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Estimation of Heterosis and Heritability for Fruits Yield and Quality Characters in Squash (*Cucurbita Pepo* L.) at Two Sowing Dates under Greenhouse Conditions

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ABSTRACT

This study was carried out in the unheated plastic greenhouses at Qaha Research Farm, Horticultural Research Institute, Qalyubia Governorate, Egypt; to evaluate the performance of a new 21 F1 squash hybrids obtained from a half diallel crosses by using seven parents at two sowing dates inside different Egyptian greenhouse conditions. Meantime, to estimate heterosis and heritability for all studied characters under different planting time inside greenhouse condition. Significant heterosis values versus mid and better parent were detected and showed highly significance for most studied traits. The most desirable mid and better parent heterosis values were detected for the crosses,P1 × P4, P1 × P5, P2 × P5, P3 × P5, P4 × P5 and P5×P6 for all traits under different environments. Broad sense heritability was higher than their corresponding in narrow sense heritability for all traits. Results exhibited that the recorded magnitudes of heritability in broad sense ranged from 74.89 to 99.95% for fruit traits and 94.30 to 98.45% for yield characters at different sowing date, respectively. While heritability in narrow sense ranged from 0.15% to 9.80% for fruit traits and 2.74% to 10.77% for yield characters under all environments, respectively. From the previous results, it could be recommended to use that the new hybrids in genetic enhancement of winter squash programme under greenhouse conditions directing to increase yield and quality traits.

KEYWORDS: Squash, Planting time, Heterosis, Heritability

1. INTRODUCTION

Squash (*Cucurbita pepo* L.) is a highly significant vegetable crop belonging to the Cucurbitaceae family, which was included in the top 10 vegetable crops globally in 2022 (FAO, 2022). The plant is diploid with chromosome number (2n=40) and is cross-pollinated.

Depending on the classification scheme, there are about 800 species and 100 genera in the Cucurbitaceae family. While more sophisticated genotypic classifications identified more genera and fewer species, more conventional morphological classifications relate to fewer genera and more species. (Grum *et et al*., 2017; Rolnik and Olas, 2020).

In Egypt, in the season of 2021/2022, the number of greenhouses that cultivated squash reached 693greenhouses (304729 m^2), producing 1639 tons, with an average productivity ranging between 5.31 and 6.63 kg-/m^2, according to the statistics of the Ministry of Agriculture and Land Reclamation (Department of Agriculture Economics and Statistics, Ministry of Agriculture and land reclamation A.R.E. 2023). Several authors across the globe refer to C. *pepo* as one of the most important house hold vegetables, important in food security and grown under a wide variety of agro-climatic conditions (Darrudi *et al*., 2018; Swanepoel, 2021).

Landraces maintain a significant degree of diversity in fruit size, shape, and color, and there have been few attempts in crop improvement programs to take use of this variation (Mohsin *et al*., 2017). The Egyptian government plans to build 100,000 greenhouses by 2030, therefore, producing vegetable seeds and hybrids in Egypt for greenhouse cultivation is crucial. The nations that produce the greatest amount of cucurbits globally include the US, China, India, Iran, Turkey, and Egypt. Maynard (2001) reports that China is still the world's leading producer of the major cucurbits, with exports including watermelon, squash seeds, and fresh fruits.
Summer squash has extremely cheap costs associated with creating hybrid seeds when compared to other vegetable crops (Metwally, 1985).

Hybrid squash cultivars imported from elsewhere are very costly. Therefore, in order to save hard currency and save costs for farmers, it is imperative that local hybrid seeds be produced. According to Marie *et al.,* (2012), El-Adl *et al.*, (2014), Abd El-Hadi *et al.*, (2013), Hussien (2015), Hussien and Hamed (2015), Othman (2016) and Chaudhari *et al*., (2017), The hybrid squash market is expanding. Furthermore, hybrids have the potential to combine parental resistance to several illnesses. To produce the best hybrids or varieties with the required characteristics, such as: stem length, number of leaves, It seems that summer squash breeding is more intense than ever in terms of earliness and total output per plant. The total production is determined by the number of fruits produced per plant and the average fruit weight. These qualities would all lead to higher production.

The purpose of this study is to assess the performance of newly created 21 F_1 squash hybrids that were produced from half diallel crossings using seven parents at two distinct sowing dates under Egyptian greenhouse environments. In the interim, calculate the heritability and heterosis of each character under study for various planting times in a greenhouse.

2. MATERIALS AND METHODS

The present investigation was carried out in the unheated plastic greenhouses at Qaha Research Farm, Horticultural Research Institute, Qalyubia Governorate, Egypt; to evaluate the performance of new 21 F_1 squash hybrids obtained from a half diallel crosses by using seven parents at two sowing dates inside Egyptian greenhouse conditions. Meantime, to estimate heterosis and heritability for all studied characters under different planting time inside greenhouse condition. All hybrids and their parents with one commercial checks, cv. Marcilla F_1, were planted in two different planting time (25/10/2020 and 8/11/2020) inside two different greenhouse conditions.

2.1. Plant materials and experimental design:

Six advanced inbred lines of winter squash (*Cucurbita pepo* L.) were obtained from U.S National Plant Germplasm System (NPGS) of United States, Department of Agriculture and one (Eskandarani) was obtained from Agricultural Research Center (ARC), Egypt as listed in Table (1). Breeding program was used in half diallel mating design. During season 2019 the inbred lines of squash were planted by direct seed inside the greenhouse. During flowering stage, all possible crosses were performed in half diallel

Table 1. Names, source and origin of included lines

Study code	Genotype name	Source	Origin	Code in Gene Bank
P_1	10575	NPGS	USA	PI 182202
P_2	Black Magic	NPGS	USA	PI 599994
P_3	Eskandarani	ARC	EGYPT	-
P_4	Kabak	NPGS	USA	PI 167136
P_5	Dolmalik	NPGS	USA	PI 171622
P_6	Sakiz	NPGS	USA	PI 174183
P_7	Dolma	NPGS	USA	PI 175710

mating design. In addition, seeds of the seven inbred lines were taken by making self-pollination in each inbred line. After maturing stage of fruits, the seeds were extracted, washed and stored after drying to the next planting season. Twenty one (F1) straight hybrids were obtained after harvesting the matured fruits, according to Griffing's schema method of the half diallel cross mating design for the seven parents Table 2.

At the winter season of 2020, all hybrids and their parents with one commercial checks, cv. (Marcilla F1) were planted in two planting times (25/10/2020(T1) and 8/11/2020(T2)) to estimate the genetic parameters. Before sowing and after germination, all agricultural managements were done.

Table 2. Schema of the half diallel crosses mating design according to Griffing's schema method (II), model (I) for the seven parents.

Parents	P_1	P_2	P_3	P_4	P_5	P_6	P_7
P_1		P_1xP_2	P_1xP_3	P_1xP_4	P_1xP_5	P_1xP_6	P_1xP_7
P_2			P_2xP_3	P_2xP_4	P_2xP_5	P_2xP_6	P_2xP_7
P_3				P_3xP_4	P_3xP_5	P_3xP_6	P_3xP_7
P_4					P_4xP_5	P_4xP_6	P_4xP_7
P_5						P_5xP_6	P_5xP_7
P_6							P_6xP_7
P_7							

The experimental design was randomized complete block design with three replicates; each replicate consists of 10 plants from the same hybrid.

The cultivation took place in two different times in two different greenhouses with a total number of 87 repetitions in each greenhouse. The experiment unit was 5.0 m length, 1.2 m width and 0.50 m apart between plants, therefore the plot area was 18 m^2

2.2.Evaluated characters:

The following traits were calculated for each of the 29genotypes' individual plants:

Fruit characters:

a. Average fruit length (cm): This characteristic measured as the average fruit length in centimeters (cm) for randomly selected fruits that picked from the selected plants every picking by using a caliper.

b. Average fruit diameter (cm): This characteristic was expressed as the typical fruit diameter, expressed in centimeters (cm), taken at random from the chosen plants.

c. Average fruit weight (g): By dividing the entire yield per plant by the total number of fruits, this attribute was determined.

d. Total soluble solids (T.S.S. %): This character estimated by hand refractometer in the fruits juice as percentage (%), for fruits T.S.S content, according to Sharaf (2020).

e. Fruit chlorophyll content: Data were recorded on chlorophyll content in epicarp by using digital chlorophyll meter (model Minolta chlorophyll meter SPAD– 501). as SPAD unit according to Manje & Bagbee, (1992).

f. Total sugars (grams of glucose per kilogram of F.W.) were measured according to Lemoine *et al.*, (2010).

Yield and its attributed characters:

The picking for fruits was every alternative day, and data registered as follow:

a. Number of fruits per plant: Every picking during the picking season was recorded for the chosen plants' total amount of fruits per plant.

b. Fruit set (%): This attribute was determined by dividing the number of fruits produced by each plant by the total number of female flowers present at the time of harvest.

c. Total fruit yield per plant (kg): Total yield was calculated by recording fruit weight per plant in the selected plants during the picking period.

2.3. Statistical Analysis:

Heterosis:

The heterosis estimated against better parent (BP) and mid-parent (MP) according to Mather (1949); Mather and Jinkes (1982) as follow:

Better parent heterosis % = $\frac{F1-BP}{BP} \times 100$

Mid-parent heterosis % = $\frac{F1-MP}{MP} \times 100$

Where:

F_1 = mean value of the obtained hybrid.

M.P. = mean value of the two parents for that hybrid i.e. $(P_1 + P_2)/2$.

B.P. = mean value of better parent for that hybrid.

* L.S.D. calculated according to the test the significance of heterosis

Effects

L.S.D. of heterosis for better parent = $t.\sqrt{\frac{2MSE}{r}}$

L.S.D. of heterosis for mid-parent = $t.\sqrt{\frac{3MSE}{2r}}$

L.S.D. of increased % (against check) = $t.\sqrt{\frac{2MSE}{2r}}$

Where:

(t) = tabulated t value at a stated rate of probability for the experimental error degrees of freedom.

(r) = number of replications.

MSE = mean squares of the experiment.

Heritability:

Broad and narrow sense heritability were estimated according to the equation suggested by Gardner (1963) as follow:

Broad sense heritability (h^2_{bs}) = $\frac{2\sigma^2 gca+\sigma^2 sca}{2\sigma^2 gca+\sigma^2 sca+\sigma^2 e}\times 100$

Narrow sense heritability (h^2_{ns}) = $\frac{2\sigma^2 gca}{2\sigma^2 gca+\sigma^2 sca+\sigma^2 e}\times 100$

Where;

$2\sigma^2\, gca = \frac{2}{n+2}(M_g - M_s)$

$2\sigma^2\, gca = M_s - M_e$

$\sigma^2\, e = M_e$

Where:

M_g and M_s are mean squares for general and specific combining abilities, respectively.

M_e is the error mean square

3. RESULTS AND DISCUSSION

3.1. Mean performance of parents and crosses

3.1.1. Fruit traits

Results in Tables (3 and 4) and (5 and 6) showed that there is significant difference among genotypes for the mean performance of fruits characters. Where, the parent P_2 reflected the highest values, 15.47 and 15.70 cm for fruit length under two different environments. While, the parent P_5 showed the lowest values, 9.83 and 9.87 cm under two different environments under greenhouse conditions, (Table 3). In addition, the straight F_1 hybrid P_2 X P_7 showed the highest value, 15.80 and 15.67 cm for fruit length and the hybrid P_1 X P_2 gave the lowest values, 11.73 and 11.37 cm for fruit length character. While, the check hybrid, Marcilla recorded the values 12.77 and 13.07 cm for fruit length at first and second planting dates, respectively. (Table 5).

Table 3. Mean performance of fruit traits for the seven parents of squash planted under two planting time.

Parents	Fruit Length (cm)		Fruit Diameter (cm)		Fruit Weight (g)	
	T1	T2	T1	T2	T1	T2
P_1	14.83	15.2•	3.27	3.17	85.27	85.17
P_2	15.47	15.70	3.17	3.30	73.00	74.33
P_3	14.80	14.57	2.20	3.03	64.00	63.67
P_4	14.00	13.80	2.20	3.03	70.67	68.33
P_5	9.83	9.87	4.10	4.03	79.03	80.40
P_6	12.83	12.80	2.98	3.33	69.23	69.07
P_7	13.37	13.40	3.23	3.13	67.33	66.67
L.S.D. 5%	1.03	0.60	0.34	0.30	3.63	3.89
L.S.D. 1%	1.36	0.80	0.45	0.40	4.83	5.17

Table 4. Mean performance of fruit traits for the seven parents of squash planted under two planting time

Parents	Total soluble solids (T.S.S %)		Fruit Chlorophyll Content		Total sugars (% f.w.)	
	T1	T2	T1	T2	T1	T2
P_1	6.30	6.27	17.03	17.23	6.01	6.53
P_2	5.43	5.53	76.67	77.10	5.71	5.94
P_3	2.17	2.23	21.13	21.90	4.59	4.27
P_4	2.00	2.10	8.70	8.93	4.13	4.60
P_5	2.13	2.50	3.90	3.93	3.50	3.87
P_6	3.40	3.50	5.13	5.10	5.00	5.00
P_7	4.17	4.23	2.60	3.10	4.68	4.80
L.S.D. 5%	0.38	0.32	0.94	0.95	0.34	0.29
L.S.D. 1%	0.50	0.43	1.24	1.26	0.45	0.39

Concerning fruit diameter, results showed that the highest mean values (4.10 and 4.03 cm) were appeared in the parent P5 under two different environments, however, the two parents P3 and P4 gave the same lowest values, 2.20 and 3.03 cm under 1st and 2nd sowing dates under greenhouse conditions, respectively (Table 3). Relative to the straight hybrids; two hybrids, i.e., P4 x P6 and P5xP7 expressed the highest fruit diameter mean values, recording, 3.97 and 4.03 cm, under two different planting dates respectively, while, the lowest values (2.6 and 2.67 cm) were detected in the hybrid P2 X P3. Meanwhile, the check hybrid Marcilla recorded the values 3.23 cm and 3.1 cm for fruit diameter, under two different planting times, respectively (Table 5).

For fruit weight (g), the highest mean values, 85.27 and 85.17 g for this trait were appeared in the parent P1 and the lowest mean values, 64.00 and 63.67 g in the parent P3 at the first and second planting time, respectively (Table 3). Concerning straight hybrids, P5 X P6 and P6 X P7 recorded the highest mean values (99.27 and 98.27 g) under the two different sowing dates, respectively. While, the check variety, Marcilla gave 98.10 and 97.00 g for fruit weight under different sowing dates, respectively (Table 5).

Data for total soluble solids (T.S.S. %) character are presented in Tables (4 and 6). The highest and desirable mean values, 6.3 and 6.27% relative to the parental lines was showed in P1, however, the lowest values, 2.00 and 2.10% were detected in the parent P4 in T1 and T2 sowing dates under different greenhouse conditions, respectively (Table 4). For the straight hybrids, the highest value, 6.25 and 6.30% was in the hybrid P1 x P5 under tow different planting date. On the contrary, two hybrids P2 x P6 and P4 xP6 showed the same lowest value, 1.40 and 1.33%. While the check variety, Marcilla recorded the values 2.30 and 2.40% for fruit weight under two

Table 5. Mean performance of fruit traits for the 21 F1 hybrids and check hybrid

Crosses	Fruit Length (cm)		Fruit Diameter (cm)		Fruit Weight (g)	
	T1	T2	T1	T2	T1	T2
P_1 x P_2	11.73	11.37	2.83	2.93	54.33	55.97
P_1 x P_3	13.30	13.37	2.90	2.93	63.07	63.73
P_1 x P_4	14.50	14.40	3.23	3.23	83.93	85.43
P_1 x P_5	11.87	11.97	3.07	3.30	53.30	49.93
P_1 x P_6	13.37	12.90	3.17	3.20	63.10	64.43
P_1 x P_7	14.00	14.17	3.00	2.93	72.43	75.10
P_2 x P_3	14.67	14.77	2.60	2.67	67.83	65.43
P_2 x P_4	12.33	12.10	3.07	3.07	79.00	75.00
P_2 x P_5	12.77	12.97	3.37	3.23	76.83	72.43
P_2 x P_6	14.53	14.17	3.03	3.03	91.63	92.67
P_2 x P_7	15.80	15.67	3.43	3.43	92.9٥	94.47
P_3 x P_4	12.03	12.03	2.77	2.83	57.53	60.33
P_3 x P_5	14.80	14.90	3.23	3.03	86.33	85.33
P_3 x P_6	12.50	12.37	2.77	3.50	87.33	84.67
P_3 x P_7	15.47	15.53	2.80	2.93	92.67	88.77
P_4 x P_5	15.10	14.90	3.10	3.00	79.33	80.33
P_4 x P_6	12.70	12.77	3.97	4.03	86.23	87.67
P_4 x P_7	12.97	13.03	3.10	3.30	71.93	72.63
P_5 x P_6	15.57	14.57	3.33	3.67	99.27	98.27
P_5 x P_7	15.20	15.07	3.97	4.03	95.33	93.67
P_6 x P_7	13.27	13.03	3.40	3.20	99.27	98.27
Control	12.77	13.07	3.23	3.10	98.10	97.00
L.S.D. 5%	1.03	0.60	0.34	0.30	3.63	3.89
L.S.D. 1%	1.36	0.80	0.45	0.40	4.83	5.17

different planting dates inside different greenhouse conditions, respectively (Table 6).

Regarding fruit chlorophyll content, the parental line (P_2) expressed the best mean values for this trait recording, 76.67 and 77.10 at early and late sowing dates. Moreover, the lowest mean values were detected in the line P7 recording 2.60 and 3.10 under the two environments inside greenhouse conditions (Table 4). Moreover, desirable mean values (high chlorophyll content) were detected by the crosses P_2 x P_5 and P_2 x P_3 at first and second sowing dates, respectively. On the other hand, the cross P_5 x P_6 expressed the lowest mean values for this character at early and late planting dates. While the check variety, Marcilla recorded the values 5.90 and 5.93 for fruit chlorophyll content under two planting dates inside greenhouse conditions, respectively (Table 6).

For total sugars (%), the parent (P_1) expressed the highest mean values for this character under early and late planting dates under greenhouse conditions, while parent (P_5) had the lowest mean values for this trait under first and second sowing dates (Table 4). The cross P_1 x P_5 exhibited the highest mean values for this trait as compared to other studied crosses under early and late sowing dates. Whereas, the lowest values for this character were detected for the cross P_2 x P_4 under T_1 and T_2 sowing dates under greenhouse conditions. While the check Marcilla recorded the values 3.60 and 4.00 for total sugars (%) under two different sowing dates inside greenhouse conditions, respectively (Table 6). These reported results were agreed with Hikal and Abdein (2018), Gad-Allah (2019), El-Shoura and Diab (2022) and Ayman and Al-Zubaae (2023).

Table 6. Mean performance of Fruit traits for the 21 F1 hybrids.

Crosses	Total soluble solids (T.S.S %)		Fruit Chlorophyll Content		Total sugars (% f.w.)	
	T1	T2	T1	T2	T1	T2
P_1 x P_2	2.27	2.17	25.13	25.57	4.64	4.60
P_1 x P_3	1.73	1.90	29.40	29.57	3.91	4.07
P_1 x P_4	2.40	2.40	10.80	10.87	4.78	4.88
P_1 x P_5	6.25	6.30	14.27	14.23	6.23	6.82
P_1 x P_6	5.73	5.67	10.70	10.83	5.83	6.24
P_1 x P_7	2.90	2.67	7.50	8.00	4.51	4.79
P_2 x P_3	2.03	2.00	52.13	52.30	4.10	4.56
P_2 x P_4	1.30	1.27	34.83	34.67	3.37	3.50
P_2 x P_5	1.87	1.93	90.03	89.80	4.37	4.82
P_2 x P_6	1.40	1.33	10.30	10.37	4.27	4.65
P_2 x P_7	1.87	1.87	5.23	5.30	3.37	3.63
P_3 x P_4	2.17	2.20	7.83	8.20	4.48	4.76
P_3 x P_5	2.17	2.10	9.63	11.63	3.90	4.07
P_3 x P_6	1.80	1.87	18.20	18.33	3.67	4.34
P_3 x P_7	1.87	1.93	13.47	14.00	4.07	4.22
P_4 x P_5	2.00	2.00	12.50	12.70	4.70	4.67
P_4 x P_6	1.40	1.33	5.10	4.70	3.57	4.13
P_4 x P_7	3.03	3.17	7.53	7.83	4.33	4.70
P_5 x P_6	2.27	2.30	4.50	4.73	4.10	4.40
P_5 x P_7	2.20	2.10	4.93	5.03	4.27	4.55
P_6 x P_7	2.30	2.33	8.40	8.30	3.73	4.07
Control	2.30	2.40	5.90	5.93	3.60	4.00
L.S.D. 5%	0.38	0.32	0.94	0.95	0.34	0.29
L.S.D. 1%	0.50	0.43	1.24	1.26	0.45	0.39

3.1.2. Total yield per plant and its component:

Results in Tables (7) and (8) indicated that there are significant differences among studied genotypes in the trait number of fruits per plant. Where, the mean performance of parental lines showed that the parent (P_3) gave the highest number, recording 61.67 and 67.33 of fruits per plant, while the lowest values, 16.00 and 20.33 were in the parent (P_4) at first and second sowing dates (Table 7). Regarding to the F_1 straight hybrids, the cross P_3 X P_7 gave the highest mean values, 85.33 and 91.00 of fruits per plant, while the hybrid P_1 x P_3 showed the lowest number of fruits per plant (23.33 and 26.00) under the two environments. Moreover, the check hybrid, Marcilla recorded the values 62.00 and 68.67 fruits per plant under 1st and 2nd sowing dates in greenhouse conditions, respectively.

Results for the percentage of fruit set in Tables (7 and 8) showed that the parent P۳ gave the highest values, 93.43 and 92.60 %, however, the lowest values, 70.23 and 68.57 % were estimated in the parent line P_7 (Table 7). Regarding to hybrids, the straight hybrid P_5 x P_6 showed the highest mean values, recording 99.03 and 98.13 % under the two environments, followed by the crosses, P_3 X P_5 and P_3 x P_7 at first and second sowing dates. Meanwhile, the check hybrid Marcilla gave moderate values (83.51 and 86.22 %) under two studied environments, respectively (Table 8).

Table 7. Mean performance of yield and its component traits for the seven parents of squash planted under two planting time.

Parents	Number of fruits per plant		Fruit set (%)		Total fruit yield per plant (kg)	
	T_1	T_1	T_2	T_1	T_2	T2
P_1	17.33	21.67	75.10	83.27	1.28	1.84
P_2	53.33	56.67	87.40	89.00	3.90	4.21
P_3	61.67	67.33	93.43	92.60	3.95	4.29
P_4	16.00	20.33	78.53	81.27	1.10	1.39
P_5	57.00	59.67	81.80	82.47	4.50	4.80
P_6	57.67	66.33	82.73	85.80	3.99	4.58
P_7	59.00	65.33	70.23	68.57	3.97	4.36
L.S.D. 5%	5.19	4.37	4.47	2.78	0.45	0.43
L.S.D. 1%	6.91	5.81	5.95	3.69	0.60	0.58

Table 8. Mean performance of Yield and its component traits for the 21 F1 hybrids

Crosses	Number of fruits per plant		Fruit set (%)		Total fruit yield per plant (kg)	
	T_1	T_2	T_1	T_2	T_1	T_2
P_1 x P_2	35.00	37.67	80.73	79.57	1.87	2.11
P_1 x P_3	23.33	26.00	67.23	69.63	1.30	1.60
P_1 x P_4	37.33	48.33	80.23	86.30	3.14	4.13
P_1 x P_5	25.33	34.67	69.50	78.90	1.36	1.83
P_1 x P_6	33.67	33.67	77.77	74.27	2.13	2.18
P_1 x P_7	28.67	36.67	75.27	80.33	2.07	2.75
P_2 x P_3	46.67	53.67	85.87	90.00	3.42	3.51
P_2 x P_4	43.00	53.33	85.37	88.43	3.40	3.99
P_2 x P_5	49.00	53.00	82.07	85.00	3.76	3.85
P_2 x P_6	43.00	51.00	83.77	89.47	3.94	4.73
P_2 x P_7	57.00	61.67	88.07	92.07	5.27	5.82
P_3 x P_4	27.67	36.33	74.57	80.77	1.59	2.19
P_3 x P_5	84.00	87.67	98.83	98.٩٠	7.26	7.49
P_3 x P_6	45.33	51.33	87.70	91.73	3.96	4.33
P_3 x P_7	85.33	91.00	98.83	98.90	7.91	8.08
P_4 x P_5	51.00	53.67	92.13	89.97	4.04	4.31
P_4 x P_6	52.33	62.00	90.73	93.47	4.52	5.44
P_4 x P_7	45.00	54.67	80.57	90.63	3.23	3.97
P_5 x P_6	67.33	72.00	99.03	98.13	6.68	7.07
P_5 x P_7	55.33	63.33	84.70	85.60	5.27	5.93
P_6 x P_7	53.67	63.33	86.10	89.90	5.22	6.15
Control	62.00	68.67	83.51	86.22	3.73	4.18
L.S.D. 5%	5.19	4.37	4.47	2.78	0.45	0.43
L.S.D. 1%	6.91	5.81	5.95	3.69	0.60	0.58

Results relative to total fruit yield per plant cleared that the parent P5 gave the highest yield 4.5 and 4.80 kg at the first and second planting dates, respectively. Whereas, the parent P_4 gave the lowest yield/plant (1.11 and 1.39kg) under the two environments (Table 7). For the crosses, the highest mean values, 7.91 and 8.08 kg estimated in the straight hybrid P_3 X P_7 followed by the cross P_5 x P_6 with significant differences between them, however, the hybrid P_1 x P_3 showed the lowest yield per plant (1.30 and 1.60 kg) at first and second sowing dates, respectively. Meanwhile, the check cultivar Marcilla showed the values 3.73 and 4.18 kg per plant under first and second dates inside different greenhouse conditions, respectively (Table 8). The previous data were in agreement with Abdein (2016), Abdein *et al.*, (2017), El-Shoura and Abed (2018), Hikal and Abdein (2018), Marxmathi *et al* (2018a), Gad-Allah (2019) and El-Shoura and Diab (2022) who found significant differences among studied genotypes for these trait.

3.2. Heterosis

3.2.1. Fruit characters

Results in Tables (9 and 10) show the estimation of heterosis compared with mid-parent and better parent at two sowing dates inside greenhouse conditions.

Results indicated that high significant positive heterosis compared to mid and better parents were appeared in the two straight hybrids, P_5 x P_6 (37.35 and 28.53%) and (21.3 and 13.8%) and P_5 X P_7 (31.03, 29.51%) and (13.72, 12.44%), at both planting time, respectively, suggesting degrees of dominance and over dominance toward parent which have long fruits, While, some other hybrids showed different levels of significant or high significant negative heterosis and the rest of hybrids did not show any significant heterotic effect.

Regarding fruit diameter, nine and ten crosses expressed desirable positive and significant mid-parent heterosis under first and second sowing dates, respectively (Table 9). However, the best mid-parent heterosis were detected for the cross, P_4 x P_6 (42.68**, 25.58**) at early and late sowing data, respectively. Whereas, one hybrid P_1 X P_7 (26.83** and 27.27**) had desirable positive and significant better-parent heterosis under two different environments, respectively (Table 10). Results in Tables (9 and 10) showed that different heterotic effect was observed for fruit weight character compared to mid and better parents, where the highest significant positive heterosis appeared in the straight hybrid P_6 x P_7 recording (42.25, 43.03%) relative to mid-parent and (40.33, 40.54%) relative to better-parent in the first and second planting dates, respectively, suggesting degrees of dominance and over dominance toward the parent which produce high fruit weight. Only twelve hybrids showed significant or highly significant positive heterosis compared to mid-parent under 2 sowing date. On the contrary, ten and nine hybrids showed significant or high significant positive heterosis compared to better parent under 2 different environments. While, the rest hybrids did not show any significant heterotic effect. Results presented in Tables (11 and 12) showed that different heterotic effect was observed for the trait total soluble solids compared to mid and better parents, where the highest significant positive heterosis appeared in the straight hybrid P_1 x P_5 recording (49.6, 49%) relative to mid-parent, respectively, and P_2 x P_4 (76.07, 77.11%) relative to better-parent, at both different planting time, respectively. Four and three hybrids expressed significant or highly significant positive heterosis compared to mid-parent under two different sowing dates. On the contrary, only one hybrid compared to better parent exhibited highly positive significant heterosis under two different environments. While, the rest of hybrids did not show any significant heterotic effect.

Results in Tables (11 and 12) for fruit chlorophyll content character showed that two straight hybrids recorded the highest significant positive heterosis compared to mid and better parents P_2 x P_5 recording (123.5, 121.64%) relative to MP and (43.68, 42.16%) relative to BP and P_6 x P_7 recording (117.24, 102.44%) relative to MP and (63.64, 62.75%) relative to B.p, under 1st and 2nd sowing dates in different greenhouse conditions, respectively. While, the other hybrids showed different levels of significant or high significant negative heterosis and the rest of hybrids did not show any significant difference.

Results in Tables (11 and 12) for total sugars character compared to mid and better parent presented that two hybrids gave the highest significant positive heterosis under two different environments *viz.*, P_1 x P_5 (31.14, 31.09 %) and (3.77, 4.34%) and P_4 x P_5 (23.14, 10.24%) and (13.71, 7.45%) at early and late planting time, respectively. In addition, other hybrids expressed significant or highly significant negative heterosis values under all environments.

Table 9. Estimation of heterosis and increased percentage of F1 hybrids relative to Mid-parents for fruit traits in squash plants.

Crosses	Fruit Length (cm)		Fruit Diameter (cm)		Fruit Weight (g)	
	T1	T2	T1	T2	T1	T2
P_1 x P_2	-22.55**	-23.28**	-11.92**	-9.28*	-31.34**	-29.82**
P_1 x P_3	-10.24**	-10.29**	-6.45*	-5.38*	-15.5**	-14.36**
P_1 x P_4	0.58	-0.8*	18.29**	10.23*	7.65**	11.31**
P_1 x P_5	-3.78*	-9.43**	-16.74**	-8.33*	-35.12**	-39.68**
P_1 x P_6	-3.37*	-7.97**	2.15*	3.23*	-18.32**	-16.45**
P_1 x P_7	-0.71	-1.05*	-7.69*	-6.88*	-5.07**	-1.08
P_2 x P_3	-3.08*	-2.42 *	-11.48**	-15.79**	-0.97	-5.17
P_2 x P_4	-16.29**	-17.97**	14.29**	2.22*	9.98**	5.14
P_2 x P_5	0.92	1.43*	-7.34*	-11.82**	1.07	-6.38**
P_2 x P_6	2.71*	-0.58	-0.55*	-4.21*	28.85**	29.24**
P_2 x P_7	9.6**	7.67**	7.29*	6.74*	32.45**	34**
P_3 x P_4	-16.44**	-15.16**	7.79*	-1.16*	-14.55**	-8.59**
P_3 x P_5	20.16**	21.96**	-8.06*	-14.15**	20.72**	18.46**
P_3 x P_6	-9.53**	-9.62**	-5.68*	15.38**	31.1**	27.57**
P_3 x P_7	9.82**	11.08**	-9.19*	-4.86*	41.12**	36.21**
P_4 x P_5	26.71**	25.92**	-1.59*	-10.89**	5.99**	8.02**
P_4 x P_6	-5.34*	-4.01*	42.86**	25.58**	23.28**	27.61**
P_4 x P_7	-5.24*	-4.17*	14.11**	13.14**	4.25	7.6**
P_5 x P_6	37.35**	28.53**	-5.21*	3.77*	33.9**	31.49**
P_5 x P_7	31.03**	29.51**	8.18*	12.56**	30.27**	27.38**
P_6 x P_7	1.27	-0.51	10.27*	3.78*	42.25**	43.03**

Where, * and ** significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table 10. Estimation of heterosis and increased percentage of F1 hybrids relative to Mid-parents for fruit traits in squash plants.

Crosses	Total soluble solids (T.S.S %)		Fruit Chlorophyll Content		Total sugars (% f.w.)	
	T1	T2	T1	T2	T1	T2
P_1 x P_2	-61.36**	-63.28**	-46.35**	-45.8**	-20.74**	-26.32**
P_1 x P_3	-59.06**	-55.29**	54.06**	51.11**	-26.29**	-24.63**
P_1 x P_4	-42.17**	-42.63**	-16.06**	-16.94**	-5.79*	-12.28**
P_1 x P_5	49.6**	49**	36.31**	34.49**	31.14**	31.09**
P_1 x P_6	18.21**	16.04**	-3.46*	-2.99 *	6.3*	8.15**
P_1 x P_7	-44.59**	-49.21**	-23.6**	-21.31**	-15.6**	-15.41**
P_2 x P_3	-46.49**	-48.5**	6.61**	5.66**	-20.48**	-10.61**
P_2 x P_4	-65.02**	-66.81**	-18.39**	-19.41**	-31.46**	-29.81**
P_2 x P_5	-50**	-49.34**	123.5**	121.64**	-5.18 *	-1.66*
P_2 x P_6	-58.49**	-57.93**	-74.82**	-74.78**	-20.32**	-14.96**
P_2 x P_7	-61.11**	-61.77**	-86.8**	-86.78**	-35.19**	-32.36**
P_3 x P_4	4.3*	1.54*	-47.49**	-46.81**	2.6*	7.37**
P_3 x P_5	3.17*	-3.08*	-23.04**	-9.94**	-3.62*	-2.1*
P_3 x P_6	-35.33**	-34.88**	38.58**	35.8**	-23.56**	-6.33**
P_3 x P_7	-41.05**	-40.21**	13.48**	12**	-12.29**	-6.84**
P_4 x P_5	-0.83*	-4.76*	98.41**	97.41**	23.14**	10.24**
P_4 x P_6	-48.15**	-52.38**	-26.27**	-33.02**	-21.9**	-13.89**
P_4 x P_7	-1.62*	0.60	33.33**	30.19**	-1.66*	-1.2*
P_5 x P_6	-16.56**	-17.86**	-0.37	4.8*	-3.53*	-0.75*
P_5 x P_7	-29.03**	-33.68**	51.79**	43.13**	4.32*	5.08*
P_6 x P_7	-39.21**	-39.66**	117.24**	102.44**	-22.87**	-17.01**

Where, * and ** significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table 11. Estimation of heterosis and increased percentage of F1 hybrids relative to Better-parents for fruit traits in squash plants.

Crosses	Fruit Length (cm)		Fruit Diameter (cm)		Fruit Weight (g)	
	T1	T2	T1	T2	T1	T2
P_1 x P_2	-24.14**	-24.42**	-13.27*	-11.11*	-36.28**	-34.29**
P_1 x P_3	-14.01**	-14.86**	-11.22*	-11.11*	-26.04**	-25.17**
P_1 x P_4	-6.25	-8.28**	-1.02	-2.02	-1.56	0.31
P_1 x P_5	-23.28**	-27.6**	-25.2**	-18.18**	-37.49**	-41.37**
P_1 x P_6	-13.58**	-17.83**	-22.76**	-20.66**	-26**	-24.34**
P_1 x P_7	-9.48	-9.77**	26.83**	27.27**	-15.05**	-11.82**
P_2 x P_3	-5.17	-5.94**	-14.74**	-19.19**	-7.08**	-11.97**
P_2 x P_4	-20.26**	-22.93**	-3.16	-7.07	8.22**	0.9
P_2 x P_5	-17.46**	-17.41**	-17.89**	-19.83**	-2.78	-9.91**
P_2 x P_6	-6.03	-9.77**	-26.02**	-24.79**	15.94**	15.26**
P_2 x P_7	2.16	-0.21	-16.26**	-14.88**	17.59**	17.5**
P_3 x P_4	-18.69**	-17.39**	-5.68	-6.59	-18.58**	-11.71**
P_3 x P_5	1.6	2.29	-21.14**	-24.79**	9.24**	6.14*
P_3 x P_6	-15.54**	-15.1**	-32.52**	-13.22**	10.5**	5.31**
P_3 x P_7	4.5	6.64**	-31.71**	-27.27**	17.25**	10.41**
P_4 x P_5	7.86*	7.97**	-24.39**	-25.62**	0.38	-0.08
P_4 x P_6	-9.29*	-7.49**	-10.57**	-10.74**	9.11**	9.04**
P_4 x P_7	-7.38*	-5.56*	-24.39**	-18.18**	-8.98	-9.66*
P_5 x P_6	21.3**	13.8**	-18.7**	-9.09*	25.6**	22.22**
P_5 x P_7	13.72**	12.44**	-3.25	-2.51	20.62**	16.5**
P_6 x P_7	-0.75	-2.74	5.15	2.13	40.33**	40.54**

Where, * and ** significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table 12. Estimation of heterosis and increased percentage of F1 hybrids relative to Better-parents for fruit traits in squash plants.

Crosses	Total soluble solids (T.S.S %)		Fruit Chlorophyll Content		Total sugars (% f.w.)	
	T1	T2	T1	T2	T1	T2
P_1 x P_2	-64.02**	-65.43**	-67.22**	-66.84**	-22.7**	-29.64**
P_1 x P_3	-72.49**	-69.68**	-61.65**	-61.65**	-34.96**	-37.7**
P_1 x P_4	-61.9**	-61.7**	-85.91**	-85.91**	-20.48**	-25.26**
P_1 x P_5	-1.06	-0.53	-81.39**	-81.54**	3.77*	4.34*
P_1 x P_6	-8.99**	-9.57**	-86.04**	-85.95**	-2.89	-4.54*
P_1 x P_7	-53.97**	-57.45**	-90.22**	-89.62**	-24.92**	-26.63**
P_2 x P_3	-62.58**	-63.86**	-32**	-32.17**	-28.25**	-23.22**
P_2 x P_4	76.07**	77.11**	-54.57**	-55.04**	-40.92**	-37.75**
P_2 x P_5	-65.64**	-65.06**	43.68**	42.16**	-23.53**	-18.84**
P_2 x P_6	-66.26**	-65.66**	-86.57**	-86.55**	-25.28**	-21.7**
P_2 x P_7	-65.64**	-66.27**	-93.17**	-93.13**	-41.04**	-38.87**
P_3 x P_4	1.1	-1.49	-62.93**	-62.56**	-2.54	3.48
P_3 x P_5	-2.1	-5.97	-54.42**	-46.88**	-15.09**	-11.59**
P_3 x P_6	-47.06**	-46.67**	-13.88**	-16.29**	-26.67**	-13.2**
P_3 x P_7	-55.2**	-54.33**	-36.28**	-36.07**	-18.67**	-15.53**
P_4 x P_5	-1.64	-4.76	17.68**	16.47**	13.71**	7.45**
P_4 x P_6	-58.82**	-61.9**	-41.38**	-47.39**	-28.67**	-17.33**
P_4 x P_7	-27.2**	-25.2**	-13.41*	-12.31*	-13.33*	-6.6*
P_5 x P_6	-33.33**	-34.29**	-12.34	-7.19	-18**	-12**
P_5 x P_7	-47.2**	-50.39**	-3.9*	-1.31*	-14.67*	-8.93**
P_6 x P_7	**-44.8****	**-44.88****	**63.64****	**62.75****	**-25.33****	**-18.67****

Where, * and ** significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

3.2.2. Fruit yield and its attributed characters

Heterosis percentage relative to both mid-parent and better-parent for yield and its attributed traits at first and second planting dates are presented in Tables (13 and 14).

For mid parent heterosis for the trait number of fruits/plant, most of the values were positive and highly significant, where the highest significant positive heterosis were in the straight hybrids, P_1 x P_4 (117.48 and 130.16%) and P_4 x P_6 (41.57 and 43.08%) at both sowing dates, respectively. For better parent heterosis, three hybrids recorded highest significant positive heterosis, *viz.*, P_3 x P_5 (36.22 and 30.2%), P_3 x P_7 (38.38 and 35.15%) and P_5 x P_6 (16.76 and 8.54%) under two different sowing dates under greenhouse conditions. On the contrary, fourteen hybrids showed significant or highly significant negative heterosis, meanwhile, the rest hybrids did not show any significant heterotic effect.

Results in Table (13) for fruit set percentage character compared to mid- parent showed that eight and ten straight hybrids indicated high significant positive heterosis *viz.*, P_3 x P_7 and P_5 x P_6 under two different environments, respectively. Moreover, five and ten hybrids registered high significant positive heterosis against better parents *viz.*, P_4 x P_5 and P_5 x P_6 at early and late planting time, respectively. For mid and better parents, most of values were negative under two sowing dates, the highest significant negative values compared to mid and better parents were estimated in the hybrid P_1 x P_3 at first and second planting dates, respectively. Also, Most of hybrids showed different significant values. On the contrary, some of hybrids did not show any significant heterotic effect (Tables 13 and 14).

Table 13. Estimation of heterosis and increased percentage of F1 hybrids relative to Mid-parents for yield and its component traits in squash plants.

Crosses	Number of fruits per plant		Fruit set (%)		Total fruit yield per plant (kg)	
	T1	T2	T1	T2	T1	T2
P_1 x P_2	-0.94	-3.83	-0.64	-7.62**	-27.88*	-30.29**
P_1 x P_3	-40.93**	-39.33**	-20.21**	-20.81**	-43.75**	-43.88**
P_1 x P_4	117.48**	130.16**	4.45	4.90	152.89**	155.73**
P_1 x P_5	-31.84**	-14.75**	-11.41**	-4.79	-52.97**	-44.95**
P_1 x P_6	-10.22 *	-23.48**	-1.46	-12.15**	-19.29	-32.19**
P_1 x P_7	-24.89**	-15.71**	3.58	5.82*	-21.19	-11.14
P_2 x P_3	-18.84**	-13.44**	-5.03	-0.88	-12.71	-17.37*
P_2 x P_4	22.27**	38.53**	2.89	3.88	33.20**	42.53**
P_2 x P_5	-11.18**	-8.88**	-2.99	-0.86	-10.56	-14.61*
P_2 x P_6	-22.52**	-17.07**	-1.53	2.36	-0.08	7.58
P_2 x P_7	1.48	1.09	11.74**	16.86**	33.84**	35.90**
P_3 x P_4	-29.66**	-17.11**	-13.28**	-7.09**	-38.12**	-22.89*
P_3 x P_5	40.57**	38.06**	12.80**	12.15**	71.83**	64.93**
P_3 x P_6	-24.02**	-23.19**	-0.44	2.84	-0.21	-2.44
P_3 x P_7	41.44**	37.19**	20.77**	22.73**	99.83**	86.89**
P_4 x P_5	37.84**	34.17**	14.93**	9.89**	41.71**	39.22**
P_4 x P_6	41.57**	43.08**	12.53**	11.89**	73.94**	82.13**
P_4 x P_7	18.42**	27.63**	8.31	20.98**	24.79**	38.17**
P_5 x P_6	17.44**	14.29**	20.38**	16.64**	57.38**	50.73**
P_5 x P_7	-4.6	1.33	11.42**	13.35**	24.42**	29.57**
P_6 x P_7	-8.2*	-3.8	12.57**	16.47**	31.01**	37.56**

Where, * and ** significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table 14. Estimation of heterosis and increased percentage of F1 hybrids relative to Better-parents for yield and its component traits in squash plants.

Crosses	Number of fruits per plant		Fruit set (%)		Total fruit yield per plant (kg)	
	T1	T2	T1	T2	T1	T2
P_1 x P_2	-34.38**	-33.53**	-7.63**	-10.60**	-52.10**	-49.92**
P_1 x P_3	-62.16**	-59.9**	-28.04**	-24.80**	-62.75**	-59.91**
P_1 x P_4	-39.46**	-28.22**	2.16	3.64*	145.31**	124.46**
P_1 x P_5	-58.92**	-48.51**	-15.04**	-5.24**	-69.80**	-61.92**
P_1 x P_6	-45.41**	-50**	-6.00*	-13.44**	-46.70**	-52.47**
P_1 x P_7	-53.51**	-45.54**	0.22	-3.52*	-47.90**	-36.80**
P_2 x P_3	-24.32**	-20.3**	-8.10**	-2.81	-13.26*	-18.10**
P_2 x P_4	-30.27**	-20.79	-2.33	-0.64	-9.83	-5.22
P_2 x P_5	-20.54**	-21.29**	-6.10*	-4.49**	-16.58**	-19.81**
P_2 x P_6	-30.27**	-24.26**	-4.16	0.52	-1.25	3.28
P_2 x P_7	-7.57	-8.42	0.76	3.45*	32.55**	33.66**
P_3 x P_4	-55.14**	-46.04**	-20.19**	-12.78**	-59.63**	-48.95**
P_3 x P_5	36.22**	30.2**	5.78*	6.01**	61.21**	56.22**
P_3 x P_6	-26.49**	-23.76**	-6.14*	-0.94	-0.75	-5.53
P_3 x P_7	38.38**	35.15**	5.78*	6.80**	99.16**	85.46**
P_4 x P_5	-10.53*	-10.06**	12.63**	9.09**	-10.21*	-10.22*
P_4 x P_6	-8.25	-6.53	9.67**	8.94**	13.20*	18.70**
P_4 x P_7	-23.73**	-17.59**	2.59	11.53**	-18.71**	-8.88
P_5 x P_6	16.76**	8.54**	19.70**	14.37**	48.41**	47.32**
P_5 x P_7	-6.21	-4.52	3.55	4.80**	17.10**	23.63**
P_6 x P_7	-8.04	-4.52	3.07	4.78**	30.74**	34.21**

Where, * and ** significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Results in Table (13) for total yield/plant character compared to mid-parent showed that eleven hybrids gave highly significant positive heterosis under two different environments, viz., P1 x P4 (152.89 and 155.73%) and P3 x P7 (99.83 and 86.89%) at first and second planting time, suggesting high degrees of dominance toward the high yielding parent. On the contrary, some other hybrids showed different levels of significant or high significant negative heterosis and the rest of hybrids did not show any significant heterotic effect. These results were in harmony with Tamiselvi et al., (2015), Hikal and Abdein (2018), Marxmathi et al., (2018a), El-Shoura and Abed (2018), Gad Allah (2019), El-Shoura and Diab (2022) and Ayman and Al-Zubaae (2023). For better parent heterosis, eight hybrids gave highly significant positive heterosis under 2 different greenhouse conditions with 2 sowing dates, viz., P1 x P4 (145.31 and 124.46%) and P3 X P7 (99.16 and 85.46%) suggesting degrees of over dominance toward the high parent. While, ten and nine hybrids gave significant or highly significant negative heterosis values under all environments, respectively. In addition, the rest of hybrids did not show any significant heterotic effect (Table 14). These results were in harmony with Mohamed (2016), Abdein et al., (2017), Hikal and Abdein (2018), Marxmathi et al., (2018a), El-Shoura and Abed (2018), Gad-Allah (2019) and El- Shoura and Diab (2022) who estimated positive heterosis for mid and better parent in studied characters.

3.3.Heritability

Data showing the values of broad and narrow sense heritability for all studied characters at early and late planting dates are presented in Fig. (1) and (2).

For fruit traits values of heritability in broad sense were noticed in fruit length (88.70 and 93.70%), fruit weight (97.22 and 96.76%), total

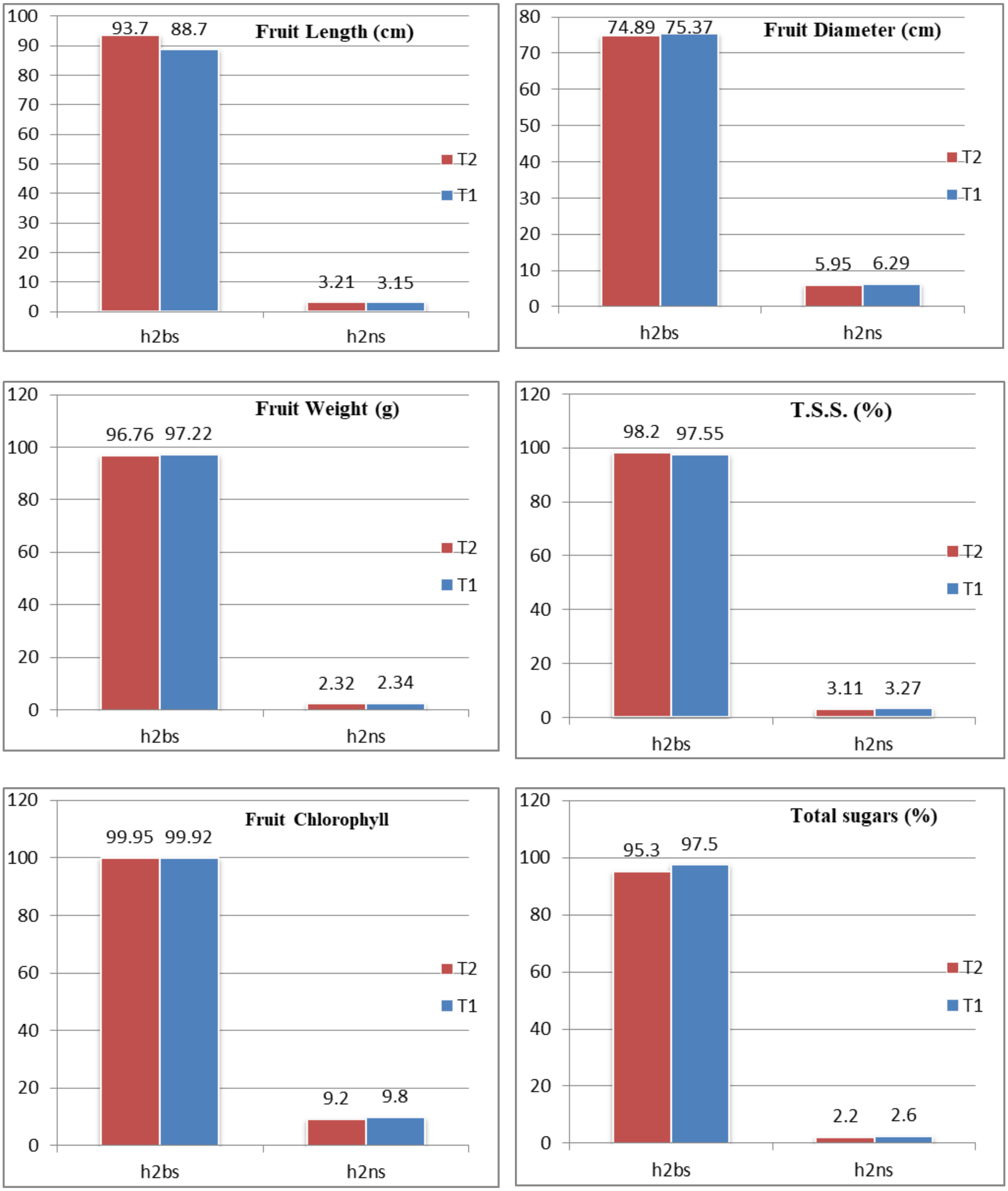
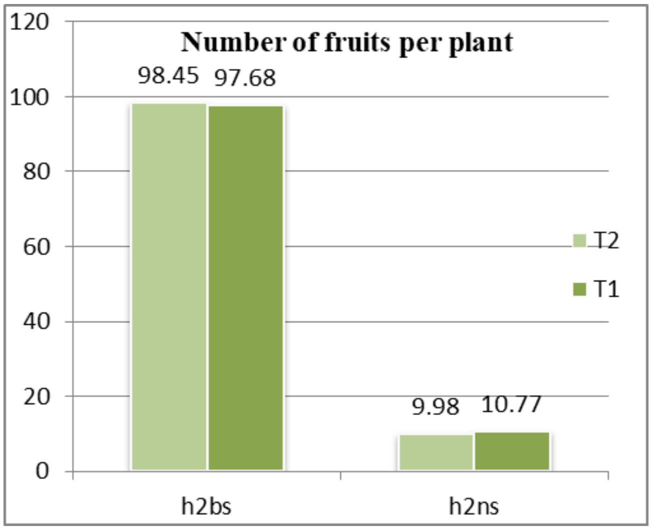
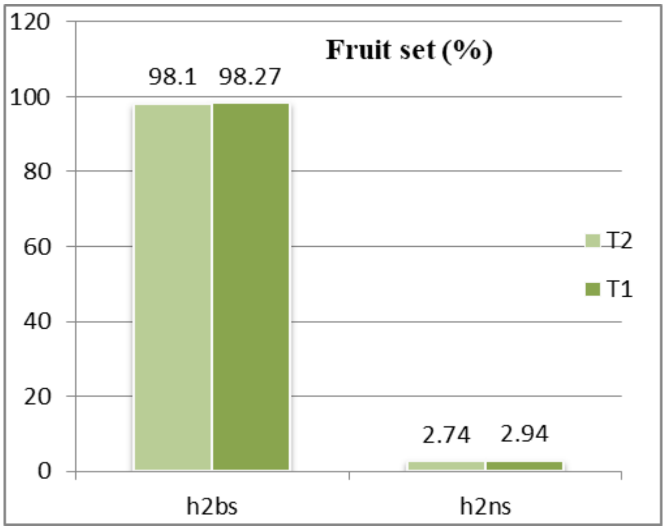


Figure 1. Estimation of heritability in broad and narrow sense for fruit traits of squash plant at two different sowing date inside greenhouse conditions.





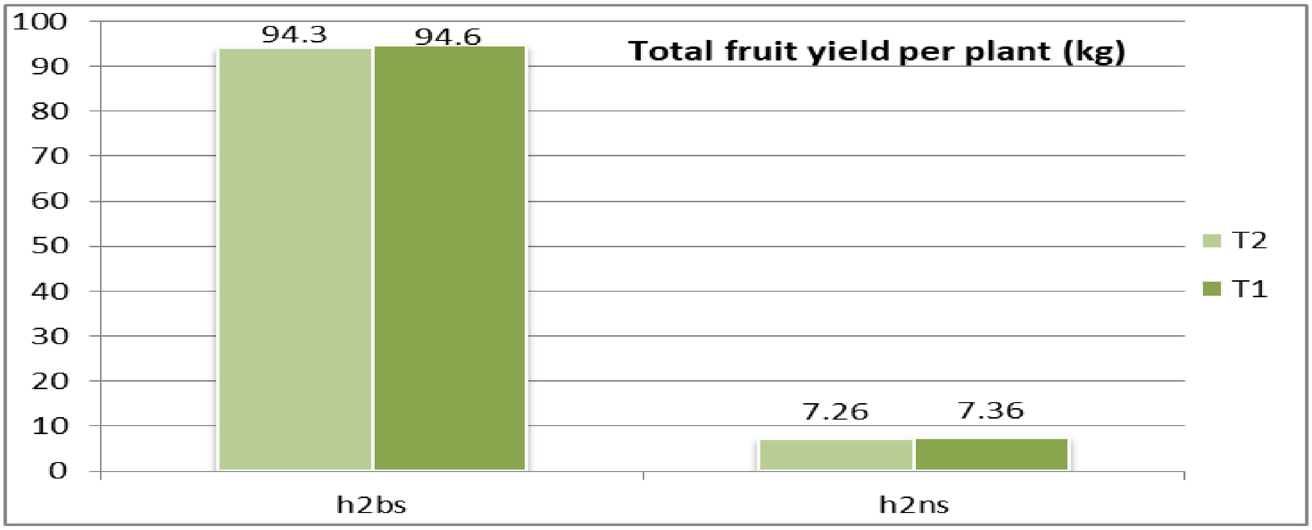


Figure 2. Estimation of heritability in broad and narrow sense for fruit yield and its attributed traits of squash plant at two sowing date inside greenhouse conditions.

soluble solids (97.55 and 98.20%), fruit chlorophyll content (99.92 and 99.95%) and total sugars (97.50 and 95.30%), whereas moderate values were obtained in fruit diameter (75.35 and 74.89%) at two different environments. Also, highest values of narrow sense heritability were noticed in fruit chlorophyll content (9.80 and 9.20%), and the lowest value was detected in fruit length (0.15 and 0.21%), fruit diameter (6.29 and 5.95%), fruit weight (0.34 and 0.32%), total soluble solids (3.27 and 3.11%) and total sugars (2.60 and 2.20%) at the first and second sowing dates under greenhouse conditions, respectively. These results were in harmony with El-Shoura and Abed (2018), Gad-Allah (2019) and Ayman and Al-Zubaae (2023).

Relative to yield and its attributed traits, high values of heritability in broad sense were obtained in number of fruits per plant (97.68 and 98.45%), fruit set (98.27 and 98.10%) and total yield per plant (94.60 and 94.30%) at first and second planting times, respectively. On the other side, the highest values of narrow sense heritability were noticed in number of fruits per plant (10.77 and 9.98%), and the lowest values were obtained in fruit set trait (2.94 and 2.74%). In addition, total fruit yield per plant (7.36 and 7.26%) at different sowing dates under greenhouse circumstance. These results were in harmony with Chaudhari et al., (2017), El-Shoura and Abed (2018) and Ayman and Al- Zubaae (2023).

The high heritability in broad sense and low heritability in narrow sense indicate that a major part of total genotypic variances are due to dominance and / or over dominance.

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الملخص العربي

تقدير قوة الهجين ودرجة التوريث بالنسبه لصفات المحصول وجودة الثمار في القرع (الكوسة) تحت ميعادين للزراعة تحت ظروف البيوت المحمية.

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أجريت هذه الدراسة في البيوت البلاستيكية غير المدفأة بمزرعة بحوث قها، معهد بحوث البساتين، بمحافظة القليوبية، مصر؛ بهدف تقييم أداء ٢١ هجيناً جديداً من القرع(الكوسة) والتي تم الحصول عليها من التهجين النصف تبادلي وذلك باستخدام سبعة آباء مختلفة وراثيا ، وتم زراعتهم تحت موعدين مختلفين للزراعة داخل ظروف الزراعات المحمية المصرية. وفي نفس الوقت، تم تقدير قوة الهجين ودرجة التوريث وذلك لجميع الصفات تحت الدراسة وذلك تحت مواعيد زراعة مختلفة داخل البيوت المحمية. وأظهرت النتائج وجود قيم معنوية لقوة الهجين مقارنة بمتوسط الأبوين والاب الأفضل، حيث أظهرت قيم معنوية عالية في معظم الصفات المدروسة. وظهرت افضل القيم المرغوبة لقوة الهجين مقارنه بمتوسط الأبوين والاب الأفضل في الهجن التالية؛ P_1 x P_4 و P_1 X P_5 وP_2 Xp_5 وP_3 x P_5 وP_4 X P_5 وP_5 x P_6 بالنسبه لجميع الصفات تحت بيئتين مختلفتين. وأظهرت نتائج تقدير درجة السيادة وجود اختلافات كبيرة في درجة السيادة بالنسة لجميع الصفات المدروسة. وكانت درجة التوريث بمعناها الواسع أعلى من درجة التوريث بمعناها الضيق بالنسبة لجميع الصفات تحت الدراسة. وكذلك أظهرت النتائج أن مقدار درجة التوريث المسجلة بمعناها الواسع تراوحت من ٧٤,٨٩ إلى ٩٩,٩٥% بالنسبه لصفات جودة الثمار و٩٤,٣٠ إلى ٩٨,٤٥% لصفات المحصول ومكوناته تحت مواعيد زراعية مختلفة داخل الصوب ،على التوالي. بينما تراوحت قيم درجة التوريث بمعناها الضيق من ٠,١٥% إلى ٩,٨٠% بالنسبه لصفات جودة الثمار ومن ٢,٧٤% إلى ١٠,٧٧% بالنسبة لصفات المحصول ومكوناته تحت جميع البيئات على التوالي. وبناءا علي النتائج السابقة يمكن التوصية باستخدام تلك الهجن الجديدة المتفوقة في التحسين الوراثي لبرنامج تربية القرع (الكوسة) الشتوي تحت ظروف البيوت المحمية وذلك بهدف زيادة كمية المحصول وتحسين الصفات النوعية للكوسة.