجريبية واللفدان .