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GENETICAL STUDIES IN TWO MAIZE CROSSES

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ABSTRACT

Gene action, heterosis, potence ratio, inbreeding depression, , genetic coefficient of variation, heritability and predicted genetic advance from selection in the two maize crosses i.e., (M4 xM_{39}) and (M_{39} x M_1) were the main objectives of the present study. Six populations in each cross, namely, P_1, P_2, F_1, F_2, Bc_1 and Bc_2 were studied. Most values of mean performance and most variance values in cross-II (M_{39} x M_1) were higher than those of cross-I except number of ears / plant and plant height. Generally, higher heterosis percentage values were detected in the second cross (M_{39} x M_1) for most studied traits including grain yield / plant and some of its components except number of rows / ear, number of ears / plant and tasseling and silking dates. The range of heterosis in cross-I was -6.15% for silking date to 115.96% for grain yield / plant relative to mid parent and –2.55% for silking date to 90.99% for grain yield / plant relative to better parent. Meanwhile, in the cross-II it ranged from -1.85% for tasseling date to 133.60% for grain yield / plant relative to mid parent, while it ranged from 3.61% for silking date to 114.16% for grain yield / plant relative to better parent. Most values of inbreeding depression were higher for the first cross than those of the second one, particularly for grain yield / plant and some of its components. Potence ratio values less than unity were detected in cross-I for ear length and tasseling and silking dates ; and in cross-II for number of rows / ear and tasseling and silking dates indicating partial dominance for these traits. Meanwhile, over dominance values were detected in remaining traits including grain yield / plant in the two crosses, hence, the values were more than unity. In the two crosses, the mean effect of parameters (m) was highly significant and the values were higher in cross-II than their corresponding ones in cross-I except few cases i.e.,number of kernels / row and number of ears / plant in cross-I. Generally, for grain yield / plant, dominance and epistatic types of gene action additive x additive were obtained in cross-I. Meanwhile, in cross-II dominance gene effects were had the major contributing factor in the performance of this trait. Heritability values for grain yield /plant in the narrow sense reached 86.67%, 92.99% for cross-I and cross-II, respectively, and in cross-I and cross-II for broad sense were 87.49% and 72.37%, respectively. The higher estimates in the broad sense indicating the prevalent of dominance and epistatic effect in the inheritance of grain yield / plant. The expected genetic advance from selection (Δg%) in F_2 for grain yield / plant was higher in cross-II (28.39%) than in cross-I (22.55%).

INTRODUCTION

Genetic information on the inheritance of agronomic traits as grain yield and its components in maize is required to help the breeder in planning suitable programmes to identify the best line and production of hybrids. Many of plant breeders are interested in the estimation of gene effects to obtain the most advantageous breeding procedure for improving the trait under study i.e. Mather 1949 who estimated both σ^2A and σ^2D in the absence of epistasis. He reported that if the scale of measurements deviated from additivity, a transformation should be done to make effects additive. Hallauer and Miranda

1981 studied additive and dominance effects. Also the presence of epistatic gene effects beside additive and dominance effects in the inheritance of various quantitative traits and the magnitude of the three types of gene effects in genetic variation is required. Several models have been used to estimate the generations means (Hayman 1958, 1960 and Gamble 1962). Hayman (1960) reported that the presence of epistatic effects would be bias estimates of additive and dominance effects. Gamble (1962) used six populations (P_1, P_2, F_1, F_2, Bc_1 and Bc_2) from crosses among six inbred lines of maize to estimate six genetic parameters (m,a,d,aa,ad and dd). All traits in all crosses for all four experiments showed significant dominance effects except kernel-row number. He obtained also, significant additive effects for all traits except yield, which was significant in 47% of the 15 crosses. Hence, it seems that both additive and dominance effects made a significant contribution to the inheritance of these traits .He also reported although not as frequent as additive and dominance effects ,significant epistatic effects were frequent for all traits. Sprague and Suwantaradon (1975) obtained similar results for yield and other traits .Nawar *et al*. (1992a) showed that the dominance and epistasis (additive x additive)gene action in two maize crosses were more important in the inheritance of grain yield /plant and that the observed heterosis was mainly due to their effects. Nawar *et al*. (1996) estimating the genetic variance components in S.C 10 using the generation mean variances .They reported that most of the estimates of genetic variance were significant . The average degree of dominance was in the range of partial dominance for all traits. Dominance variance was more important and significant than other portions of genetic variance components. Khalil (1999) estimated genetic effects from generation means in two maize crosses through six generations i.e.,P_1,P_2,F_1, F_2, Bc_1 and Bc_2. He reported that, in the two crosses most studied traits especially grain yield/plant exhibited over dominance effects. For grain yield /plant, significant dominance and epistatic (additive x additive) gene effects were found in cross-1. Meanwhile, in cross- II only significantly positive of gene effects of dominance was prevalent. For grain yield/plant, heritability estimates values in the narrow sense for the two crosses were intermediate and reached to 42.92% and 38:7s% for cross-I and cross-II respectively, while in the broad sense the estimated values were 83.18% and 74.7o% for the two crosses, respectively. The range of heterosis effects in cross-I were from 1.o1% and -3.31% for silking date to 87.89% and 54.3.% for grain yield /plant relative to mid and better parent, respectively. Meanwhile, it ranged in cross-II from – 4.05% and -7.57% for tasseling date to l09.12% and 54.90% for grain yield/plant relative to mid and better parent, respectively. Significant and positive inbreeding depression values were found for all traits except for tasseling and silking dates in the two crosses. Most estimates of inbreeding depression were higher in cross-I than those of cross-II, particularly for grain yield/plant. The expected genetic advance from selection (Δg%) reached 26.61% and 13.22% for cross-I and cross-II, respectively. The present work was conducted to investigate the types of gene action and heterotic effects for eleven agronomic traits including grain yield/plant, also, to determine heritability and predicted genetic advance in the F_2 generation for all studied traits of the two crosses. The ultimate goal of this study is to give an insight in the breeding value of both crosses that could be utilized in maize breeding programme aiming to improve these traits under study.

MATERIAL AND METHODS

The experiments reported herein were carried out at EL-Rahib Experimental Station Faculty of Agriculture Minufiya University during the three successive seasons 1997,1998and1999. Three Egyptian maize inbred lines produced by the Agronomy Department, Faculty of Agriculture Minufiya University, i.e., M_4,M_{39} and M_1 were crossed in 1997 season to produce the two crosses, i.e., cross-I(M_4 x M_{39}) and cross-II (M_{39} x M_1). In 1998, the F_1 plants of the two crosses were selfed pollinated and backcrossed to each parent of each cross to generate the seeds of F_2 and backcross populations.

In 1999 season, the two adjacent experiments were conducted including the six populations of each cross,ie,P_1,P_2,F_1,F_2,Bc_1,and Bc_2.These materials were grown in three replications in each experiment. Each replication consisted of 15 ridges for each population,i.e.,P_1, P_2, F_1, Bc_1, and Bc_2 and 30 ridges for F_2 population in each experiment. The kernels were planted in each hill, thinned later at one plant per hill on one side of the ridge. Apart between hills were 30 cm and 70 cm between ridges. Normal agricultural practices of maize were followed. eleven quantitative characters were measured, i.e., grain yield / plant (gm.), ear length (cm.), ear. diameter (cm.), number of rows /ear, number of kernels / row,1oo-kernel weight (gm.), number of ears/plant ,plant and ear heights (cm.), silking and tasseling dates (days).The grain yield /plant for each entry in all populations was adjusted based on 15.5% moisture in the grain and shelling percentage. The genetic variance within F_2 population was firstly estimated. If that variance was significant, various genetical parameters were then computed. The genetical parameters were: heterosis relative to mid and better parents %, inbreeding depression%, potence ratio, heritability in broad and narrow sense (calculated according to Mather (1949). Also, according to Gamble's procedure (1962), six parameters of gene effects and their significance were estimated i.e., mean (m), additive (a), dominance (d), additive x additive (aa), additive x dominance (ad) and dominance x dominance (dd).

RESULTS AND DISCUSSION

Mean ($\overline{x}$), variance (σ^2), variances of means ($\sigma^2\overline{x}$),and coefficient of variability (C.V) of the eleven traits in the two crosses for parents, F_1,F_2, Bc_1,and Bc_2 are presented in Table (1). Estimates of the genetic variance in F_2 plants for all traits in the two crosses were significant, hence, the other needed estimates were calculated. Most values of mean performance of cross-II were higher than those of cross-I. Also, most variance values in cross- II were higher than those of cross-I except number of ears / plant and plant height.

Table (1): Mean ($\bar{x}$), variance (σ^2_e), Variance of mean (σ^2 x) and coefficient of variability (C.V.%) of the six populations of crosses I and II for all studied traits.

Traits	Population	Cross I (M_4 x M_{39})				Cross II (M_{39} x M_1)			
		$\bar{x}$	σ^2e	$\sigma^2 \bar{x}$	C.V%	$\bar{x}$	σ^2e	$\sigma^2 \bar{x}$	C.V%
Grain yield / plant (gm.)	P_1	180.9	186.17	31.03	7.54	139.07	113.45	18.91	7.66
	P_2	139.07	113.45	18.91	7.66	166.84	227.63	37.94	9.04
	F_1	345.50	172.30	28.72	3.80	357.30	358.29	59.72	5.30
	F_2	274.54	1179.97	3026.64	12.51	302.75	3323.62	100.72	19.04
	BC_1	333.46	545.22	60.58	7.00	301.17	1917.14	213.02	14.54
	BC_2	334.70	782.30	86.92	8.36	296.30	2324.69	258.30	16.27
Ear length (cm)	P_1	18.38	0.86	0.14	5.04	15.39	0.27	0.05	3.38
	p_2	15.39	0.27	0.05	3.38	15.89	0.78	0.13	5.54
	F_1	19.57	0.73	0.12	4.35	20.40	0.56	0.09	3.67
	F_2	19.11	2.09	0.07	7.56	19.97	2.19	0.07	7.41
	BC_1	19.62	1.28	0.14	5.77	19.71	1.90	0.21	7.00
	BC_2	20.47	1.87	0.21	6.68	20.26	1.46	0.16	5.97
Ear diameter (cm)	P_1	4.13	0.02	0.004	3.56	4.35	0.02	0.003	2.82
	P_2	4.35	0.02	0.003	2.82	4.27	0.04	.007	4.85
	F_1	4.78	0.02	0.003	2.78	4.80	0.02	0.003	2.63
	F_2	4.56	0.08	0.002	6.23	4.68	0.07	0.002	5.61
	BC_1	4.81	0.04	0.005	4.22	4.69	0.03	0.003	3.75
	BC_2	4.91	0.04	0.005	4.13	4.80	0.07	0.008	5.52
No of rows/ear	P_1	11.20	1.33	0.05	10.31	10.63	5.12	0.15	21.29
	P_2	10.63	5.12	0.15	21.29	13.24	0.98	0.03	7.46
	F_1	13.68	2.16	0.07	10.74	14.00	1.87	0.06	9.76
	F_2	13.39	3.26	0.02	13.49	13.40	3.76	0.24	14.48
	BC_1	14.11	2.81	0.08	11.87	13.91	3.55	0.08	13.54
	BC_2	14.09	3.08	0.07	12.46	13.49	3.64	0.09	14.14
No of kernels/ row	P_1	34.84	18.89	0.76	12.47	19.42	36.09	1.24	30.30
	P_2	19.42	36.09	1.24	30.30	31.54	14.87	0.62	12.22
	F_1	45.50	10.53	0.35	7.13	43.97	33.25	1.15	13.11
	F_2	39.90	55.00	0.41	18.59	39.70	53.78	0.35	18.47
	BC_1	38.94	41.17	1.18	16.48	43.47	35.76	0.80	13.76
	BC_2	42.24	42.66	0.84	15.47	39.82	51.13	1.16	17.96
100-kernel weight (gm.)	P_1	26.33	2.67	0.44	6.20	25.17	10.17	1.69	12.67
	P_2	25.17	10.17	1.69	12.67	26.50	7.10	1.18	10.06
	F_1	34.83	2.17	0.36	4.23	36.17	4.57	0.76	5.91
	F_2	32.04	9.11	0.34	9.42	32.27	15.58	0.47	12.23
	BC_1	33.22	2.69	0.30	4.94	33.89	11.86	1.32	10.16
	BC_2	32.00	8.00	0.89	8.84	35.22	14.94	1.66	10.98

Table (1): Cont.

Traits	Population	Cross I (M_4 x M_{39})				Cross II (M_{39} x M_1)			
		$\bar{x}$	$\sigma^2 e$	$\sigma^2 \bar{x}$	C.V%	$\bar{x}$	$\sigma^2 e$	$\sigma^2 \bar{x}$	C.V%
No of ear/plant	P_1	1.09	0.02	0.003	13.14	1.04	0.01	0.002	9.79
	P_2	1.04	0.01	0.002	9.79	1.15	0.008	0.001	7.95
	F_1	1.36	0.002	0.0003	3.25	1.21	0.005	0.001	6.06
	F_2	1.27	0.06	0.002	18.52	1.14	0.02	0.0004	10.91
	BC_1	1.39	0.06	0.006	17.28	1.12	0.01	0.001	9.76
	BC_2	1.29	0.02	0.002	11.26	1.12	0.009	0.001	8.59
Plant height	P_1	245.17	137.04	4.57	4.77	183.08	358.15	13.78	10.34
	P_2	183.08	358.15	13.78	10.34	234.14	294.77	10.16	7.33
	F_1	295.22	220.18	8.16	5.03	307.59	166.10	6.15	4.19
	F_2	274.38	836.05	6.43	10.54	287.23	346.28	2.21	6.48
	BC_1	283.50	570.77	14.27	8.43	300.00	230.68	5.13	5.06
	BC_2	286.89	540.10	12.00	8.10	293.63	230.75	5.77	5.17
Ear height (cm)	P_1	120.50	33.36	1.11	4.79	84.23	137.38	5.28	13.92
	P_2	84.23	137.38	5.28	13.92	108.60	105.25	4.27	9.45
	F_1	142.22	119.87	4.44	7.70	182.31	292.46	11.25	9.38
	F_2	129.96	362.21	2.79	14.64	138.01	651.51	4.18	18.49
	BC_1	140.24	137.44	3.35	8.36	163.11	373.06	8.29	11.84
	BC_2	142.19	281.82	5.87	11.81	144.66	590.00	13.41	16.79
Tasseling date (days)	P_1	56.33	0.67	0.11	1.45	51.67	1.07	0.18	2.00
	P_2	51.67	1.07	0.18	2.00	56.00	1.20	0.20	1.96
	F_1	50.33	0.67	0.11	1.62	54.17	0.97	0.16	1.81
	F_2	50.19	1.16	0.04	2.14	55.85	2.63	0.08	2.91
	BC_1	50.22	1.19	0.13	2.18	54.89	1.61	0.18	2.31
	BC_2	51.33	0.75	0.08	1.69	54.67	1.25	0.14	2.05
Silking date (days)	P_1	61.17	0.57	0.09	1.23	55.33	0.67	0.11	1.48
	P_2	55.33	0.67	0.11	1.48	57.83	0.97	0.16	1.70
	F_1	54.67	0.27	0.04	0.94	57.33	0.67	0.11	1.42
	F_2	54.67	1.00	0.04	1.83	57.76	2.63	0.08	2.81
	BC_1	53.22	0.44	0.05	1.25	56.89	1.61	0.18	2.23
	BC_2	55.78	0.69	0.08	1.49	56.67	1.25	0.14	1.97

Heterotic effects, inbreeding depression, and potence ratio in the two crosses for all traits are presented in Table (2). Higher and highly significant heterosis was obtained for grain yield / plant , ear length , number of kernels / row , plant height and ear height in cross-II relative to mid and better parent ; number of rows / ear and number of ears / plant in cross-I relative to mid and better parent ; ear diameter and 100 - kernel weight in cross-I relative to mid parent ; ear diameter and 100 - kernel weight in cross-II relative to better parent . Highly significant and negative heterosis values were obtained for tasseling and silking dates in cross- I followed by cross –II relative to mid and better parent. The range of heterosis in cross - I was - 6.15 % for silking date to 115.96 % for grain yield / plant relative to mid parent , and –2.55% for silking date to 90.99 % for grain yield / plant relative to better parent. Meanwhile, in cross - II it ranged from -1.85% for tasseling date to 133.60% for grain yield / plant relative to mid parent , while, it ranged from 3.61% for silking date to 114.16% for grain yield / plant relative to better parent.

Table (2) : Estimates of heterosis, inbreeding depression (I. D%) and potence ratio (P) of crosses I and II for all studied traits.

Traits	Cross- I (M4 × M39)				Cross- II (M39 × M 1)			
	Heterosis		I. D %	P	Heterosis		I D %	P
	M.P	B.P			M. P.	B. P.		
Grain yield / plant	115.96**	90.99**	20.54*	4.44	133.60**	114.16**	15.27	-7.36
Ear length	15.89**	6.44**	2.32**	0.90	30.46**	28.41**	2.12**	-9.52
Ear diameter	12.77**	9.95**	4.71**	-2.50	11.41**	10.34**	2.54**	5.92
No. of rows /ear	25.31**	221.12**	2.11**	4.83	17.30**	5.73**	4.29**	-0.79
No. of kernels/ row	67.70**	30.60**	12.32**	1.19	72.53**	39.39**	9.70**	-1.53
100. kernel weight	82.66**	32.28**	8.03**	7.79	40.00**	36.48**	10.77**	-7.75
No. of ears/ plant	27.23**	24.54**	6.30**	6.30	10.20**	5.24**	5.08**	-1.08
Plant height	37.88**	61.25**	7.06	1.31	47.45**	68.00**	6.62*	-1.94
Ear height	38.94**	68.85**	8.62**	1.10	89.09**	116.83**	24.30**	-3.52
Tasseling date	-6.79**	-2.55**	0.28	-0.79	-1.85**	4.83**	-3.10**	0.08
Silking date	-6.15**	-1.14**	6.09	-0.61	1.28**	3.61**	-0.74	-0.28

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

Generally , higher heterosis percentage values were detected in the second cross (M39 x M1) for most studied traits than those obtained from the first one (M4 x M39) for most studied traits including grain yield / plant and some of its components except number of rows / ear, number of ears / plant and tasseling and silking dates. Our results which concerned heterosis percentages for grain yield/plant were smaller than those calculated by Darrah and Hallauer (1972) in one set of diallel crosses. Mohamed (1979) obtained 443.54% and 376.9% heterosis values relative to mid and high parents, respectively. Meanwhile, our estimates of heterosis percentages for grain yield/ plant were similar with Gorgan and Francis (1972), Khalil (1999) and El-Shamarka (1999) in cross-I only. On the other hand Nawar (1985a) obtained an average heterosis of two sets of diallel crosses relative to mid and high parent 35.30%, 15.60% and 15.60%, 44.30% respectively. Nawar *et al.,* (1992b) obtained in one cross 29.05%, 30.52% and 30.10% at the three nitrogen levels 125, 200 and 300 kg N/ha, and 24.17%, 27.20% and 21/41% at the same nitrogen levels relative to mid and high parent, respectively. El Shamarka (1999) obtained in one cross 13.65%, and 11.55% relative to mid and high parent, respectively.

Significant and positive inbreeding depression values were obtained for most studied traits in the two crosses except grain yield/plant and tasseling date in cross- I; plant height and tasseling date in cross-II and silking date for the two crossses. Most values of inbreeding depression were higher for the first cross than those of the second one, particularly for grain yield and some of its components. Except for grain yield/plant and silking date at cross - II; plant height and tasseling and silking dates in cross-I, significant heterosis and inbreeding depression associated in all other traits (Table 2). This is logical since the expression of heterosis in F_1 will be followed by considerable reduction in F_2 performance. Results of the characters were in harmony with that have been previously detected by El-Hosary (1981, 1982) in field beans, El-Shamarka (1999) and Khalil (1999). Finally, conflicting estimates of heterosis and inbreeding depression presented herein may be due to the presence of linkage disequalibrium between genes in the parental stock (Van der Veen, 1959).

Potence ratio values were less than unity in cross-I for ear length and tasseling and silking dates; and in cross-II for number of rows/ear and tasseling and silking dates indicating partial dominance range for these traits. Meanwhile, over dominance values or linkage were detected in remaining traits including grain yield/plant in the two crosses, hence, the values were more than unity.

Nature of gene action was also studied according to Gamble (1962) and the obtained values are given in Table (3). In all cases, the mean effect of parameters (m) was highly significant and values were higher in cross-II than their corresponding ones in cross-I except few cases i.e., number of kernels/row and number of ears/plant in cross-I. Significant positive additive effects were detected for number of kernels/row and ear height in cross- II, Significant positive dominance effects were detected for most traits except number of rows/ear, number of ears/plant and silking date in cross- II; and only for tasseling date in cross-I which showed non-significant effects. Significant negative values were obtained for tasseling date in the two crosses and for silking date in cross-I. Significant and positive additive x additive effects were obtained for most traits in cross-I including grain yield except number of kernels/row, 100-kernel weight, number of ears / plant, tasseling and silking dates; and for cross-II significant and positive values for number of kernels/row, 100-kernel weight, plant and ear heights; while significant and negative values were obtained for tasseling and silking dates, the remaining cases for this cross showed non-significant values. Significant and positive values of additive x dominance effects were obtained in cross- II for number of kernels / row, plant height and ear height; and for ear height in cross-I. On the other hand significant and negative values were detected in cross-I for number of kernels/row, plant height and tasseling and silking dates. Most values of dominance x dominance effects had highly significant negative values and less magnitude except number of rows/ear in cross-II; and number of kernels/row and silking date in cross-I

Table (3): Values of gene action of crosses I and II for all studied traits.

Traits	Cross - I (M4 X M39)						Cross - II (M39 X M1)					
	Gene action						Gene action					
	m	a	d	aa	ad	dd	m	a	d	aa	ad	dd
Grain yield / plant	274.54**	-1.24	423.68**	238.17**	-19.68	-363.51**	302.75**	4.87	188.29**	-16.06	18.75	-158.37
Ear length	19.11**	-0.85	6.40*	3.71*	-2.35	-10.98**	19.97**	-0.55	4.84**	-0.07	-0.30	-7.94**
Ear diameter	4.56**	-0.10	1.76**	1.21**	0.01	-2.61**	4.68**	-0.11	0.76**	0.27	-0.15	-1.03*
No. of rows /ear	13.39**	0.03	5.62**	2.85**	-0.26	-10.08**	13.40**	0.42	3.27	1.20	1.73	6.49*
No. of kernels/ row	39.90**	-3.29*	21.14**	2.78	11.00**	19.87**	39.70**	3.65**	26.24**	7.76*	9.71*	-35.43**
100. kernel weight	32.04**	1.22	11.68**	2.30	0.64	-11.57*	32.27**	-1.33	19.46**	9.13*	-0.67	-23.35**
No. of ears/ plant	1.27**	0.10	0.57*	0.28	0.07	-0.81	1.14**	0.01	0.02	-0.10	0.06	0.21
Plant height	274.38**	-3.39	123.54**	43.24**	-34.43**	165.33**	287.23**	6.38	137.32**	38.33**	31.91**	-193.18**
Ear height	129.96**	-1.94	84.88**	45.02**	20.08**	-120.71**	138.01**	18.45**	149.38**	63.49**	30.64**	-121.58**
Tasseling date	50.19**	-1.11*	-1.32	2.35	-3.44**	3.21	55.85**	0.22	-3.95**	-4.28**	1.94	1.17
Silking date	54.67**	-2.56**	-4.25**	-0.67	-5.47**	8.50**	57.76**	0.22	-3.19	-3.92*	1.50	4.69

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

Generally, for grain yield/plant, dominance and epistatic type of gene action additive x additive were obtained in cross I. Meanwhile, in cross-II dominance gene effects had the major contributing factor in the performance of this trait. Our result was partially agreed with those detected by Nawar *et al*. (1992a) who reported that the dominance and epistasis (additive x additive) gene actions were more important in the inheritance of grain yield/plant. The same result was obtained by Gamble (1962), Nawar (1984,1985 a,b) Galal *et al*., (1987), Nawar *et al*., (1998), El-shamarka (1999) and Khalil (1999).

Heritability in broad and narrow senses and genetic advance as a percent of the F_2 mean in the two crosses for all traits are presented in Table (4). For cross-I heritability values were ranged betwen 11.97% for number of rows/ear to 86.67% for grain yield/plant relative to narrow sense, and from 19.34% for number of rows/ear to 98.10% for ear diameter; for cross-II the data showed heritability values between 21.16% for plant height to 92.99% for grain yield/plant; and from 9.90% for number of rows/ear to 91.32% for tasseling date relative to narrow and broad senses.

Table (4): Values of heritability in the narrow and broad sense (h (n), h(b)) and the predicted genetic advance from selection (∆g, ∆g%) for crosses I and II for all studied traits.

Traits	Cross - I (M4 X M39)				Cross - II (M39 X M1)			
	Heritability		Predicted genetic advance		Heritability		Predicted genetic advance	
	h (n)	h (b)	∆g	∆g%	h (n)	h(b)	∆g	∆g%
Grain yield / plant	86.67	87.49	61.91	22.55	92.99	72.37	85.95	28.39
Ear length	70.34	48.85	1.45	7.60	75.52	46.14	1.41	7.04
Ear diameter	77.24	98.10	0.57	12.59	64.18	53.34	0.29	6.16
No. of rows /ear	11.97	19.34	0.72	5.38	29.47	9.90	0.40	2.95
No. of kernels /row	60.30	47.58	7.27	18.22	38.45	47.81	7.22	18.19
100. kernel weight	45.14	35.27	2.19	6.85	53.29	27.95	2.27	7.04
No. of ears/plant	80.26	57.32	0.28	21.87	48.80	63.81	0.16	14.35
Plant height	71.48	67.13	39.99	14.57	21.16	66.75	25.59	8.91
Ear height	73.25	84.25	33.03	25.42	72.62	52.18	27.44	19.88
Tasseling date	30.82	31.93	0.71	1.41	59.06	91.32	3.05	5.47
Silking date	49.99	86.20	1.78	3.25	70.81	91.09	3.04	5.27

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

Generally, heritability values for grain yield/plant in the narrow sense reached 86.67%, 92.99% for cross-I and cross-II, respectively, and in cross-I and cross-II for broad sense were 87.49% and 72.37%, respectively. The higher estimates in the broad sense indicating the prevalent of dominance and epistatic effects in the inheritance of grain yield/plant. This result was confirmed by the finding of the potence ratios (Table 2), where over dominance effect play the major role in this concern. The present heritability values for grain yield/plant were higher than those reported by Hallauer and Miranda (1981). They reached to 18.70% for grain yield/plant also, Nawar *et al.* (1996) in SC_{10} obtained intermediate value of heritability in the narrow sense 23% for grain yield / plant. On the other hand our data were similar with those obtained by Nawar *et al*. (1992a). They obtained an average heritability values 83.70% and 84.05% in cross-I (M_1xM_2) and cross-II (M_3 x M_7) respectively.

The expected genetic advance from selection in F_2 for grain yield / plant was higher in cross - II (28.39%) than in cross-I (22.55%).Many researchers calculated the expected genetic advance from different methods of selection , beside heritability values to get more useful in predicting the resultant effect of selection than heritability values alone (Johanson *et al*., 1955) in soybean . Nawar *et al*. (1995) calculated the expected genetic advance from different methods of selection in maize population Giza-2.The higest valus from-full-sib family selection based on S_1 and S_2 (66.72 grams or Δg% 32.93%), and (87.0 grams or Δg% 42.94%) respectively. Also, Nawar *et al.,* (1996) obtained 19.38% for grain yield/plant (Δg% , 19.38%) in SC_{10} with recurrent selection method. Khalil (1999) obtained (Δg%) 32.61 and 13.22% for cross-I, and cross-II, respectively. Therefore, selection would be effective for superior genotypes may be used in maize breeding programmes and hybrid production.

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دراسات وراثية علي هجينين من الذرة الشامية

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أجريت هذه الدراسة بهدف تقدير قوة الهجين والكفاءة الوراثية ومقدار النقص المصاحب للتربية الداخلية في الجيل الثاني ودرجة السيادة ومقدار التحسين الوراثى المتوقع الحصول عليه من ممارسة الإنتخاب وكذلك دراسة فعل الجين الوراثي المؤثر فى وراثة بعض الصفات الكمية وقد اشتملت الدراسه على هجينين فرديين هما (منوفيه ٤ × منوفيه٣٩) و (منوفيه ٣٩ × منوفيه ١) والسلالات الأبويه وكذلك الجيل الأول، والجيل الثاني، والهجين الرجعى الأول، والهجين الرجعى الثانى لكل منهما، وتم أخذ القياسات على احدى عشرة صفة كمية هى:

محصول الحبوب للنبات الفردى وطول وقطر الكوز وعدد الحبوب بالصف وعدد الصفوف بالكوز ووزن ١٠٠ حبة وعدد الكيزان على النبات وارتفاع النبات وارتفاع الكوز، وميعاد التزهير لكل من النورة المذكرة، والنورة المؤنثة، وحللت النتائج بطريقة الثوابت الوراثية الستة والمقترحة من قبل جامبل ١٩٦٢.

وكانت النتائج كالتالى:

١- تفوق الهجين الثاني (منوفيه ٣٩ × منوفية١) عن الهجين الأول (منوفية٤ × منوفية ٣٩) فى المتوسط وقيم التباين الوراثى ماعدا صفتى عدد الكيزان على النبات وارتفاع النبات.

٢- أظهرت قيم قوة الهجين تقديرات معنويه وموجبة للهجين الثانى عن الهجين الأول لمعظم الصفات المدروسة بما فى ذلك صفة محصول الحبوب للنبات الفردى عدا صفات عدد الصفوف بالكوز، وعدد الكيزان على النبات وميعادى التزهير للنورتين المذكرة والمؤنثة وتراوحت قوة الهجين بين -٦,١٥% إلى ١١٥,٩٦% لصفة التزهير للنورة المؤنثة ومحصول الحبوب للنبات الفردى على أساس الأب المتوسط بينما تراوحت بين -٢,٥٥% لميعاد التزهير للنورة المؤنثة إلى ٩٠,٩٩% لصفة محصول الحبوب للنبات الفردى على أساس الأب الأفضل وقد حاز الهجين الثانى قيماً تراوحت بين -١,٨٥% لصفة التزهير للنورة المذكرة إلى ١٣٣,٦٠% لمحصول الحبوب للنبات الفردى على أساس الأب المتوسط، وكذلك تراوحت قيمة قوة الهجين على أساس الأب الأفضل للهجين الثانى أيضاً بين ٣,٦١% لصفة التزهير للنورة المؤنثة إلى ١١٤,١٦% لصفة محصول الحبوب للنبات الفردى.

٣- أظهرت قيم النقص المصاحب للتربية الداخلية للجيل الثانى لمعظم الصفات قيماً مرتفعة فى الهجين الأول عن الهجين الثانى بما فى ذلك صفة محصول الحبوب للنبات الفردى وبعض مكوناتها.

٤- أظهرت قيم درجة السيادة قيماً أقل من الوحدة فى الهجين الأول لصفات طول الكوز وميعادى التزهير للنورتين المذكرة والمؤنثة، وكذلك فى الهجين الثانى أيضاً لصفات عدد الصفوف بالكوز وميعادى التزهير للنورتين المذكرة والمؤنثة، وكانت تلك القيم فى مدى السيادة الجزئية لهذه الصفات. بينما تحققت زيادة فائقة أو ارتباط وراثى فى باقى الصفات بما فى ذلك صفة محصول النبات الفردى من الحبوب حيث كانت درجة السيادة أعلى من الوحدة.

٥- أظهرت الدراسة أن فعل الجين الوراثى المتحكم فى وراثة صفة محصول الحبوب للنبات الفردى فى الهجين الأول ترجع إلى الفعل السيادى والفعل التفوقى من النوع (الإضافى × الإضافى) بينما كان النوع السيادى من فعل الجين هو المتحكم فى وراثة هذه الصفة فى الهجين الثانى.

٦- أظهرت قيم الكفاءة الوراثية بالمعنى الضيق لصفة محصول الحبوب للنبات الفردى قيماً ٨٦,٦٧% ، ٩٢,٩٩% للهجين الأول والثانى على الترتيب. بينما كانت قيم الكفاءة الوراثية على أساس المعنى الواسع ٨٧,٤٩% ، ٧٢,٣٧% للهجين الأول والثانى على الترتيب لنفس الصفة وأظهرت القيم العالية للكفاءة الوراثية بالمعنى الواسع للهجين الأول والثانى تحكم فعل الجين من النوع السيادى وكذلك الفعل التفوقى فى وراثة محصول الحبوب للنبات الفردى.

٧- أظهرت قيم التحسين الوراثى المتوقع الحصول عليه عند ممارسة الإنتخاب (Δ g%) تفوق الهجين الثانى عن الهجين الأول حيث كانت ٢٢,٥٥% ، ٢٨,٣٩% على الترتيب.