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HETEROTIC PATTERNS AMONG EIGHT EXOTIC AND LOCAL YELLOW MAIZE POPULATIONS

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ABSTRACT

Information about heterotic patterns in breeding programs is very important. Introduction of exotic germplasm into national maize breeding program can help in providing new heterotic patterns to maize breeders. This study was conducted to determine heterotic patterns among eight yellow maize populations. Six of these populations are exotics while the other two were local populations. Full diallel was done among these eight populations. The eight populations, their crosses and reciprocals were evaluated at three locations in 2003 season. The results showed that populations 45 and 31 produced the highest per se grain yield. The highest heterotic combinations for yield among the parental populations were found between the two exotic populations 31and 45 and each of the two local populations, Sakha 21 (SK.21) and Nubaria Yellow Population (NYP). High parent heterosis was observed in crosses between Pop31 and each of SK.21 and NYP. Pop.31 demonstrated the highest general combining ability (GCA) for grain yield. The study indicated that, populations 31, 45, SK.21 and NYP have a good potential for use in the National Maize Breeding Program (NMBP) especially in a hybrid development program.

Keywords: Maize, Corn, Zea mays, Heterotic pattern, GCA, SCA, Diallel, Reciprocal.

INTRODUCTION

Due to increasing demand for yellow maize hybrids in EGYPT in the last few years, the National Maize Research Program (NMRP) has begun various breeding activities which focus on developing new yellow maize hybrids. Information about combining ability and heterotic pattern among exotic and local populations is essential to maximize their use for hybrid development. The use of exotic germplasm to broaden the germplasm base used by maize breeders has been widely emphasized (Beck *et al*, 1991; Vassal *et al*, 1982; Ron Parra and Hallauer, 1997). Introgression exotic germplasm is often suggested as an approach to increase genetic differences between opposing heterotic populations, thereby potentially increasing heterotic response.

Several scientists have reviewed studies on heterotic patterns existing in the major maize production regions of the world (Wellhausen, 1978; Ron Parra and Hallauer, 1997). Some heterotic patterns had importance in specific production regions.

Mungoma and Pollak (1988) reported that introgression has been used to introduce exotic germplasm to the Corn Belt region, but it is not clear how much exotic germplasm should be incorporated into an adapted germplasm. Hallauer and Miranda (1981) showed that plant breeders are faced with the task of identifying parents that, when crossed, will express maximum hetrosis. Diallel analysis for a fixed set of populations provides a basis for preliminary analysis of hetrotic pattern among population crosses.

Genetic diversity can be increased by using exotic germplasm as suggested by Goodman (1965), Moll *et al* (1965), Bridges and Gardner (1987) and Crossa *et al* (1987). Hallauer (1978) reported high levels of hetrosis expressed among exotic germplasm and among exotic varieties. Ismail (1999) indicated that several exotic populations were well adapted to the Egyptian environment and were utilized directly to develop some high yielding varieties and varietal crosses during the period 1970 – 1980.

The objectives of this study were i) to obtain information on combining ability and heterosis among some exotic and local populations, and ii) to identify the potential use of some exotic germplasm in the national breeding program.

MATERIALS AND METHODS

A diallel set was produced among eight (6 exotic and 2 local) yellow maize populations (2 tropical, 4 subtropical and 2 temperate) in the breeding nursery at Nubaria Agric. Res. Station, ARC, Egypt in 2002 season. The six exotic populations used in this investigation were obtained from the germplasm bank of the National Maize Research Program (NMRP). Four populations were from the International Maize and Wheat Improvement Center (CIMMYT), Mexico, while the other two populations were from Turkey (Table 1).

The crosses were done between parents using bulk pollen from about 100 plants to pollinate at least 100 plants in the opposing parent. Seeds of crosses and reciprocal crosses were bulked for use in the evaluation trials.

The parents, their crosses and reciprocal crosses were evaluated at three locations (Nubaria, Sakha and Mallawy) in 2003 season. The experimental design was a randomized complete block with three replicates. The experimental unit consisted of two rows, each 6 m. long and spaced 80 cm apart. Plots were hand-planted using two seeds/hill, and then thinned to one plant per hill, with 25 cm between hills providing a population density of approximately 50000 plants per hectare. All agronomic practices and pest control procedures were applied as recommended.

Data were recorded for days to mid-silking (number of days from planting to 50% extruded silks), plant height (from soil surface to the point where tassel begins), ear height (from soil surface to node of the first ear), yield per plot, percent of resistance to late wilt disease (no of resistant plants relative to the number of plants per plot), shelling percent and grain moisture at harvest. Plots were hand harvested and ears were shelled and yield was adjusted to ton per hectare at 15.5% seed moisture content.

Analysis of variance (ANOVA) was completed for studied traits using plot data. Locations were analyzed separately and then in a combined analysis. Locations were considered random and genotypes were considered fixed effects in the ANOVA. Griffing's (1956) method 1 analysis was used to obtain estimates of general (GCA) and specific (SCA) combining ability for each parent and their crosses. Only main effects were tested against their respective interaction with location

Table (1): Population, population abbreviation and germplasm description of the eight studied populations.

Population	Population abbreviation	Germplasm description
Nubaria Yellow Population	NYP	Subtropical, semident grain, local population derived from 15 different local and exotic germplasm.
Sakha 21	Sk.21	Subtropical, semident grain, local population derived from 21 different local and exotic germplasm.
Antigua	ANT	Tropical, semident grain, consisted of materials from CIMMYT, Mexico.
Wistigua	WIST	Subtropical, semident grain, consisted of materials from CIMMYT, Mexico.
Population 31	Pop.31	Tropical, flint grain, consisting of materials from CIMMYT, Mexico.
Population 45	Pop.45	subtropical, dent grain, consisted from U.S. corn belt and other materials from CIMMYT, Mexico.
ADA	ADA	Temperate, dent grain, Turkish population.
AE	AE	Temperate, dent grain, Turkish population.

RESULTS AND DISSCUSION

Analysis of variance combined across locations, indicated significant differences among entries for all studied traits (Table 2). For grain yield, all sources of variation of main effects were highly significant, and loc x GCA was significant. All sources of variation for days to silking were significantly different except for SCA. Also, all sources of variation were highly significant for plant and ear heights. For late wilt disease resistance, highly significant differences were observed among populations, crosses and interaction of locations with GCA, SCA and reciprocals.

A separate test of populations vs crosses; (nonadditive genetic effects) indicated that average heterosis was significant for all studied characters.

Grain yield

Grain yield for all crosses ranged from 5 to 7.6 t/ha with an average of 6.1 t/ha, and from 4.7 to 7.5 t/ha with an average of 6.4 for reciprocal crosses. For parental populations, it ranged from 3.7 to 5.5 t/ha with an average of 4.9 t/ha (Table 3). Yield heterosis (high-parent) ranged from – 4.3 to 41.3% and from – 10.3 to 40.2 with means of 25.9 and 30.9% for crosses and reciprocal crosses, respectively.

Among the parents, Pop.45 and Pop.31 had the highest grain yield of 5.5 and 5.4 t/ha, respectively, while Wistigua was the lowest yielding parental population (3 7 t/ha).

The crosses Sk.21 x Pop.31 and NYP x Pop.31 produced the highest yield among all studied crosses. They yielded 7.6 and 7.5 t/ha, respectively.

They also revealed the highest heterosis values; 41.3 and 40.2%, respectively. The same trend was found for crosses Pop.45 x NYP and SK.21 x Pop.45, where they yielded 7.2 and 7.3 t/ha. The reciprocal crosses differences of the four previous crosses were insignificant except for NYP x Pop.31 where the difference (0.7 t/ha) was significant. The superiority of these 4 crosses can be explained on the basis that it represents two divergent germplasm groups since each cross consisted of subtropical (local) x tropical (exotic) germplasm. Also, pop.31 had flint endosperm while the others were dent. Heterosis is expected if among divergent crosses. Falconer showed the heterosis is function of difference in gene frequency as well as dominance effect. These results are in correspondence with those obtained by Goodman (1956), Moll *et al*, (1965), Bridges and Gardner (1987) and Crossa *et al.* (1987), which showed that genetic diversity in breeding programs can be increased by using exotic germplasm.

Reciprocal crosses for yield were highly significant (Table 2). Thirteen out of 28 reciprocal cross differences were significant. The highest reciprocal cross differences were detected for the crosses ANT x Pop.31, ANT x WIST, Pop.31 x Pop.45, NYP x Pop.31, Pop.31 x AE and Pop.31 x ADA where yield differences were 4.7, 3.3, 2.5, 2.4 and 1.9 ard/fad, respectively. These differences are big enough to be considered in a hybrid development program. Moreover, it was noticed that Pop.31 and Pop.45, in most of the crosses, produced higher yield when they were used as female parents. Melchinger *et al* (1985), and Seka *et al* (1995) reported significant reciprocal differences in the studied crosses.

Table 2. Mean squares for studied traits of the eight populations across three locations in 2003.

S.O.V.	D.F.	Grain Yield	Days to mid-silking	Plant height	Ear height	Late wilt resistance% $
Location (Loc)	2	26.61 **	954.78 **	174548.11 **	4463.79 **	662.39 **
Replicates (Rep)/Loc	6	0.21	5.44 **	341.36 **	308.13 **	765.11 **
Entries	63	6.80 **	15.96 **	1124.37 **	510.42 **	126.42 **
GCA	7	29.98 **	98.95 **	4162.90 **	1630.88 **	3.85
SCA	28	6.42 **	7.39	1071.53 **	534.83 **	21.06
Reciprocal (Recp)	28	1.39 **	3.79 **	417.58 **	205.88 **	15.85
Loc x Entries	126	0.20	4.19 **	320.89 **	199.27 **	49.58
Loc x GCA	14	0.41 *	6.81 **	742.97 **	516.87 **	32.60 **
Loc x SCA	56	0.21	4.28 **	310.76 **	173.49 **	19.72 **
Loc x Recp.	56	0.14	3.46 **	225.49 **	145.66 **	16.49 **
Pooled error	378	0.20	1.10	72.64	61.74	43.06
C.V.		7.5	1.8	3.9	6.8	7.1

***, ** Significant at P = 0.05 and 0.01, respectively.**

$ Measured at two locations only (Sakha and Mallawy).

High-parent hetrosis for grain yield ranged from – 11.5 to 29.2% for all crosses and reciprocal crosses (Table 3). Crosses that demonstrated superior hetrosis were Sk.21 x Pop.31 (29.2%), Pop.31 x NYP (28.7%) Pop.31 x Sk.21 (28.1%) and SK.21 x NYP (26.8%). It should be noticed that the highest values for heterosis were obtained from the 4 crosses that involved only Pop.31, NYP and SK.21 populations which indicates the divergent genetic background of these populations. Five crosses had negative or equal to zero yield heterosis%.

Table (3). Means of crosses, reciprocal crosses and populations for grain yield, yield heterosis[#] and late wilt disease resistance across all locations in 2003.

Crosses	Grain yield (t/ha)		Yield heterosis (%)		Late wilt $ resistance (%)	
	Direct	Recipe	Direct	Recipe	Direct	Recipe
NYP x SK.21	6.6	7.1	27.3	36 6	93 9	92.2
NYP x ANT	6.3	6.0	25.1	19.8	93.2	91.3
NYP x WIST	5.4	5.3	8.4	6.0	93.9	90.0
NYP x Pop.31	6.8	7.5	26.8	40.2	97.6	98.6
NYP x Pop.45	6.9	7.2	25.5	30.4	97.3	99.7
NYP x ADA	6.6	6.5	31.1	29.9	93.1	90.1
NYP x AE	6.0	6.1	14.4	17 2	91.9	91.3
SK.21 x ANT	6.2	6.4	20.9	23.3	90.6	95.8
SK.21 x WIST	5.8	6.3	12.2	22.7	93.4	94.3
SK.21 x Pop.31	7.6	7.5	41.3	39.1	95.4	98.3
SK.21 x Pop.45	7.3	6.9	31.5	24.5	93.9	98.7
SK.21 x ADA	5.8	5.8	12.8	11.6	95.5	94.6
SK.21 x AE	6.3	6.2	20.1	18.4	91.5	88.6
ANT x WIST	5.6	4.7	26.2	4.0	89.8	81.2
ANT x Pop.31	5.7	7.1	5.6	31.8	93.9	97.2
ANT x Pop.45	5.3	5.8	- 4.3	4 3	89.9	96.4
ANT x ADA	5.0	5.5	12.1	23.5	88.4	91.2
ANT x AE	5.8	5.8	11.5	11.5	94.1	85.9
WIST x Pop.31	6.0	6.4	12.3	19.0	89.1	95.5
WIST x Pop.45	5.3	5.5	- 3.8	0.0	91.1	90.9
WIST x ADA	5.1	4.9	14.9	10.1	80.1	88.9
WIST x AE	5.1	4.7	- 2.3	- 10.3	85.9	77.9
Pop.31 x Pop.45	6.1	6.8	9.8	23.4	97.5	96.6
Pop.31 x ADA	7.1	6.5	31.3	20.7	90.4	92.4
Pop.31 x AE	7.2	6.5	34.6	21.2	95.9	90.8
Pop.45 x ADA	6.5	5.9	18.5	7.6	96.3	90.2
Pop.45 x AE	6.1	5.7	9.8	3.8	93.2	91.9
ADA x AE	5.8	5.3	11.5	1.7	91.7	90.1
Mean	6.1	6.4	25.9	30.9	92.4	92.1
Populations						
NYP	5.0		-----		88.4	
SK.21	5.2		-----		99.2	
ANT	4.5		-----		88.1	
WIST	3.7		-----		84.2	
Pop.31	5.4		-----		98 0	
Pop.45	5.5		-----		98.1	
ADA	4.4		-----		90.9	
AE	5.2		-----		87.1	
Mean	4.9		-----		91 7	
LSD $_{0.05}$	0.4		-----		7.5	

$ Measured at two locations only (Sakha and Mallawy).

[#] High-parent heterosis

Previous studies of diallel crosses among some CIMMYT tropical materials revealed low hetrosis (Beck *et al*, 1990; Crossa *et al*, 1990). This was not surprising considering CIMMYT's emphasis on developing broad base genetic pools and populations composited with principal emphasis on combining desirable traits for different ecological situations (Vasal *et al*, 1982). Consideration was generally not given to keeping heterotic groups separate. Therefore, crosses of CIMMYT's broad base genetic materials at the population level lead to partial cancellation of heterotic effects.

Table (4). Means of crosses, reciprocal crosses and studied populations for days to mid-silking, plant and ear heights across locations in 2003.

Crosses	Days to mid-silking		Plant height (cm)		Ear height (cm)	
	Direct	Recipe	Direct	Recipe	Direct	Recipe
NYP x SK.21	60.2	59.7	231.9	226.7	121.9	118.1
NYP x ANT	59.0	60.8	219.9	207.7	111.0	108.7
NYP x WIST	57.3	58.1	212.9	232.7	110.9	130.6
NYP x Pop.31	59.6	59.7	217.8	224.7	115.6	129.7
NYP x Pop.45	60.2	59.3	220.3	227.3	118.0	119.9
NYP x ADA	59.8	59.4	211.9	215.7	113.1	113.3
NYP x AE	58.0	59.0	215.9	219.0	113.0	117.8
SK.21 x ANT	60.3	61.8	239.3	218.9	124.4	113.6
SK.21 x WIST	59.2	60.7	217.3	219.6	114.3	116.1
SK.21 x Pop.31	60.4	60.7	242.2	239.4	132.7	131.9
SK.21 x Pop.45	60.2	61.6	250.9	237.0	134.4	126.8
SK.21 x ADA	61.0	60.8	223.6	228.2	118.2	119.2
SK.21 x AE	59.1	59.3	238.1	225.1	126.3	113.9
ANT x WIST	58.4	59.1	217.1	209.0	108.2	110.1
ANT x Pop.31	60.9	59.8	218.7	212.8	116.0	111.0
ANT x Pop.45	61.9	61.3	217.6	211.1	109.6	110.0
ANT x ADA	62.1	61.3	216.6	224.8	111.0	121.7
ANT x AE	60.0	58.3	219.7	223.2	114.2	119.4
WIST x Pop.31	58.1	58.3	222.1	224.9	117.1	118.9
WIST x Pop.45	58.1	59.1	220.8	207.9	119.7	113.6
WIST x ADA	60.1	58.6	221.3	212.2	118.6	110.8
WIST x AE	57.7	57.8	215.2	219.8	113.2	115.1
Pop.31 x Pop.45	61.6	61.4	226.7	224.4	118.4	117.6
Pop.31 x ADA	59.4	60.3	240.8	220.2	120.9	118.4
Pop.31 x AE	58.6	58.4	221.9	226.7	117.2	120.3
Pop.45 x ADA	60.4	61.1	223.1	224.1	116.3	117.4
Pop.45 x AE	59.8	58.9	217.2	222.6	116.2	116.7
ADA x AE	60.6	59.8	232.1	221.3	119.4	115.0
Mean	59.7	59.8	224.0	221.7	117.5	117.7
Populations						
NYP	60.1		192.4		96.6	
SK.21	63.9		235.3		123.7	
ANT	61.7		199.4		99.2	
WIST	58.6		190.1		103.6	
Pop.31	61.6		209.4		110.6	
Pop.45	61.6		205.0		107.8	
ADA	61.8		203.2		98.2	
AE	58.9		203.4		106.6	
Mean	61.0		204.4		105.8	
$LSD_{0.05}$	0.9		7.9		7.2	

Pop.31 had the highest significant value of general combining ability (GCA) for grain yield, followed by NYP and Sk.21 (2.21, 1.13 and 1.09), respectively (Table 5), while WIST had the highest significant negative value (- 2.49). The highest specific combining ability (SCA) effects were observed for crosses of Pop.45 with both Sk.21 and NYP (2.01 and 1.98), respectively (Table 5). Also, Sk.21 had high values of SCA with Pop.31 and WIST (1.93 and 1.71), respectively. Pop.31 had high values of SCA effects for its reciprocal crosses with ANT and NYP (2.34 and 2.19), respectively (Table 5). As expected, populations containing relatively high levels of exotic tropical and subtropical germplasm such as Pop.31 showed the highest GCA effects for yield.

The correlation coefficient between GCA and population mean was 0.85, highly significant from zero indicating that the high yielding population would transmit this property to their crosses. On the other hand, the SCA for NYP x SK.21 was low and was negative for pop.31 x pop.45, suggesting that crosses within local or within exotic population would not recommended.

Table (5):General combining ability (GCA) effects (on diagonal), specific combining ability effects for crosses and reciprocal crosses (above and below diagonal, respectively) for grain yield across locations in 2003.

	NYP	SK21	ANT	WIST	Pop31	Pop45	ADA	AE
NYP	1.13	0.60	0.59	- 0.63	1.66	1.98	1.66	- 0.36
SK21	- 0.84	**1.09**	1.13	1.71	1.93	2.01	- 0.81	0.28
ANT	0.46	- 0.19	**- 1.13**	0.88	0.27	- 0.95	- 0.31	1.15
WIST	0.22	- 0.93	1.6	**- 2.49**	1.11	0.02	0.14	- 0.57
Pop31	- 2.19	0.22	- 2.34	- 0.59	**2.21**	- 1.25	1.34	1.32
Pop45	- 0.45	0.63	- 0.76	- 0.34	- 1.21	**0.59**	1.23	- 0.33
ADA	0.11	0.09	- 0.86	0.39	0.99	0.99	**- 0.90**	0.04
AE	- 0.26	0.22	0.02	0.70	1.22	0.54	0.85	**- 0.50**

SE $g_i = 0.08$, $g_i - g_j = 0.12$,

$s_{ij} = 0.22$, $s_{ij} - s_{kl} = 0.30$

Late wilt disease resistance

Percent of late wilt (*Cephallosporium maydis*) disease resistance ranged from 77.9 to 99.7 for all crosses and reciprocals with an average of 92.2% (Table 3), while it ranged from 84.2 to 99.2 with an average of 91.7% for the parental populations.

Significant differences were observed between means of crosses, reciprocal crosses and parental populations. The highest values of late wilt resistance were obtained from crosses of populations 31 and 45 with each other or in their crosses with NYP and SK.21, while the lowest values were obtained from crosses of WIST with AE and ADA populations. The most resistant populations were SK.21 (99.2%), Pop.45 (98.1%) and Pop.31 (98%) while the least resistant populations were Wistigua (84.2%) and AE (87.1%) populations. GCA effects showed that pop.31 and WIST populations had the highest significant values 0.60 and 0.41, respectively. Therefore, these populations are considered a good source of favorable alleles for both yield and late wilt disease resistance.

Some reciprocal differences were observed for late wilt disease resistance. Pop.31 and Pop.45 showed better resistance in their crosses with the other populations when they were used as a female parent who may indicates that cytoplasmic effects are involved in resistance to late wilt.

Table (6). Estimates of general combining ability effects (GCA) for days to mid-silking, plant and ear heights and resistance to late wilt disease for 8 populations across locations in 2003.

Population	Late wilt resistance	Days to mid-silking	Plant height	Ear height
NYP	0.26	- 0.52	- 3.85	- 1.46
SK21	0.07	0.88	11.13	6.33
ANT	- 0.86	0.61	- 4.72	- 4.41
WIST	0.41	- 1.30	- 5.49	- 2.10
Pop31	0.60	0.11	3.21	3.06
Pop45	0.16	0.59	0.64	0.76
ADA	- 0.61	0.61	- 0.53	- 1.75
AE	- 0.04	- 0.98	- 0.38	- 0.43
SE g_i	0.24	0.12	0.08	0.66
$g_i - g_j$	0.37	0.17	0.12	1.00

Days to mid-silking

Significant differences were found among crosses, reciprocal crosses and populations (Table 2). Number of days to mid-silking ranged from 57.3 to 62.1 days for crosses and reciprocal crosses, while it ranged from 58.6 to 63.9 days for parental populations (Table 4). Generally, the differences in silking were small to upset selection for yield. Crosses and reciprocal crosses were earlier than their parental populations. The earliest populations were WIST and AE (58.6 and 58.9 days) respectively, therefore, their crosses with the other populations had the lowest number of days to mid-silking. High negative significant value of GCA for WIST population, in opposite, SK.21 had the highest positive significant value of GCA, which explains earliness or lateness that WIST or SK.21 conveys to their crosses with other populations.

Plant and ear height

Differences among crosses, reciprocal crosses and populations for plant and ear height were highly significant (Table 2). Negative GCA effects for both traits usually indicate better agronomic performance because lower plant and ear heights are desirable (Pollak *et al* 1991). NYP, WIST and ANT had high negative GCA effects for both traits, while SK.21 and Pop 31 had the highest positive GCA effects.

Means for plant height ranged from 190.1 cm for WIST to 235.3 cm for Sk.21 (Table 4). Generally, short populations such as WIST and NYP had shorter plants in their crosses with the other populations. On the opposite, Sk.21 was the tallest population (235.3 cm), subsequently; its crosses with the other populations produced the tallest plants.

NYP, ADA and ANT populations had the lowest ear height (96.6, 98.2 and 99.2, respectively) and they produced lower ear height in their crosses with the other populations. The opposite trend was found for SK.21 (123.7 cm) as shown in Table 4.

SK.21 had highest positive significant value of GCA effects for plant height (11.13) while, WIST and ANT populations had the highest negative significant values of GCA (-5.49 and -4.72). Also, for ear height, SK.21 population had the highest positive significant value for GCA (6.33), while ANT population had the highest negative value for GCA (- 4.41).

Finally, the present study indicated that the two exotic populations Pop.31 and Pop.45 in one side with NYP and SK.21 as the second side represent a good germplasm source for the National Maize Breeding Program. It is suggested to develop a four population program to breed for high yielding yellow hybrid. The cross pop.31 x pop.45 would be used as a female parent while the cross SK.21 x NYP as pollen parent. Inbred lines would be isolated from each composite. This cross between the two composite would have the highest heterosis while selection within each composite would posses high yielding genes as well as resistance to late wilt. The only a disadvantage of this scheme is the tallness of the composite.

REFERENCES

Beck, D.L., S.K Vand J. Crossa. 1991. Heterosis and combining ability of CIMMYT's tropical and intermediate maturity maize germplasm. Maydica 35 : 279- 285.

Bridges,W.C.,Jr., and C.O.Gardner. 1987. Foundation populations for adapted exotic crosses. Crop Sci. 27:501-506.

Crossa, J.; C.O. Gardner and R.M. Mumm. 1987. Heterosis among populations of maize (*Zea mays* L.) with different levels of exotic germplasm. Theor. Appl. Genet. 73:445-450.

Crossa, J.; S.K. Vassal and D.L.Beck. 1990. Combining ability study in diallel crosses of CIMMYT's tropical late yellow maize germplasm. Maydica 35 : 273-278.

Falconer,D.C. 1960. Introduction to quantitative genetics. Ronald Press, New York.

Goodman , M.M. 1965. Estimates of genetic variance in adapted and exotic populations of maize. Crop Sci. 5:87-90.

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. Aust. J. Biol. Sci. 9:463-493.

Hallauer, A.R. 1978. Potential of exotic germplasm for maize improvement. In: International Maize Symposium, W.L.Walden, ed., pp. 229-247. McGraw-Hill, New York, USA.

Hallauer, A.R. and J.B. Miranda, 1981. Quantitative genetics in maize breeding. 1st ed., Iowa State Univ. press, Ames, IA, USA.

Ismail,A.A. 1999. History of maize development in Egypt. In: Proc. 1st Plant Breed. Conf., Egypt. J. Plant Breed., 3:149-158.

Melchinger,AE; H.H. Geiger and F.W. Schnell. 1985. Reciprocal differences in single-cross hybrids and their F2 and backcross progenies in maize. Maydica. 30:395-405.

Moll, R.H., J.H.Lonnquist, J.Velez-Fortuno, and E.C.Johnson. 1965. The relationship of heterosis and genetic divergence in maize. Genetics 52:139-144.

Mungoma,C., and L.M.Pollak. 1988. Heterotic patterns among ten Corn Belt and exotic maize populations. Crop Sci. 28:500-504.

Pollak,L.M., Torres,C.S., and R.A.Sotomayor. 1991. Evaluation of hetrotic patterns among Caribbean and tropical x temperate maize populations. Crop Sci. 31:1480-1483.

Ron Parra,J., and A.R.Hallauer. 1997. Utilization of exotic maize germplasm. Plant Breed. Rev. 14:165-187.

Seka,D. H.Z. Cross and P.E. McClean. 1995. Maize kernel development in vitro: sucrose concentration, xenia and maternal effects. Crop Sci. 35:74-79.

Vassal, S.K., A. Ortega, and S. pandey. 1982. CIMMYT's maize germplasm management, improvement , and utilizalion program. CIMMYT, El Batan, Mexico.

Wellhausen,E.J. 1978. Recent developments in maize breeding in the tropics. P.59-91. *In*: D.B.Walden (ed.) Maize breeding and genetics. John Wiley & Sons, N. Y, USA.

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النماذج الائتلافيه المختلفه بين ثمانية عشائر صفراء مستورده ومحليه من الذره الشاميه

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أجريت هذه الدراسه على ٨ عشائر مختلفة المصدر الوراثى (٦ عشائر مستورده وعشيرتين محليتين) وذلك بهدف دراسة النماذج الائتلافيه المختلفه بينهم. تم عمل كل الهجن والهجن العكسيه بين العشائر تحت الدراسه موسم ٢٠٠٢. تم تقييم العشائر والهجن والهجن العكسيه لها فى تصميم قطاعات عشوائيه كامله فى ثلاث محطات بحثيه (سخا – النوباريه – ملوى) خلال موسم ٢٠٠٣.

أوضحت النتائج فروقا معنويه بين العشائر تحت الدراسه وكذلك بين الهجن والهجن العكسيه لها وذلك لكل الصفات تحت الدراسه عدا صفة المقاومه لمرض الذبول المتأخر للهجن العكسيه.

تراوح محصول الحبوب للعشائر من ١٢,٣ الى ١٨,٤ أردب للفدان وقد أعطت العشيرتين المستوردتين pop.31, pop.45 أعلى كمية محصول مقارنة بالعشائر الأخرى (١٨,٤ و ١٧,٩ أردب للفدان) بينما أعطت العشيره WIST أقل كمية محصول (١٢,٣ أردب للفدان).

تراوح محصول الحبوب لكل الهجن والهجن العكسيه تحت الدراسه من ١٥,٥ الى ٢٥,٣ أردب للفدان.

أعطت الهجن SK.21 x pop.31 و NYP x pop.31 أعلى كمية محصول للحبوب (٢٥,٣ و ٢٥,١ أردب/فدان) كما أعطت أعلى تفوق هجينى لهذه الصفه (٢٩,٢ و ٢٨,٧%).

أعطت هجن العشيره pop.45 مع كلا من العشيرتين المحليتين مجتمع النوباريه الأصفر (NYP)ومجتمع سخا الأصفر (SK.21) محصولا يقدر بحوالى ٢٤ و ٢٤,٢ أردب/فدان.

أوضحت النتائج وجود نماذج ائتلافيه جيده للعشيرتين pop.31, pop.45 مع كلا من العشيرتين NYP و SK.21 .

أظهرت العشيره pop.31 أعلى قيمه للقدره العامه على التآلف (GCA) لصفة محصول الحبوب ثم العشيرتين NYP و SK.21 (٢,٢١ ، ١,٣٣ و ١,٠٩) بينما أعطت العشيره WIST أقل قيمه من GCA (-٢,٤٩).

أظهرت العشيره pop.45 أعلى قيمه للقدره الخاصه على التآلف (SCA) لصفة محصول الحبوب مع كلا من العشيرتين NYP , SK.21 (٢,٠١ و ١,٩٨) ، وكذلك أعطت العشيره pop.31 مع كلا من العشيرتين NYP , ANT قيما عاليه من SCA (٢,٣٤ و ٢,١٩).

تراوحت نسبة النباتات المقاومه لمرض الذبول المتأخر من ٧٧,٩ الى ٩٩,٧% لكل الهجن تحت الدراسه وقد أظهرت هجن العشيرتين pop.31 و pop.45 أعلى القيم لهذه الصفة.

أوضحت هذه الدراسه أن العشائر pop.45 ,pop.31 , SK.21 وNYP يمكن الاستفاده منها كمصادر جيده لعزل سلالات جديده ضمن برنامج انتاج الهجن فى البرنامج القومى لبحوث الذره الشاميه.