J. Agric. Sci. Mansoura Univ., 28(7): 5589 – 5598, 2003

RECONSTITUTION OF *Fragaria X Ananassa* 2- HYBRID YIELD PERFORMANCE AND FRUIT PHYSICAL CHARACTERISTICS AND THEIR HETEROSIS

Okasha, Kh. A.; R. M. Helal; M.E. Ragab and S. A. Esmail
Hort. Dept., Fac. of Agric., Ain Shams Univ., Shoubra El-Khima, Cairo, Egypt.

ABSTRACT

This study was conducted during 1999/2000 and 2000/2001 seasons to produce some new strawberry hybrids from the specific hybridization between the two octaploid species *Fragaria chiloensis* and *Fragaria virginiana*. Twelve new released strawberry hybrids and their parents were evaluated according to plant growth, hybrid yield performance and fruit physical characteristics and their heterosis. Results showed that significant increment in number of leaves/plant was obtained from all hybrids. Moreover, most of the hybrids showed positive heterosis except A4 which had no heterosis for this trait. A1 and B12 hybrids had the highest crown diameter compared with all tested hybrids in the two seasons and all the hybrids showed negative heterosis except B12 in the two tested seasons and A1 in the first season. Concerning earliness,B6 recorded the least number of days for flowering followed by A1, A3, A4, B5, B9 and P2. All the hybrids exhibited positive heterosis for earliness trait except B6 which had heterotic effect over the best parent in the second seasons. B9 and B12 hybrids recorded the highest early yield as compared with all tested hybrids in the two tested seasons. Also B9 and B12 had the positive significant heterosis over the best parent in both experimental seasons. While the rest of hybrids had negative heterosis. B9 and B12 hybrids gave the highest total yield in both seasons in addition to B5 in the second year only. On the other hand, B9 had the highest positive heterosis followed by B12 and B5. B6 hybrid exhibited the highest average fruit weight as compared with all hybrids in the two tested seasons. All the hybrids showed negative heterosis for average fruit weight except the hybrid B6 which had a positive heterosis in both tested seasons. A2 and B9 hybrids gave the highest values of fruit firmness. All hybrids exhibited negative heterosis for fruit firmness in the two seasons except for the hybrid A2 which showed no heterosis for this trait in the first season.

Keywords: Strawberry hybrids, Earliness, Yield, Fruit physical characteristics.

INTRODUCTION

Yield performance and physical characteristics of strawberry fruits are very important for local and export markets. Dradi *et al.* (1997) mentioned that fruit yield was correlated positively with the number of leaves per plant during October. Matsuda *et al.* (1988) found that F1 hybrids were intermediate between their parents and no heterotic effect was noticed in number of leaves/plant in all F1 hybrids. The rest of the hybrids had positive heterosis over the best parent. Ragab *et al.* (2000) found significant differences among some strawberry cultivars in terms of plant height. They mentioned also that there were significant differences in early and total yield and fruit weight. Govorova (1993) and Simpson *et al.* (1993) pointed out that the obtained strawberry hybrids were differed in their flowering date. Chandler *et al.* (1997) and Ragab *et al.* (2000) pointed out that there were significant differences among strawberry cultivars in their early yield. Human

and Low (1993) indicated that genetic variance between crosses was largely attributable to main effects of male and female parents in all traits except berry number and total yield. Galletta *et al.* (1996), Turemis *et al.* (1997) and Coman *et al.* (2000) found significant differences among strawberry cultivars and in total yield. Lal *et al.* (1984) showed that some strawberry hybrids gave positive heterosis over the better parent in fruit yield. Hancock and Bringhurst (1988) concluded that *F. virginiana* has a strong negative impact on fruit size and large-fruited F1 hybrids can indeed be recovered in *F. virginiana x F. ananassa* crosses. Hancock *et al.* (2001) reported that *F. chiloensis* has been utilized much than *F. virginiana* in breeding program, also, they began to reconstruct *F. ananassa* by selecting a small group of native *F. chiloensis* and *F. virginiana* clones. Which were known to carry horticultural important traits and made the hybridization between them. They found that some of the interspecific hybrids had fruit that were larger than would be predicated from the size of their parents. Shaw (1987) suggested that a unique pattern of inheritance fruit firmness trait in the current breeding programs. Moore (2001) studied fruit firmness of 19 clones, it was found that strawberry clones differed in firmness in both years. The common shapes of strawberry varieties are classified by Darrow (1966) to eight shapes, viz., oblate, global, globe-conic, conic, long conic, necked long conic, long wedge and short wedge. He also added that the shape may be affected by the cold growing conditions. Ahokas (1993) noted that the berries of *F. chiloensis* and *F. virginiana* were varied according to shape, size and color. As respect to *F.chiloensis,* he observed that the variation in color of flesh ranged from yellowish to dark red, flesh was floury and flattened berries (broad and short), whereas, *Fragaria virginiana* fruit had scarlet-red, interior berry flesh red and flesh was firm. Foley and Hennerty (1993) reported that only five lines had the same fruit shapes, while, the rest had different shapes relative to their original cultivar. Therefore the aim of this study was to investigate hybrid yield performance and fruit physical characteristics and their heterosis.

MATERIALS AND METHODS

This study was carried out at The Experimental Station of Strawberry and Non-Traditional Crops Center, Faculty of Agriculture, Ain Shams University at Nubaria during the period from 1999 to 2002. In a former paper (Esmail *et al.*, 2003), we studied on seed germination, transplant production and its heterosis and achene morphology of the twelve new obtained strawberry hybrids with their parents. In this paper we present studies conducted on yield, fruit characteristics and yield heterosis of the released hybrids. A randomized complete block design, with three replicates, was used. Each replicate contained the 12 hybrids and their two parents. The plants were arranged in four row beds with 120-cm width, 10m long and 50-cm height, at plant distances of 25 cm apart. The beds were covered with a 40-micron clear plastic as a mulching, one-month after planting, the plants were covered with 80-micron plastic tunnels (70-cm height) on November 1. Sprinkler irrigation was taken place in the first month after planting, then the drip irrigation was used under mulching until the end of the season. The soil texture of the experimental site was sandy with pH of 7.8 and EC of 0.86. The

agricultural practices concerning cultivation, fertilization, irrigation, and pest- and disease control were conducted as recommended. The following data were recorded:

1. Vegetative growth characters:

Random samples of 10 plants from each experimental plot was chosen at the anthesis period for expressing the average number of leaves per plant, plant height, which was recorded from the surface of the soil to the highest leaf and crown diameter which was determined by the vernier caliber.

2. Earliness of flowering:

It was determined for all genotypes as number of days from the planting date to the onset of the emergence of first flower.

3. Yield components:

3.1. Early yield:

Early yield produced in December - January - was collected from each experimental plot and calculated.

3.2. Total yield:

All harvested fruits at the ¾ color stage collected from each plot all over the season were weighed and average total yield per feddan was calculated.

4. Physical characteristics of fruits:

4.1 Average fruit weight/plant:

All harvested fruits from each plant of each genotype were weighed and average fruit weight was calculated.

4.2 Fruit shape:

Ten fruits from each plot at full ripe stage were taken to indicate fruit shape as reported by Darrow (1966).

4.3 Fruit firmness:

Fruit firmness was determined in twenty fruits at ¾ color stage using a Chatillon pentameter firmness. Each fruit was tested at blossom, top end and shoulder, then the average fruit firmness was calculated as gm/cm2.

5. Heterosis:

Heterosis was computed according to the following equations reported by Singh and Singh (1994).

The best –parents heterosis % = $\frac{\overline{F_1} - \overline{B.P}}{\overline{B.P}} x100$

Where: F1 and B.P represent mean performance of hybrid and best-parents. To test the significance of differences between the F1 means and their best-parents values, the T-test was applied. The standard error was calculated according to the formula:

SE = (EMS / r + EMS / 2r)1/ 2

Where: EMS is the mean squares due to error from the analysis of variance and r is number of replications.

6. Statistical analysis:

Analysis of data was done by IBM computer, M-state program for statistical analysis .The differences among means for all traits were tested for significance according to Waller and Duncan (1969).

RESULTS AND DISCUSSION

1. Vegetative growth characters:

1.1. Number of leaves/ plant:

Results in Table (1) show that most of the hybrids had significantly higher number of leaves than their parents, A1, A3, B9, B10 and B11 had the highest values in the two tested years. Differences among strawberry genotypes in number of leaves were reported by Ragab et al. (2000). In this connection, the highest values of leaf number were correlated positively with fruit yield as mentioned by Dradi et al. (1997). In respect to heterosis, A2, A4, B8 and B12 had no heterosis for leaf number in the first season. These results are in agreement with Matsuda et al. (1988). The rest of hybrids had positive heterosis over the best parent.

1.2. Plant height:

Results in Table (1) clearly indicate that the highest average of plant height was obtained from A3 hybrid. On the other hand P1 and B7 had the lowest values in the two tested years. In this connection, Ragab *et al.* (2000) found significant differences among strawberry cultivars in terms of plant height. Regarding to heterosis of plant height, results in Table (2) showed that A2, B7, and B12 had negative heterosis in the two seasons while A4 and B6 hybrids had negative heterosis, only, in the second year.

Table (1): Averages number of leaves, plant height and crown diameter of two strawberry species and their 12 selected F_1 hybrids.

Genotypes	Number of leaves		Plant height (cm)		Crown diameter (cm)	
	99/2000	2000/2001	99/20001	2000/2001	99/2000	2000/2001
P1	8.33 bc	8.00 d	10.52 g	10.16 e	1.257 a	1.221 bc
P2	7.67 c	6.33 e	12.90 cde	12.37 bcd	1.016 e	1.004 f
A1	10.35 a	10.67 ab	14.17 b	13.18 bc	1.187 abc	1.316 a
A2	8.33 bc	10.63 ab	12.33 def	11.27 cde	1.127 bcd	1.160 cde
A3	9.33 ab	10.00 abc	16.03 a	15.83 a	1.179 abc	1.191 bcde
A4	8.33 bc	8.00 d	13.90 bc	10.68 de	1.187 abc	1.202 bc
B5	9.33 ab	9.33 c	13.17 bcd	13.57 abc	1.099 cde	1.098 cdef
B6	8.67 abc	10.00 abc	11.50 fg	12.57bcde	1.067 de	1.036 f
B7	9.67 ab	9.67 bc	10.43 g	11.16 cde	1.190 abc	1.071 def
B8	8.33 bc	9.33 c	11.67 efg	12.87 bcd	1.146 bcd	1.164 cde
B9	9.33 ab	10.33 abc	12.83 cde	13.51 abc	1.070 de	1.068 ef
B10	10.37 a	11.00 a	12.33 def	13.13 bcd	1.196 ab	1.190 bcd
B11	10.35 a	11.00 a	13.67 bc	13.77 ab	1.198 ab	1.195 bc
B12	8.33 bc	9.33 c	12.00 def	12.53 bcde	1.258 a	1.290 a

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

P1= *Fragaria chiloensis* P2 = *Fragaria virginiana* A = *F. virginiana x F. chiloensis* B = *F. chiloensis x F. virginiana*

1.3. Crown diameter:

Results in Table (1) show that P1, A1 and B12 genotypes had the highest values as compared with the rest of genotypes in the two experimental years. In this respect, Ragab *et al.* (2000) mentioned that the crown diameter is considered one of the very important factor affect earliness, total yield and strawberry fruit quality. As for heterosis of crown diameter, B12 showed positive heterosis in the two tested years while the

rest genotypes exhibited negative heterosis values in the two tested years except A1 which had negative heterosis only in the first season (Table 2).

Table (2): **Heterosis for number of leaves, plant height and crown diameter of two strawberry species and their 12 selected F_1 hybrids.**

Hybrids	Number of leaves		Plant height (cm)		Crown diameter (cm)	
	99/2000	2000/2001	99/20001	2000/2001	99/2000	2000/2001
A1	24.25	33.37	9.84	3.53	-5.57	7.78
A2	0	32.87	-4.42	-11.47	-10.34	-4.99
A3	12.00	25.00	24.26	24.35	-6.20	-2.46
A4	0	0	7.75	-16.10	-5.57	-1.55
B5	12.00	16.25	2.09	6.59	-12.57	-10.07
B6	4.08	25.00	10.85	-1.25	-15.11	-15.15
B7	16.08	20.87	-19.15	-12.33	-5.33	-12.28
B8	0	16.62	-9.53	1.09	-8.83	-4.67
B9	12.00	29.12	-0.54	6.13	-14.87	-12.53
B10	24.49	37.50	-4.40	3.14	-4.85	-2.54
B11	24.25	37.50	5.97	8.17	-4.69	-2.13
B12	0	16.25	-6.97	-1.57	0.08	5.65

A = *F. virginiana x F. chiloensis* B = *F. chiloensis x F. virginiana*

2. Earliness of flowering:

It appears from data presented in Table (3) that the lowest number of days to first flower was significantly recorded for B6 hybrid with non significant difference between it and P2 in the two tested seasons followed by A1, A3, A4, B5 and B9. In general all tested hybrids flowered earlier than the delayed parent (P1) with a significant difference. On the contrary, P2 was evidently a good parent for earliness and earlier than P1, These findings were supported by the work of Govorova (1993) and Simpson et al. (1993). As for heterosis, results in Table (4) showed that all hybrids exhibited positive heterosis in the two seasons except B6 in the second season, and the highest value of heterosis was recorded for B7, B10 and B11 over the best parent in the two seasons. These results coincide with those obtained by Human and Low (1993) who recorded hybrid vigor for earliness.

3. Yield components:

3.1. Early yield:

Results presented in Table (3) clearly show genotypic differences in early yield per plant. B9 and B12 hybrids produced the highest early yield as compared with all tested genotypes in the two tested seasons in addition to B5 hybrid in the second season. Similar results were obtained by Chandler *et al.* (1997) and Ragab *et al.* (2000) who reported that strawberry cultivars and hybrids had variable early yield.

As for heterosis, results in Table (4) indicate that only B9 and B12 hybrids had positive heterosis in the first season while, all hybrids showed negative heterosis for early yield except B12 hybrid in the second season.

3.2. Total yield:

Results in Table (3) showed that significant increment in total yields were recorded to B5, B9, and B12 hybrids than the parents in the two tested seasons. These findings are in harmony with those of Galletta et al. (1996), Turemis *et al.* (1997) and Coman *et al.* (2000), who found significant differences among strawberry genotypes in total yield. As for heterosis, results in Table (4) clearly indicate that all tested hybrids exhibited negative

heterosis for total yield except B5, B9 and B12 hybrids. Such results coincide with those of Human and Low (1993). Moreover, B9 hybrid had the highest value of heterosis in the two tested seasons. These results agree with Lal *et al.* (1984).

Table (3): Earliness, early yield and total yield of two strawberry species and their selected F_1 hybrids.

Hybrids	Earliness (days)		Early yield/plant (g)		Total yield/plant (g)		Total yield/fed. (ton)	
	99/2000	2000/2001	99/2000	2000/2001	99/2000	2000/2001	99/2000	2000/2001
P1	151.00a	153.54a	18.13de	19.26bcd	51.91fg	59.32efg	2.10fg	2.37efg
P2	78.67i	74.98d	22.54bc	22.87ab	124.50c	129.11bc	4.98c	5.16bc
A1	83.33h	86.20cd	9.83gh	10.82gh	59.68f	60.85efg	2.39f	2.43efg
A2	96.67f	94.25cd	18.61de	18.00cde	93.07de	92.15de	3.72de	3.69de
A3	92.66g	90.22cd	7.43hi	7.09hi	34.45gh	33.25g	1.40gh	1.29g
A4	93.33eg	91.16cd	15.03f	15.22efg	111.60cd	116.23cd	4.46cd	4.65cd
B5	92.67g	94.36cd	20.66cd	21.19abc	156.80b	159.57ab	6.27b	6.38ab
B6	77.33l	74.81d	11.53g	11.20gh	91.29e	90.82de	3.65e	3.63de
B5	111.30cd	109.60bc	17.45ef	16.23ef	69.93f	70.21ef	2.79f	2.81ef
B8	108.00d	103.98bcd	18.25de	17.57df	116.40c	120.36cd	4.66c	4.81cd
B9	90.33g	86.51cd	23.92ab	22.37abc	189.80a	192.11a	7.59a	7.68a
B10	123.00b	124.36ab	11.20	11.84fg	40.17gh	39.20fg	1.61gh	1.57fg
B11	111.70c	114.68bc	4.75l	5.86l	29.52h	30.16g	1.18h	1.21g
B12	103.00e	100.62bcd	26.89a	25.11a	183.90a	186.01a	7.36a	7.44a

Values in the same column by the same letter(s) do not differ significantly from each other according to Duncan's multiple range test 5%.
P1= *Fragaria chiloensis* P2 = *Fragaria virginiana* A = *F. virginiana x F. Chiloensis*
B = *F. chiloensis x F. virginiana*

Table (4): Heterosis of earliness of flowering, early yield and total yield of selected 12 F_1 strawberry hybrids.

Hybrids	Earliness		Early yield		Total yield	
	99/2000	2000/2001	99/2000	2000/2001	99/2000	2000/2001
A1	5.92	14.96	-56.39	-52.69	-52.06	-52.87
A2	22.88	25.70	-17.43	-21.29	-25.24	-28.63
A3	17.78	20.32	-67.03	-68.99	-65.10	-74.24
A4	18.63	21.58	-33.32	-33.45	-10.36	-9.97
B5	17.79	25.84	-8.34	-7.34	25.94	23.59
B6	1.70	-0.22	-48.84	-51.03	-26.67	-29.65
B7	41.47	46.17	-22.58	-29.03	-43.83	-45.62
B8	37.28	38.67	-19.03	-23.17	-6.51	-6.78
B9	14.82	15.38	6.12	-2.18	52.45	48.79
B10	56.35	65.86	-50.31	-48.23	-67.73	-69.64
B11	41.99	52.98	-78.92	-74.37	-76.29	-76.64
B12	30.93	34.19	19.29	9.79	47.71	44.07

A = *F. virginiana x F. chiloensis* B = *F. chiloensis x F. virginiana*

4. Physical characteristics of fruits:

4.1 Average fruit weight:

It is evident from Table (5) that B6 hybrid exhibited the highest average fruit weight as compared with all tested genotypes. Results are in harmony with those of Hancock and Bringhurst (1988), and Hancock *et al.* (2001). They reported that the *F.chiloensis* is a good parent for fruit size. On the other hand, P2 and B11had the lowest fruit weights in the two tested years.

Concerning heterosis, data recorded in Table (6) showed that all hybrids exhibited negative heterosis for average fruit weight except the hybrid B6 which had positive heterosis. Such results did not agree with those of Hancock and Bringhurst (1988) and Hancock *et al.* (2001). These contrary results may be due to the different parents used in each study. The low total yield for the obtained hybrids may be due to the genetic constituents for the used parents with their very small fruit size as a wild.

Table (5): Fruit weight and fruit firmness of two strawberry species and their F1 hybrids.

Genotypes	Fruit weight (g)		Fruit firmness (g/cm^2)	
	99/2000	2000/2001	99/2000	2000/2001
P1	5.627 b	6.325 b	186 9 a	192 3 a
P2	1.633 g	2.109 e	108.9 f	109 5 l
A1	3.503 cd	3.921 cd	168.7 abc	171 2 cde
A2	3.323 d	3.419 d	186 9 a	184 6 ab
A3	3.060 def	3.562 d	150 5 de	153 7 fg
A4	3.283 de	3.719 d	158.7 cde	160 3 ef
B5	2.737 f	2 564 d	140 8 f	139 5 h
B6	7 383 a	8.359 a	172 8 abc	175 2 bcd
B7	5.473 b	5.874 bc	178.8 abc	177.6 bcd
B8	3.113 def	4.254 cd	164 2 bcd	166.3 de
B9	3.883 c	3.426 d	180.5 ab	182 9 abc
B10	2.790 f	2.758 d	175.3 abc	177 3 bcd
B11	1.763 g	2.301 d	173 0 abc	173.8 bcd
B12	2.803 ef	3.216 d	145.3 e	148.6 gh

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

P1= *Fragaria chiloensis* P2 = *Fragaria virginiana*

A = *F. virginiana x F. chiloensis* B = *F. chiloensis x F. virginiana*

Table (6): Heterosis of physical characteristics of fruit for selected 12 F1 strawberry hybrids.

Hybrids	Fruit weight		Fruit Firmness	
	99/2000	2000/2001	99/2000	2000/2001
A1	37.75	-38.01	-9.74	-10.97
A2	-40.94	-45.49	0.0	-4.00
A3	-43.84	-43.68	-19.47	-20.07
A4	-41.65	-41.50	-15.09	-16.38
B5	-51.36	-59.46	-24.66	-27.46
B6	31.21	48.55	-7.54	-8.89
B7	-2.74	-7.13	-4.33	-7.64
B8	-44.68	-32.74	-12.14	-13.52
B9	-30.99	-45.83	-3.42	-4.89
B10	-50.42	-56.40	-6.21	-7.80
B11	-68.67	-63.62	-7.44	-9.62
B12	-50.19	-49.15	-22.26	-22.72

A = *F. virginiana x F. chiloensis* B = *F. chiloensis x F. virginiana*

4.2. Fruit firmness:

Results in Table (5) indicate that none of the obtained hybrids showed firmer fruits compared with the best parent for this trait in the two tested years. Shaw (1987) and Moore (2001) found differences among strawberry hybrids in fruit firmness. In respect to heterosis for fruit firmness, results in (Table 6) clearly indicate that only A2 had no heterosis for fruit firmness in the first season while all hybrids exhibited negative heterosis in the two tested seasons.

4.3 Fruit shape:

Results in Fig. (1) illustrated that fruit shape of F.chiloensis (P1) was a globe conical with white internal color and external yellowish to dark with somewhat large size while F. virginiana fruits had conical shape with internal dark red flesh colored and external light red. It is clear from Fig. (1) that A1, A3, B6, B9 and B11 hybrids were similar to their parent P1 in white colored flesh and somewhat in large size. However, B6 exhibited clearly necked shape and slightly necked in B9. This shape did not found in both of two parents. In the meantime, most of selected hybrids had a shape ranged between globe conic and oblate shapes. In addition, the flesh colored was from slightly red (A2, B11) to dark red (A4, B7, B10, B12).Our results are in agreement with those obtained by Darrow (1966), Ahokas (1993) and Foley and Hennerty (1993).

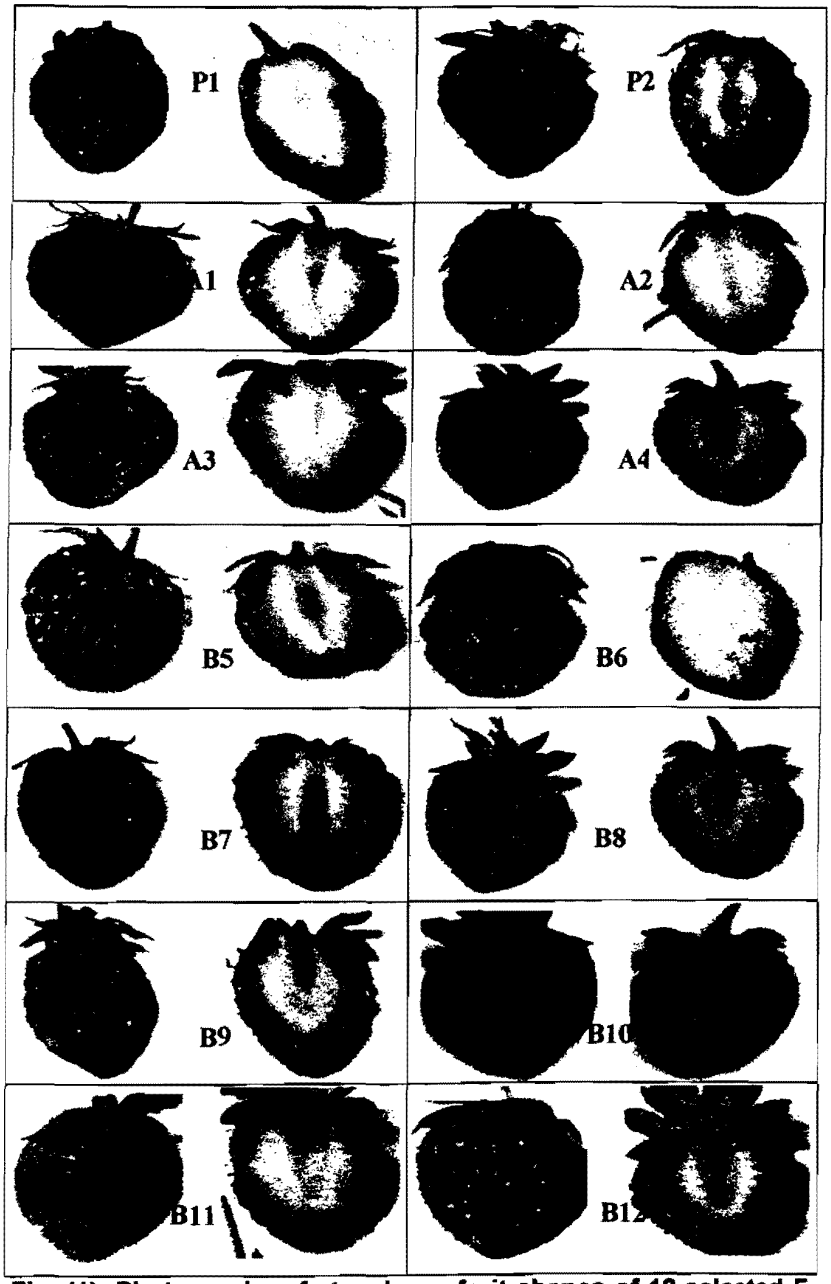

Fig. (1): Photographs of strawberry fruit shapes of 12 selected F_1 hybrids and their two parents.

P1= *Fragaria chiloensis* P2 = *Fragaria virginiana*
A = *F. virginiana x F. chiloensis* B = *F. chiloensis x F. virginiana*

REFERENCES

Ahokas, H. (1993). Two decades of naturalization in Finland of the octaploid strawberry, Fragaria chiloensis and Fragaria virginiana, from the boreal worth Amenica.Memor. Soc.Fauna Flora Fennica 69:33-45.

Chandler, C. K., D. E. Legard and C. A. Sims, (1997). Rosa Linda strawberry. HortScience 32 (6): 1134-1135.

Coman, M. S., A. N. Popescu and V. S. Isac, (2000). New strawberry cultivars and promising selections from the fruit research institute Pitesti, Romania. Acta Hort. 538:775-778.

Darrow, G. M. (1966). The strawberry: history, breeding and physiology. Holt, Rinehart and Winston, N. Y.

Dradi, R., W. Faedi, R. Fiori and R. Casadei, (1997). Dry matter and carbohydrate distribution in plant tissue of different strawberry cultivars during the crop cycle. Rivista di Frutticolturae Ortofloricoltura. 59 (9): 73-77. (C.A. CAB Abstracts 1996-1998).

Esmail. S. A.; Kh.A. Okasha; R.M.Helal and M.E. Ragab (2003). Seed germination, transplant production and its heteroses and achenes morphology. Annals Agric. Sci., Ain Shams Univ., Cairo, 48(1): 329-342.

Foley , I. and M. J. Hennerty, (1993). Field performance of androgenic strawberry plants. Acta Hort. 348: 188-195.

Galletta, G. J., J. L. Maas, J. M. Enns, J. C. Scheerens, R. J. Rouse and R. F. Heflebower. (1996). Latestar strawberry . HortScience. 31 (7): 1238-1242.

Govorova, G. (1993). Strawberry breeding in Russia. Acta Hort.348: 45-55

Hancock, J. F., and R. S. Bringhurst, (1988). Yield component interactions in wild populations of California Fragaria. HortScience 23: 889-891.

Hancock, J. F., P. W. Callow, A. Dale, J. J. Luby, C. E. Finn, S. C. Hokanson and K. E. Hummer, (2001). From the Andes to the Rockies, Native strawberry collection and utilization. HortScience, 36 (2): 221-225.

Human, J.P. and B.H.Low,(1993).An analysis of genetic variability in yield and quality components in South Africa strawberry germplasm. Acta Hort. 348-355.

Lal, S. D., J. N., Seth and S. S. Solanki, (1984). Heterosis and inbreeding depression in strawberry (Fragaria x ananassa Duch.) Progressive-Horticulture. (C.A. CAB Abstracts 1994-1996).

Matsuda, T., H. Hara and M. Izak, (1988). Inheritance of some characteristics in the strawberry (Fragaria x ananassa Duch.) Scientific Reports of the Faculty of Agriculture Ibaraki University No. 36; 1-18. (C.A. CAB Abstracts 1987-1989).

Moore, P. P. (2001). Firmness and drained weight of fruit of 19 strawberry clones. HortScience 36: 116-117.

Ragab, M. E., I. I. El-Oksh and H. M. El-Sayed, (2000). New promising cultivars and large crown diameter of transplants increased earliness, productivity and fruit quality of annual plastic-mulched strawberry. J. Agric. Sci. Mansoura Univ. 25 (12) 8039-8052.

Shaw, D. V. (1987). Genetic variation for objective and subjective measures of fresh fruit color in strawberries J. Amer. Soc. Hort. 116: 894-898

Simpson, D. W., J. L. Mass and G. J. Galletta, (1993). The performance of North American day neutral cultivars and the use of this germplasm for breeding in the United Kingdom. Acta Horticulture. 348: 124-130.

Singh, R. R. and P. K. Singh, (1994). A manual on genetics and plant breeding experimental techniques, Kalyani Publisher Lundhinan. New. Delhi-Noida.

Türemis, N., N. Kaska, S. Kafkas and N. Comlekcioglu, (1997). Comparison of yield and quality of strawberry cultivars using frigo plants and fresh runners rooted in pots. Acta. Hort. 439: 537-542.

Waller, R.A.. and D. B. Duncan (1969).Ways for the symmetric multiple comparison problem. Amer. Stat.Assoc. J. 19 : 1485-1503.

إعادة تكوين الفراجارايا x أناناسا

٢ ــ محصول الهجن والصفات الطبيعية للثمار ودرجة تفوقهم

خليفة عطية عكاشة – رفعت محمد هلال – محمد إمام رجب – شادية عبد اللاه إسماعيل

قسم البساتين – كلية الزراعة – جامعة عين شمس – شبرا الخيمة – القاهرة

هذه الدراسة خلال موسمي ١٩٩٩ – ٢٠٠٠ و ٢٠٠٠ – ٢٠٠١ بهدف تقدير الصفات الكيماوية للثمار ودرجة تفوقهم والبصمة الوراثية بطريقة البروتين لعدد ١٢ هجين فراولة جديد تم الحصول عليها بالتهجين بين نوعى الفراولة شلونسز وفرجينيانا . تم تقييم الهجن الناتجة مع الأباء من حيث النمو الخضري والمحصول والمواصفات الطبيعية للثمار ودرجة تفوقها.

أظهرت النتائج زيادة معنوية في عدد الأوراق للنبات في جميع الهجن الناتجة وكانت درجة تفوق الهجين موجبة لمعظم الهجن الناتجة ما عدا الهجين A4 الذي لم يظهر تفوقا لهذه الصفة . كانت اعلي قيمة لقطر التاج في النبات في الهجينين A1 ، B12 مقارنة بجميع الهجن الأخرى خلال موسمي الدراسة وكانت قيمة درجة التفوق لجميع الهجن سالبة ما عدا B12 خلال الموسمين للهجين A1 في الموسم الأول فقط بالنسبة للتبكير في الأزهار فقد سجل الهجين B6 اقل عدد من الأيام حتى الأزهار يلي ذلك الهجن A1 ، A3 ،B4 ، B5 ، B9 ، P2 وقد أظهرت جميع الهجن تفوقا موجبا لهذه الصفة ما عدا الهجينB6 .

أعطى الهجينان B9 ، B12 اعلي محصول مبكر مقارنة بجميع الهجن المختبرة خلال موسمي الدراسة وقد أعطى الهجينان B9، B12 درجة تفوق موجب عن الأب الأفضل خلال موسمي التجربة أما باقي الهجن فأعطت تفوقا سالبا لهذه الصفة . بالنسبة للمحصول الكلي أعطت الهجن B9 ، B12 اعلي محصول كلي خلال موسمي الدراسة بالإضافة إلى الهجين B5 في الموسم الثاني فقط ومن ناحية أخرى فسجل الهجين B9 اعلي درجة تفوق موجب يلي ذلك الهجن B12، B5 .أظهرت النتائج أيضا تفوق الهجين B6 في صفة متوسط وزن الثمرة عن جميع الهجن الأخرى خلال موسمي الدراسة وقد أعطت جميع الهجن درجة تفوق سالب لهذه الصفة ما عدا الهجين B6 وكانت درجة تفوقه موجبة خلال الموسمين. أعطت الهجن A2 ، B9 اعلي قيمة لصلابة الثمار أعطت جميع الهجن درجة تفوق سالب لهذه الصفة.