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NATURE OF GENE ACTION FOR SOME ECONOMICAL TRAITS IN OKRA.

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ABSTRACT

In this investigation, four varieties of okra belong to *Abelmoschus esculentus*, L. Moench representing a wide range of diverse in the fruit characteristics were used. These varieties were named as: Romi, Balady, Mansoura Red and Cairo Red. All possible combinations among these four varieties were made according to a complete diallel crosses mating design. The obtained genotypes were evaluated during two successive growing summer seasons. The obtained results could be summarized in the following; performance of the four parental varieties and their F_1 hybrids including reciprocals were variable from year to another.

Out of the four parental varieties, Cairo Red was the highest in number of branches per plant. However, the variety giving the highest yield as number of fruits/plant and weight of fruits/plant was Romi followed by Cairo Red. While, the desirable variety with lower means for earliness traits as number of nodes for first flower and days to first flower was Romi. However, the best variety in fruit characteristics as length and diameter of fruit was Balady.

On the other hand, no specific hybrid showed superiority over other combinations for all studied traits. However, the best combination for number of branches/plant was Romi x Mansoura Red. The desirable combinations for earliness traits with lower means for number of nodes for first flower and days for first flower were Romi x Mansoura Red and Cairo Red x Romi, respectively. In addition, the best combination for yield as number of fruits and weight of fruit was Cairo Red x Balady.

The results exhibited desirable negative heterosis over the high parent in the earliness traits as number of nodes for first flower and days to first flower. In spite of no heterosis observed in the cases of number of branches/plant, number of fruits per plant and weight of fruits per plant when the overall hybrids means were compared by either mid-parental values or higher parent, some combinations showed heterosis over their higher parent, such as P_1 x P_3 for number of branches per plant and weight of fruits per plant, in addition P_3 x P_2 for number of fruits per plant.

Comparison of the GCA effects of individual parent exhibited that the variety Romi was the best combiner for earliness traits as number of nodes to the first flower, days to the first flower as well as the yield as fruit number per plant. However, the best combiners for number of branches per plant (N.B/p) and fruit yield as weight of fruits were Mansoura Red and Cairo Red, respectively. Thus, it could be suggested that these varieties posses favorable genes for improving hybrids and could be utilized in a breeding program for improving these traits.

The results showed that additive genetic variances played the major role in the inheritance of these traits. On the other hand, considerable values of reciprocal effects variance were observed in all studied traits except for number of branches/plant, indicating the role of cytoplasmic factors in the expression of these studied traits. In addition, the three sources of variances (additive, dominances and reciprocal effects) interacted with different years with different magnitudes, indicating that these parameters, especially reciprocal effects (high magnitudes) are unstable with different environmental conditions. In conclusion, it could be claimed that the studied traits were mainly controlled by additive effects, while non-additive, cytoplasmic factors and epigenetic factors played a minor role in the expression of studied traits. Thus, a selection procedure could yield superior lines through the pedigree breeding program.

INTRODUCTION

Okra is considered one of the popular vegetable crops in Egypt as well as other countries. Great efforts have been directed towards the improvement of yield production in addition to quality properties (Hoque and Hazarika, 1996; Wankhade *et al.*, 1995; Ramesh and Singh, 1999; Vagish and Arora,2001; Liou *et al.*, 2002 and El-Gendy and El-Diasty, 2004).

A breeding program usually makes use of the informations concerning the relative importance of genetic variance components. When the additive gene action represents the main component in the genetic variation, a maximum progress must be expected in the selected characters. On the other hand, the presence of a relatively high non-additive gene action indicates that a hybrid production program will perform great prospects for the considered character. This could happen as a result of the direct relationship between the non-additive gene action and heterosis. In this respect, Ramesh and Singh (1999) concluded that the fixable component of genetic variance represented by additive effects was predominate in the inheritance of important quantitative traits including pod yield. However, Hoque and Hazarika (1996) reffered that days to flowering and number of branches/plant were controlled by non-additive gene action. In addition, Liou *et al.*, (2002) studied 6 x 6 diallel crosses of Okra. They found that, days to flowering, number of fruits per plant, yield, fruit diameter and fruit weight were controlled by additive and non-additive gene action.

Furthermore, the reciprocal effects were significant for days to flowering, number of fruits per plant, fruit length and fruit weight, indicating the role of cytoplasmic factors in the inheritance of these traits. Hence, in this study, an attempt was made in order to further partition the genetic variance to its components to determine the desirable breeding program for improving some important traits in Okra.

MATERIALS AND METHODS

Genetic Materials:

The genetic materials used in this investigation included four varieties belong to *Abelmoschus esculentus*, representing a wide range of diverse in the fruit characteristics. The seeds of these varieties were obtained from previous study conducted at the Department of Genetics, Faulty of Agriculture Mansoura University. These varieties were named as Romi (P_1), Balady (P_2), Mansoura Red (P_3) and Cairo Red (P_4). (El-Gendy and El-Diasty, 2004).

During the summer growing season of 2002 at El-Baramoon Research Station, seeds from each variety were sown. At the flowering time, all possible combinations among these four varieties were made according to a complete diallel crosses mating design to produce six F_1 hybrids and six F_1

reciprocal hybrids. In addition, all parental varieties were self-pollinated to increase seeds from each one.

Experimental design:

The obtained genotypes (four varieties, six F_1 hybrid. and six F_1 reciprocal hybrids) were evaluated during two successive summer growing seasons of 2003 and 2004.

The experimental design used was a Randomized complete blocks with three replications in both seasons. Each block included 16 plots. The plot consisted of a single row, 5 m. long and 60 cm. wide. Hills were spaced 25 cm. apart. Therefore, each row contained about 20 hills with one plant each. All cultural practices were applied as recommended for Okra cultivation.

Observations were recorded on 10 plants chosen at random from each plot. The measurements were recorded on the following traits: number of branches per plant (N.B/P), number of nodes to the first flower (N.N.F.), days to the first flower (D.F.F.), fruit length (F.L.), fruit diameter (F.D.), number of fruits per plant (N.F/P) and weight of fruits per plant (W.F/P). These measurements were recorded in the same manner for two seasons.

Statistical analysis:

Combined data over two years were subjected to the combined analysis of variances in order to test the significance of the differences among varieties and their F_1 hybrids according to Cochran and Cox (1957).

The amount of heterosis was determined as the deviation of F_1 hybrids mean than mid-parents (M.P) and higher parent (H.P) values. Therefore, the values of heterosis could be estimated from the following equations: Heterosis over the mid-parents ($H,_{M.P}$%) = (F_1 – M.P/M.P) x 100. Heterosis over the heigher -parent ($H,_{H.P}$%) = (F_1 – H.P/H.P) x 100.

Griffing's (1956) method 1, was used to partition the sum squares of crosses as well as crosses by years into sources of variations due to general (GCA), specific (SCA) combining abilities and reciprocal effects (R.E) in addition to their interactions with the two years (GCA x Y, SCA x Y and R.E x Y). Furthermore, GCA effects (g_i) for each parental variety as well as SCA effects (S_{ij}) for each cross were determined from the combined data over two years for all studied traits.

On the basis of the expected mean squares, the variances due to GCA (σ^2_{gca}), SCA (σ^2_{sca}), reciprocal effects ($\sigma^2_{R.E}$) and their interactions with years ($\sigma^2_{gca\ x\ y}$, $\sigma^2_{sca\ x\ y}$ and $\sigma^2_{R.E\ x\ y}$) were obtained for all studied traits. These estimates could be expressed in terms of covariance among the two types of relatives in a diallel mating design. General combining ability variance (σ^2_{gca}) is equivalent to the covariance among full-sibs minus twice the covariance among half-sibs (Hallaur and Miranda, 1988). The covariance of relatives was translated into appropriate genetic components of variance as outlined by Matzinger and Kempthorne (1956). Additive (σ^2_A), dominance (σ^2_D), additive by years (σ^2_{AY}) and dominance by years (σ^2_{DY}) genetic variances were *estimated.*

Estimates of heritability in broad and narrow senses were determined as the following equations:

$$h_{b.s}\% = [\sigma^2_A + \sigma^2_D / \sigma^2_A + \sigma^2_D + \sigma^2_r + \sigma^2_{AY/Y} + \sigma^2_{DY/Y} + \sigma^2_{rY/Y} + \sigma^2_e] \times 100.$$

$$h_{n.s}\% = [\sigma^2_A / \sigma^2_A + \sigma^2_D + \sigma^2_r + \sigma^2_{AY/Y} + \sigma^2_{DY/Y} + \sigma^2_{rY/Y} + \sigma^2_e] \times 100.$$

Where, σ^2_e: is the error variance divided by the number of replications; and Y is the number of seasons.

RESULTS AND DISCUSSION

The major objectives of this study were derived towards evaluation of the hybrids produced from four divers Okra varieties, in addition to gather information about the genetic behavior of some important traits in Okra.

Analyses of variance showed highly significant differences among genotypes, years and their interactions, as shown in Table 4 with respect to all studied traits. This indicated that the planned comparisons could be made as well as further partition of genetic variance to its components is valid.

Performances of the four parental varieties and their F_1 hybrids including reciprocals were variable from year to another. Therefore, the means over both years would be more suitable to represent the data. The mean performances of all genotypes were estimated from the combined data over both years and the obtained results for all studied traits are presented in Table1.

Table 1: The mean performances of four parental varieties and their F_1 hybrids for all studied traits from combined data over two years

Genotypes	N.B/P	N.N.F	D.F.F	F.L	F.D	N.F/P	W.F/P
Romi(P_1)	4.8	2.02	52.83	6.22	4.65	492.7	2.32
Balady (P_2)	7.98	2.45	59.50	3.90	7.00	391.2	2.13
Mansoura red (P_3)	7.60	5.73	67.83	4.35	5.03	385.8	2.01
Cairo red (P_4)	8.35	4.17	61.67	4.37	6.25	442.5	2.43
P1 x P2	4.13	2.95	56.17	4.87	5.55	403.8	1.89
P1 x P3	9.12	2.78	55.83	5.28	4.87	510.7	2.52
P1 x P4	5.13	3.03	56.50	6.53	5.37	511.3	2.19
P2 x P3	6.15	3.10	55.50	4.43	5.38	394.0	1.88
P2 x P4	7.27	3.90	61.83	4.03	5.83	436.2	1.89
P3 x P4	6.13	4.93	66.17	3.77	5.52	375.5	2.13
P2 x P1	5.82	3.80	54.67	5.63	5.05	481.3	2.21
P3 x P1	6.75	4.33	64.50	4.13	5.52	451.5	1.95
P4 x P1	7.70	4.50	63.17	3.48	5.83	454.7	1.91
P3 x P2	5.15	3.42	59.67	4.37	5.03	491.7	2.10
P4 x P2	6.50	3.95	61.50	4.40	5.85	529.7	2.78
P4 x P3	6.12	4.58	64.83	4.82	5.62	481.7	2.21
LSD 0.05	2.64	1.00	3.87	0.84	0.33	102.4	0.48
LSD 0.01	3.52	1.33	5.14	1.12	0.43	136.1	0.64

Out of the four parental varieties, Cairo Red (P_4) was the highest in number of branches per plant (N.B/p) and the variety giving the highest yield as number of fruits/plant (N.F/p) and weight of fruit/plant (W.F/p) was Romi (P_1) followed by Cairo Red, with mean values of (492.7 and 2.32 kg) and

(442.5 and 2.45 kg), respectively. While, the desirable variety with lower means for earliness traits as number of nodes for first flower (N.N.F) and days to first flower (D.F.F) was Romi with mean values of 2.02 and 52.83 days, respectively. However, the best variety in fruit characteristics as length and diameter of fruit was Balady with means of 3.90 and 7.00 for fruit length (F.L) and fruit diameter (F.D), respectively.

On the other hand, no specific hybrid showed superiority over other combinations for all studied traits. However, the best combination for number of branches/plant was P_1 x P_3 (Romi x Mansoura Red) with mean of 9.12. The desirable combinations for earliness traits with lower means for number of nodes for first flower (2.78) and days for first flower (54.67 days) were P_1 x P_3 (Romi x Mansoura Red) and P_4 x P_1 (Cairo Red x Romi), respectively. In addition, the best combination for yield as number of fruits (529.7) and weight of fruit (2.78) was P_4 x P_2 (Cairo Red x Balady).

In general, some F_1 hybrids means exceeded their mid-parental varieties in the desirable direction. This fact may be confirmed by the estimated amount of heterosis which were determined from overall means and single crosses and the obtained results are shown in Tables 2 and 3, respectively.

Table 2: Heterosis estimates as relative to mid-parents (M.P) and higher parent (H.P) for all studied traits from the combined data over two years.

	N.B/P	N.N.F	D.F.F	F.L	F.D	N.F/P	W.F/P
M.P	7.18	3.59	60.46	4.71	5.73	428.04	2.22
H.P	8.35	5.73	67.83	6.22	7.00	492.67	2.43
M.F_1	6.33	3.77	60.03	4.65	5.45	460.17	2.14
$H._{M.P}$%	-11.84	5.11	-0.71	-1.27	-4.86*	7.51	-3.60
LSD 0.05	1.87	0.71	2.73	0.60	0.23	72.37	0.34
LSD 0.01	2.49	0.94	3.63	0.79	0.31	96.26	0.46
$H._{H.P}$%	-0.24	-34.19**	-11.50**	-25.21**	-22.14**	-6.60	-12.08
LSD 0.05	3.37	1.27	4.93	1.08	0.42	130.45	0.62
LSD 0.01	4.48	1.69	6.55	1.43	0.55	173.50	0.82

*, ** Significant at 0.05 and 0.01 levels of probability, respectively.

The results exhibited the presence of desirable negative heterosis over the high parent in the studied earliness traits as number of nodes for first flower (N.N.F) and days to first flower (D.F.F), in addition to fruit length (F.L.) and fruit diameter (F.D) with heterotic values of -34.19, -11.50, -25.21 and -22.14, respectively. On the other hand, in spite of no heterosis observed in the cases of number of branches/plant (N.B/P), number of fruits per plant (N.F/P) and weight of fruits per plant (W.F/P) when the overall hybrids means were compared by either mid-parental values or higher parent, some combinations showed heterosis over their higher parent, such as P_1 x P_3 for number of branches per plant and weight of fruits per plant, in addition P_3 x P_2 for number of fruits per plant as observed from the results presented in Table 3.

Table 3: Estimates of heterosis from single crosses as relative to mid-parents (M.P) and higher parent (H.P) for all studied traits from the combined data over two years.

Crosses		N.B/P	N.N.F	D.F.F	F.L	F.D	N.F/P	W.F/P
$P_1 \times P_2$	M.P	-35.37	32.29	0.00	-3.62	-4.63	-8.62	-14.91
	H.P	-48.27	20.41	-5.60	-21.71	-20.71**	-18.03	-18.51
$P_1 \times P_3$	M.P	47.05	-28.35	-7.45	0.00	0.56	16.26	16.75
	H.P	19.96	-51.48**	-17.69**	-15.07	-3.29	3.65	8.80
$P_1 \times P_4$	M.P	-21.99	-1.84	-1.31	23.44*	-1.52	9.36	-7.89
	H.P	-38.53	-37.39	-8.38	5.08	-14.12**	3.79	-9.94
$P_2 \times P_3$	M.P	-21.05	-24.21	-12.83**	7.59	-10.43*	1.41	-8.83
	H.P	-22.93	-45.95**	-18.18**	1.91	-23.10**	0.72	-11.79
$P_2 \times P_4$	M.P	-11.05	17.82	1.65	-2.34	-11.89**	4.64	-16.93
	H.P	-12.97	-6.41	0.26	-7.64	-16.67**	-1.43	-22.20
$P_3 \times P_4$	M.P	-23.15	-0.34	2.18	-13.40	-2.18	-9.34	-4.18
	H.P	-26.59	-13.95	-2.46	-13.73	-11.72*	-15.14	-12.61
$P_2 \times P_1$	M.P	-8.97	70.40*	-2.67	11.54	-13.23**	8.91	-0.63
	H.P	-27.13	55.10	-8.12	-9.39	-27.85**	-2.30	-4.83
$P_3 \times P_1$	M.P	8.87	11.60	6.91	-21.72	13.99**	2.79	-9.95
	H.P	-11.18	-24.47	-4.91	-33.52**	9.62	-8.36	-16.09
$P_4 \times P_1$	M.P	17.02	45.63	10.34*	-34.15**	7.02	-2.76	-19.78
	H.P	-7.78	7.99	2.43	-43.97**	-6.67	-7.71	-21.56
$P_3 \times P_2$	M.P	-33.89	-16.45	-6.29	5.99	-16.25**	26.56*	1.84
	H.P	-35.46	-40.40**	-12.03**	0.39	-28.10**	25.69	-1.45
$P_4 \times P_2$	M.P	-20.44	19.34	1.52	6.53	-11.63**	27.07*	21.92
	H.P	-22.16	-5.21	-0.27	0.75	-16.42**	11.11	14.22
$P_4 \times P_3$	M.P	-23.35	-7.41	0.13	10.73	-0.40	16.30	-0.41
	H.P	-26.74	-9.98	-4.42	10.30	-10.121*	8.85	-9.16
$LSD_{;M.P}$	0.05	3.97	1.50	5.80	1.26	0.48	153.50	0.72
	0.01	5.27	1.99	7.71	1.68	0.65	204.19	0.97
$LSD_{;H.P}$	0.05	4.58	1.73	6.69	1.46	0.56	177.28	0.83
	0.01	6.09	2.30	8.90	1.94	0.75	235.78	1.11

***, ** Significant at 0.05 and 0.01 levels of probability, respectively.**

Combined analysis of variance and mean squares for all studied traits are presented in Table 4.

The results showed that the genotype mean squares were highly significant for all studied traits. These findings indicated that these genotypes are varied in their performances and the further partition of this genetic variances to its components are valid. Furthermore, years and its interaction with genotypes mean squares were highly significant except for fruit diameter in the case of year's mean square. This fact indicated that these genotypes were highly affected by the environmental conditions. General combining ability (GCA) mean squares were highly significant for all studied traits. While, specific combining ability (SCA) mean squares were highly significant for number of branches per plant (N.B/p), number of nodes to the first flower (N.N.F), days to the first flower (D.F.F) and fruit diameter (F.D). However, the ratio of GCA/SCA exceeded unit with respect to all studied traits, indicating that the GCA variance was more important in the genetic expression of these traits than the SCA variance. Therefore, the additive genetic variance played the major role in the inheritance of these traits. The same trend was observed in other investigations carried by Ramesh and Singh (1999) and Vagish and Arora (2001) for fruit yield; Hoque and Hazarika (1996) and Wankhade *et al* (1995) for number of branches/plant, and days to flowering, Sood and Pritam (2001) for fruit length and fruit diameter. While, Partap *et al* (1980) Arora (1993), Liou *et al* (2002), Vagish *et al* (2002), reported that both additive and non-additive gene action were important in most of these studied traits. In addition, significant reciprocal effect (R.E) mean squares were observed for all studied traits except for number of branches per plant (N.B/p), suggesting that these traits were controlled by extra-nuclear factors as well as nuclear factors. Hence, there is a need for careful choice of female parents during the production of hybrids.

Table 4: Combined analysis of variance and mean squares for all studied traits

S.O.V	d.f	N.B/P	N.N.F	D.F.F	F.L	F.D	N.F/P	W.F/P
Years	1	80.3**	8.82**	787.76**	18.82**	0.13	561051.3**	18.0**
R/Years	4	2.44	0.23	5.135	0.41	0.10	3729.7	0.12
Geno.	15	11.52**	5.79**	122.34**	4.46**	1.98**	15170.0**	0.39**
GCA	3	5.77**	6.48**	122.96**	4.17**	2.29**	8860.3**	0.13**
SCA	6	4.81**	0.71**	16.96**	0.17	0.34**	2613.6	0.06
R.E	6	1.90	0.90**	23.50**	1.46**	0.17**	5597.9**	0.21**
G x Y	15	11.21**	0.87*	19.58**	1.07**	0.32**	10666.6**	0.39**
GCAx Y	3	3.50*	0.75**	13.02**	0.50**	0.05*	429.7	0.07
SCA xY	6	4.69**	0.13	2.45	0.16	0.11**	2443.1	0.09*
R.E x Y	6	2.90**	0.22	7.36**	0.48**	0.13**	4305.9**	0.19**
Error	60	0.87	0.12	1.87	0.09	0.013	1309.5	0.03
GCA/SCA		1.20	9.13	7.28	24.5	6.74	3.39	2.17
GCAxY/SCA xY		0.74	5.76	5.31	3.13	0.45	0.18	0.78

*, ** Significant at 0.05 and 0.01 levels of probability, respectively.

Significant interaction between genotypes and years were detected for all studied traits. Therefore, this variance was partitioned to its components (GCA x Y, SCA x Y and R.E x Y). The results revealed that GCA x Y was significant for all studied traits except for yield as number and weight of fruits. However, SCA by years interaction was significant for number of branches/plant, fruit diameter and weight of fruits. Whereas, the magnitude of interaction variance was higher for the SCA x years than GCA x years as shown by the ratio of GCA x Y/SCA x Y for number of branches/plant, fruit diameter, number of fruits/plant and weight of fruits/plant. These results indicated that the non-additive gene action interacts by years with higher degree than additive gene action for these traits. Suggesting that the additive genetic effects are more stable than non-additive genetic effects with respect to these traits. While, non-additive genetic effects are more stable over the different environmental conditions in the inheritance of number of nodes to first flower (N.N.F), days to the first flower (D.F.F) and fruit length. Thus, these genetic parameters need further investigation at more different environmental conditions to obtain precise estimates.

The estimates of general combining ability effects (g_i) of the parental varieties for all studied traits are shown in Table 5.

Table 5: General combining ability effects (g_i) of four parental varieties for all studied traits from the data combined over two years

Varieties	N.B/P	N.N.F	D.F.F	F.L	F.D	N.F/P	W.F/P
P_1	-0.83*	-0.69**	-3.07**	0.74**	-0.44**	27.30*	0.03
P_2	0.15	-0.34*	-1.59**	-0.33*	0.42**	-16.89	-0.06
P_3	0.60	0.73**	2.64**	-0.33*	-0.17**	-22.18	-0.08
P_4	0.08	0.29	2.03**	-0.08	0.19**	11.74	0.11
S.E	0.29	0.11	0.42	0.09	0.04	11.08	0.05

*, ** Significant at 0.05 and 0.01 levels of probability, respectively.

Comparison of the GCA effects of individual parent exhibited that the variety Romi was the best combiner for earliness traits as number of nodes to the first flower (N.N.F), days to the first flower as well as the yield as fruit number per plant (N.F/p). While the best combiner for fruit characteristics from the customer point of view is Balady (P_2) with the highest negative value for fruit length and positive value for fruit diameter.

However, the best combiner for number of branches per plant (N.B/p) and fruit yield as weight of fruits were Mansoura Red (P_3) and Cairo Red (P_4), respectively. Thus, it could be suggested that these varieties posses favorable genes for improving hybrids and could be utilized in a breeding program for improving these studied traits. Specific combining ability effects (S_{ij}) for each cross with respect to the studied traits are presented in Table 6.

Table 6: Specific combining ability effects (S_{ij}) for each cross from the data combined over two locations for all studied traits

Hybrids	N.B/P	N.N.F	D.F.F	F.L	F.D	N.F/P	W.F/P
P_1 x P_2	-0.89	0.67*	-0.05	0.17	-0.20	-19.99	-0.08
P_1 x P_3	1.62*	-0.22	0.46	-0.36	0.28*	23.80	0.13
P_1 x P_4	-0.65	-0.11	0.73	0.12	-0.08	10.30	-0.15
P_2 x P_3	-0.37	-0.32	-3.59**	-0.04	-0.16	11.26	-0.12
P_2 x P_4	0.11	0.25	1.09	-0.03	-0.29**	35.93	0.12
P_3 x P_4	-1.10	0.02	0.70	0.04	0.02	-13.11	-0.02
S.E	0.70	0.26	1.02	0.22	0.09	27.14	0.13

*, ** Significant at 0.05 and 0.01 levels of probability, respectively.

The results revealed that one hybrid exhibited desirable positive and significant SCA effects for number of branches/plant and fruit diameter. This hybrid resulted from the combination between Romi and Mansoura Red (P_1 x P_3). While, desirable negative SCA effect estimate was observed for days to the first flower in one cross [Balady (P_2) x Mansoura Red (P_3)]. In general, the best combination for these traits involved at least one of its parents which is good general combiner indicating predictions of hybrids yield based on the general combining ability effects of the parents would generally be valied. On the other hand, no hybrid showed significant SCA effects in the cases of fruit length, number of fruits/plant and weight of fruits/plant, in addition most of hybrids did not exhibit significant SCA effects in other traits. This finding insures the importance of additive genetic effects in the inheritance of these traits and may explain the absence of heterosis with respect to the studied hybrids for these traits. Based on the analysis of combining ability, the different genetic parameters were estimated and the obtained results are presented in Table 7.

Table 7: Genetic parameters estimates for all studied traits from the data combined over two years

	N.B/P	N.N.F	D.F.F	F.L	F.D	N.F/P	W.F/P
VA	0.32	1.45	26.79	1.00	0.49	1586.8	0.02
VD	0.07	0.35	8.92	0.01	0.14	104.96	-0.02
Vr	-0.50	0.34	8.07	0.49	0.02	646.03	0.01
VAy	-0.23	0.15	2.65	0.09	-0.01	480.97	-0.003
VDy	2.35	0.01	0.36	0.05	0.06	697.58	0.04
Vry	1.01	0.05	2.75	0.20	0.06	1498.2	0.08
Ve	0.87	0.12	1.87	0.09	0.01	1309.5	0.03
h_b%	8.35	72.85	69.47	52.69	81.40	26.75	9.94
h_n%	6.85	58.61	52.10	52.55	62.97	25.09	9.94

The results showed that considerable values of additive genetic variance were obser' d for all studied traits. These values were larger in magnitude than the orresponding values of SCA and reciprocal effect variances. This findi suggested that additive genetic variance played the major role in the inh tance of these traits. On the other hand, considerable values of reciprocal effects variance were observed in all studied traits except for number of branches/plant, indicating the role of cytoplasmic factors in the expression of these traits. In addition, the three sources of variances (additive, dominances and reciprocal effects) interacted with different years with different magnitudes, indicating that these parameters, especially reciprocal effects (high magnitudes) are unstable with different environmental conditions. Furthermore, heritability in broad sense values were moderate and close to the heritability in narrow sense estimates for most of studied traits. This finding verified the predominance of additive gene action in the inheritance of these traits.

In conclusion, from the previous results, it could be claimed that the studied traits were mainly controlled by additive effects, while non-additive, cytoplasmic factors and epigenetic factors play a minor role in the expression of these traits. Thus, a selection procedure could yield superior lines through the pedigree breeding program.

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طبيعة الفعل الجينى لبعض الصفات الاقتصادية فى الباميا

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استخدم فى هذه الدراسة أربعة أصناف من الباميا تمثل مدى واسعا من الاختلاف فى مواصفات الثمار. كل التهجينات الممكنة بين هذه الأصناف الأربعة والآباء تم تقيمها فى موسمين متتاليين ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى:-

- سلوك الآباء والهجن الناتجة منها شاملة الهجن العكسية تختلف من عام إلى عام آخر. حيث كان الصنف أحمر القاهرة هو الأفضل فى عدد الأفرع للنبات بينما الصنف الرومي متبوعا بالصنف أحمر القاهرة هو الأفضل في كمية المحصول كعدد ووزن الثمار للنبات بالإضافة إلى ذلك كان الصنف رومي هو الأفضل أيضا فى صفات التبكير كرقم العقدة التى تحمل أول زهرة وعدد الأيام لخروج أول زهرة بينما الصنف البلدى تميز فى مواصفات الثمرة كطول وقطر. وعلى الجانب الآخر لم يظهر هجين معين تميزه على بقية الهجن لكل الصفات المدروسة. بينما كان أحسن الهجن فى عدد الأفرع للنبات هو الرومى x أحمر المنصورة. وكان أفضل الهجن فى صفات التبكير هى الرومى x أحمر المنصورة ، أحمر القاهرة x الرومي. بالإضافة إلى ذلك فإن أفضل الهجن فى المحصول كان أحمر القاهرة x البلدى.
- أظهرت النتائج أن هناك قوة هجين سالبة ومرغوبة مقارنة بأفضل الأباء فى صفات التبكير كعدد العقد لأول زهرة وعدد الأيام لتفتح أول زهرة رغم أنه لم يلاحظ قوة هجين لعدد الأفرع لكل نبات وعدد ووزن الثمار لكل نبات عندما قورن المتوسط العام للهجن بأي من متوسط الآباء أو بأفضل الآباء ، وقد أظهرت بعض الهجن قوة هجين أعلى من أفضل الآباء مثل P_1xP_3 لعدد الأفرع لكل نبات ووزن الثمار لكل نبات وأيضا P_3xP_2 لعدد الثمار لكل نبات.
- وبمقارنة تأثير القدرة العامة على التآلف لكل أب أتضح أن الصنف رومى كان أفضلهم قدرة على التآلف لصفات التبكير كعدد العقد لأول زهرة وعدد الأيام لتفتح أول زهرة بالإضافة لعدد الثمار لكل نبات. بينما كان الأفضل قدرة عامة على التآلف لعدد الأفرع للنبات ووزن الثمار للنبات أحمر المنصورة وأحمر القاهرة على التوالي. ولذلك يمكن أن نقترح أن هذه الأصناف يمكن أن تشارك بجينات مرغوبة لتحسين الهجن وبالتنبيه تدخل فى برامج التربية لتحسين هذه الصفات.
- وأظهرت النتائج أيضا أن التباين الوراثى الإضافى يلعب الدور الرئيسى فى توريث هذه الصفات وعلى الجانب الآخر فإن التباين الراجع لتأثير التهجينات العكسية كان له قيم تؤخذ فى الاعتبار لكل الصفات المدروسة فيما عدا صفة عدد الأفرع للنبات مشيرا إلى الدور الذي تلعبه العوامل السيتوبلازمية فى تغيير هذه الصفات. بالإضافة إلى ذلك كانت مصادر التباين (الإضافة – السيادة – تأثير التهجين العكسى) تتداخل معنويا مع السنوات بدرجات مختلفة مشيرا إلى أن هذه المقاييس تختلف باختلاف الظروف البيئية المحيطة.
- ونستخلص من الدراسة أن هذه الصفات كانت محكومة رئيسيا بالعوامل ذات التأثير الإضافي بينما العوامل ذات التأثير الغير إضافي والسيتوبلازمية بالإضافة إلى العوامل البيئية تلعب دورا ثانويا فى تغير هذه الصفات. ولذلك فإن طريقة الانتخاب يمكن أن تؤدى إلى الحصول على سلالات مميزة من خلال برنامج الانتخاب بسجلات النسب.