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COMBINING ABILITY OF TEN NEW DEVELOPED MAIZE INBRED LINES AND PERFORMANCE OF THEIR CROSSES UNDER THREE PLANTING DATES

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ABSTRACT

A half diallel set of crosses was made among ten newly developed maize inbred lines to evaluate combining ability and mean performance for grain yield / plant and some of its components, i.e. No .of ears/ 10 plants, No. of rows / ear, No. of kernels/ row and 100- kernels weight at three planting dates, i.e. 5th of May (early planting), 5th of June (recommended planting) and 5th of July (late planting). The ten inbred lines were in S_7 generation namely; L3 (P1), L6 (P2), L 22(P3), L24 (P4), L27 (P5), L58 (P6), L61 (P7), L63 (P8), L85 (P9) and L90 (P10). A field experiment was devoted for each planting date. Each experiment included 45 F_1 hybrids as well as the check variety S.C. 10 using randomized complete blocks design with three replicates at the Experimental Station of National Research Center at Kalubia Governorate, Egypt. Results indicated that mean squares due to planting dates, crosses and crosses × planting dates interaction were significant for grain yield / plant and its components at each planting date and their combined data, except crosses mean squares which were not significant for No .of ears/ 10 plants at late planting, revealing the presence of sufficient genetic variability among crosses for the studied traits. General (GCA) and specific (SCA) combining ability mean squares were found to be highly significant for all traits studied at each planting and the combined analysis, except the mean squares due to GCA and SCA for No .of ears/ 10 plants at late planting and the mean squares due to SCA for No .of rows / ear in combined analysis and 100-kernels weight at recommended planting which were insignificant, indicating the importance of both additive and non-additive gene effects in the inheritance of most studied traits. The ratios of δ^2GCA / δ^2SCA variances were greater than unity for No. of rows /ear at the three plantings, indicating that the additive type of gene action is of great importance in the inheritance of this trait. However, these ratios were less than unity for No. of kernels / row, 100 -kernel weight (except at recommended planting) and grain yield / plant at the three planting dates and their combined data, suggesting that these traits are mainly controlled by the non-additive gene effects. Meantime, the ratios of δ^2GCA / δ2SCA for No .of ears /10 plants and 100-kernels weight were inconsistent across different planting dates. Interactions of the GCA with different planting dates were highly significant for all studied traits, except No. of rows /ear and 100-kernels weight, while interaction of SCA was insignificant for the studied traits. Such results illustrate the importance of planting dates as effective factor in declaring GCA variance and its high sensitivity to planting dates than the SCA variance. The parental inbred line P4 was found to be the best general combiner for all the studied traits followed by the parental inbred lines, P2, P7 and P10 for three traits at most planting dates meanwhile, the inbred lines; P1, P5, P6 and P8 seemed to be best combiners for one or two of yield components at certain planting dates. These parental inbred lines could be considered as good general combiners for improving these traits

through hybridization programs at respective planting dates. Based on desirable SCA effects, the best crosses were $P_1 \times P_2$ for No. of ears / 10 plants; $P_4 \times P_8$ and $P_8 \times P_{10}$ for No. of rows/ ear; $P_5 \times P_8$, $P_5 \times P_{10}$, $P_6 \times P_8$ and $P_6 \times P_{10}$ for No. of kernels/ row; $P_2 \times P_7$, $P_1 \times P_4$ and $P_7 \times P_{10}$ for 100- kernels weight and $P_2 \times P_3$ and $P_3 \times P_4$ for grain yield / plant. These crosses are considered as good F_1 hybrids for these traits and could be selected and used in maize breeding programs for improving these traits. The results revealed that the two crosses; $P_1 \times P_4$ and $P_4 \times P_7$ significantly superiored the check cv. by 51.27 and 58.60g at early planting date.

Key words: ***Maize, Zea mays, Planting dates, Combining ability.***

INTRODUCTION

Maize is one of Egypt's principal cereal crops. It is used as feed for livestock and poultry, either as green fodder or as main component of dry feed. Also, it is used for human food in rural areas where it is mixed with wheat flour in bread making. In addition, it is a major component in several important industries such as corn oil, starch and fructose. The local production is not enough to cover the consumption need. Increasing maize production can be achieved by both increasing maize area in newly reclaimed soils and increasing productivity of unit area via using high yielding cultivars and improved cultural practices at suitable planting date. Corn breeders give great and continuous efforts to improve the yield of this crop. On the other hand, one of the most important factors affecting growth and productivity of a cultivar is determining its optimum planting date. The suitable date for maize planting mainly depends on many factors as weather conditions and the previous crop. In Egypt maize is planted successfully under irrigation from mid-April to mid-August, although most of the area is planted between mid May to mid June as optimum period for production, whereas grain yield decreases after this date. When maize grown at different dates, plants exposed to various climatic factors like temperature, light and humidity. Genotypes will interact differentially with these factors according to their photothermal responses and adaptability. The corn breeder is concerned with estimating genetic parameters and their interaction under different environmental conditions to choose the most effective breeding program for his materials. Therefore many research workers studied general (GCA) and specific (SCA) combining ability different planting dates and the interaction between them. In general, GCA variance is assumed to be a function of additive variance while SCA is a function of non-additive variance. El -Hosary (1988) computed GCA and SCA in a half diallel cross among ten inbred lines and their interactions with two planting dates, i.e .4 th of June and 3 rd of July. He found a significant interaction between planting dates and both types of combining abilities. The magnitude of the interaction for GCA by planting dates were generally higher than those for SCA ones, indicating that additive and additive by additive types of gene action appeared to be more affected by environments than non – additive genetic type for number of rows per ear, number of kernels per row, 100 - kernel weight and grain yield /plant. Sedhom (1994) studied GCA and SCA for the same traits and their interaction with two planting dates at June 10 and July 10. He found highly significant variances for GCA and SCA for all studied traits in the two planting dates as well as their combined data, indicating the importance of both additive and no-additive genetic variance in the inheritance of the traits studied. High ratios of GCA / SCA mean squares were obtained for all traits indicating the predominance of additive and additive × additive gene actions in the inheritance of the studied traits. Significant interactions between both types of combining ability and planting dates were detected for No. of rows / ear and grain yield / plant. Al-Ahamed *et al* (2004) indicated that additive and additive by additive types of gene action were more important than non-additive gene effects controlling grain yield / plant. Mean squares due to interaction of either GCA or SCA effects with planting dates for grain yield / plant was significant. The present investigation aimed to evaluate general and specific combining ability and performance for grain yield and some of its components in maize diallel crosses at three planting dates to find out the best parental lines and the prospective single crosses for the sake of improving maize productivity under target planting dates.

MATERIALS AND METHODS

The field experimental work of this investigation was carried out during the two successive growing seasons 2006 and 2007 at the Experimental Station of National Research Center at Kalubia Governorate, Egypt.

Ten new white maize (*Zea mays*, L.) inbred lines were randomly chosen to establish the experimental material of this investigation. The ten inbred lines in the S_7 generation were developed from different sources, i.e. the variety G.2; T.W.C. 310 and D.C. 215 by Prof .Dr. K.A .El-Shouny through the breeding program at the Agronomy Department, Fac .of Agric., Ain Shams Univ Egypt. The code numbers of the ten parental inbred lines are: L3 (P1), L6 (P2), L 22(P3), L24 (P4), L27 (P5), L58 (P6), L61 (P7), L63 (P8), L85 (P9) and L90 (P10). In 2006 summer season, a half diallel set of crosses was achieved among the ten inbred lines and 45 F_1 seeds were obtained. In 2007 summer season, the seeds of 45 hybrids as well as the chick cv. S.C.10 were sown at three planting dates, i.e. 5th of May (early planting), 5th of June (recommended planting) and 5th of July (late planting). A field experiment was devoted for each planting date and laid out in a randomized complete block design with three replications. Each plot consisted of one ridge, 5 m in length and 70 cm width. Seeds were sown at

25 cm within ridge; two kernels per hill and later thinned to one plant after about three weeks of planting. F_1 hybrids were cultivated using the dry method (Afir) and preceding crop was clover (*Trifolium alexandrinum* L.). Recommended cultural practices for ordinary maize fields in the area were followed during the growing season. Data were recorded on ten individual guarded plants chosen at random from each plot for grain yield / plant and some of its components, i.e. No. of ears/10plants, No. of rows/ear, No. of kernels/row and 100- kernels weight.

Statistical analysis was made for each planting date and their combined data according to Gomez and Gomez (1984). L.S.D. was computed to compare differences among means at 5% and 1% levels of probability. The (GCA) and (SCA) combining ability variances and effects were calculated using Griffing's (1956) method 4, model 2, at each planting date and their combined data. Superiority of hybrids was computed as the percentage of F_1 mean from the check variety mean (S.C.10) for all traits.

RESULTS AND DISCUSSION

Combining ability variances

Results in (Table 1) indicate that mean squares due to planting dates, crosses and crosses × planting dates interactions were significant for grain yield / plant and some of its components, i.e. No .of ears / 10 plants, No. of rows / ear, No. of kernels / row and 100- kernels weight at each planting date and their combined data, except for No .of ears / 10 plants at late planting, revealing the presence of sufficient genetic variability among crosses for the studied traits. General and specific combining ability mean squares were found to be highly significant for all traits studied at each planting and for combined analysis, except mean squares due to GCA and SCA for No .of ears / 10 plants at late planting and mean squares due to SCA for No .of rows / ear in combined analysis and 100-kernels weight for recommended planting date which were insignificant, indicating the importance of both additive and non-additive gene effects in the inheritance of most studied traits. In this connection Sedhom (1994a), El-Shamarka (2000), El-Beially (2003), Shafey *et al* (2003), Al-Ahmad *et al* (2004), El-Hosary *et al* (2005), El-Shenawy (2005), Katta *et al* (2007), Osman and Ibrahim (2007) and Ali *et al* (2009) found that both general and specific combining ability variances were significant for one or more of the studied traits in present investigation.The ratios of δ^2GCA δ^2/SCA variances were greater than unity for No .of rows / ear on the three plantings, indicating that the additive type of gene action is of great importance in the inheritance of this trait. However, these ratios were less than unity for No. of kernels / row, 100 -kernel weight (except at recommended planting) and grain yield / plant at the three plantings and their combined data, suggesting that these

Table 1. Mean squares of separate and combined analysis of variance for each planting date and across the three planting dates for the studied traits in maize crosses.

Source of variation	d.f		Number of ears /10 plants				Number of rows / ear				Number of kernels / row			
	Single	combined	D1	D2	D3	Combined	D1	D2	D3	Combined	D1	D2	D3	Combined
Planting dates		2				59.48**				5.43**				1763.00**
Crosses	44	44	6.92**	4.68**	0.76*	8.27**	4.18**	4.17**	4.53**	11.86**	198.69**	158.61**	160.82**	464.69**
GCA	9	9	6.37**	4.28**	0.41 ns	8.42**	5.82**	6.00**	6.53**	17.95**	144.79**	121.37**	110.01*	338.10**
SCA	35	35	1.26**	0.86*	0.21 ns	1.30*	0.26*	0.21*	0.24**	0.36 ns	46.03**	35.26**	39.10**	107.78**
Crs. × Date		88				2.04**				0.541*				26.72**
GCA × Date		18				1.32**				0.20 ns				19.03**
SCA × Date		70				0.52 ns				0.18 ns				6.30 ns
δ GCA/δ² SCA			0.71	1.37	-	1.01	5.90	8.16	6.32	-	0.28	0.36	0.26	0.35
Error			1.08	1.65	0.51	1.08	0.42	0.35	0.36	0.38	6.341	15.53	13.24	11.70

Table 1. Cont.

Source of variation	d.f		100- kernel weight				Grain yield/plant			
	Single	Combined	D1	D2	D3	Combined	D1	D2	D3	Combined
Planting dates		2				3451.36**				80863.24**
Crosses	44	44	28.21**	25.67**	28.58**	47.55**	7063.34**	4568.71**	1891.63**	11285.2**
GCA	9	9	23.79**	16.34*	21.36**	40.47**	6326.44**	3579.67**	1666.56**	10132.66**
SCA	35	35	5.70**	6.56ns	6.49**	9.51**	1333.07**	993.98**	364.14**	2123.49**
Crs.× Date		88				17.453**				119.21**
GCA× Date		18				10.51				720.00**
SCA× Date		70				4.61 ns				283.86 ns
δ^2 GCA/δ^2 SCA			0.68	-	0.55	0.68	0.56	0.56	0.47	0.57
Error			7.10	14.32	9.33	10.25	65702	124383	5285	75124

D1,D2, D3= Plants at May 5, June 5, July 5, respectively.
***and ** denote significant differences at 0.05 and 0.01 levels of probability, respectively.**

traits are mainly controlled by the non-additive gene effects. Meantime for No .of ears /10 plants and 100-kernels weight, the ratios of δ^2GCA / δ^2SCA variances were inconsistent at different planting dates. In this respect Sedhom (1994), Soliman *et al* (2005), El-Zair *et al* (1997 and 1999), El-Shamarka (2000), El-Beially (2003), Al-Ahmad *et al* (2004) and Katta *et al* (2007) indicated that additive gene action played the major role in the genetic expression for one or more of the studied traits. While, Abd El Sattar *et al* (1999), Shafey *et al* (2003), Abd El-Moula (2005), El- Shenawy (2005) and Aly and Mousa (2009) indicated that non-additive gene action was more important in the inheritance of most studied traits. Interactions of the GCA with different planting dates were highly significant for all studied traits, except No .of rows /ear and 100-kernels weight, while interaction of SCA with planting dates was insignificant for the studied traits. Such results suggesting the importance of planting dates as an effective factor in declaring GCA variance and its high sensitivity to planting dates than the SCA. In this connection El -Hosary (1988), Sedhom (1994) and Al-Ahamad *et al* (2004) indicated that the interactions of both GCA and SCA with planting dates were significant for No. of rows /ear, No .of kernels /row, 100-kernel weight and grain yield/plant.

General combining ability effects (g_i)

Significant positive GCA effects were found for all the studied traits (Table 2). Based on GCA estimates, it could be concluded that the best general combiners for No. of ears / 10 plants were the inbred lines; P2 and P4 at early and recommended planting dates and their combined data and P1 and P5 at early planting date and for No. of rows/ ear were the inbred lines; P2, P4, P8 and P10 at each planting and combined data. The best general combiners for No. of kernels / row were the inbred lines; P4, P7 and P10 at each planting date and across them and P8 and P9 at early and recommended planting dates and the combined data and for 100-kernels weight were the inbred lines; P4 at early and late planting dates and combined data and P6 and P7 at early and recommended planting dates, respectively. For grain yield / plant, the inbred lines P4 and P7 were the best at the three planting dates and their combined data, P2 at early and late planting and combined data and P10 at late planting date. These results indicated that these inbred lines could be considered as good general combiners for improving these traits through hybridization programs in he respective planting date.

Specific combining ability effects (S_{ij})

Significant positive SCA effects were found in all studied traits (Table 3). Based on SCA estimates it could be concluded that the crosses which showed significant and positive SCA effects for No. of ears /10 plants were P1×P2 at early and late planting dates and their combined data, P2×P3 and

Table 2. General combining ability effects for the studied traits of the ten white maize inbred lines at three planting dates and their combined data.

Inbred lines	Number of ears/ 10 plants				Number of rows /ear				Number of kernels /row			
	D1	D2	D3	Combined	D1	D2	D3	Combined	D1	D2	D3	Combined
P1	0.65**	0.10	0.28	0.34	-1.15**	-1.12**	-1.12**	-1.13**	-5.28**	-5.51**	-4.89**	-5.23**
P 2	1.03**	1.02**	0.11	0.72**	0.95**	1.00**	1.02**	0.99**	0.28	0.96	1.77	1.00
P 3	0.32	0.10	0.11	0.18	-0.67**	-0.91**	-0.81**	-0.80**	-4.62**	-3.92**	-2.67**	-3.74**
P 4	1.23**	1.23**	0.44	0.97**	0.68**	0.38*	0.56**	0.54**	2.32**	2.23*	3.05**	2.53**
P 5	0.57*	0.19	-0.14	0.20	-0.82**	-0.73**	-0.87**	-0.81**	-4.04**	-4.08**	-4.63**	-4.25**
P 6	-0.48	-0.48	-0.10	-0.35	-1.09**	-0.85**	-1.01**	-0.98**	-4.16**	-3.76**	-3.15**	-3.69**
P 7	-0.35	0.22	-0.18	-0.10	0.63	0.25	0.05	0.31	1.86**	3.85**	5.41**	3.70**
P 8	-1.43**	-0.90**	-0.27	-0.87**	0.98**	1.40**	1.31**	1.23**	6.86**	3.16**	0.04	3.36**
P 9	-1.06**	-0.90**	-0.14	-0.70**	0.05	0.08	0.12	0.08	4.10**	2.06*	0.69	2.28**
P 10	-0.48	-0.57	-0.10	-0.38	0.45**	0.50**	0.75**	0.56**	2.70**	5.02**	4.39**	4.03**
SE(gi)	0.20	0.25	0.14	0.20	0.13	0.12	0.12	0.12	0.49	0.76	0.70	0.66
SE(gi-gj)	0.30	0.37	0.21	0.30	0.19	0.17	0.17	0.18	0.73	1.14	1.05	0.99

Table 2. Cont.

Inbred lines	100-kernel weight				Grain yield/plant			
	D1	D2	D3	Combined	D1	D2	D3	Combined
P1	-0.16	-0.76	-0.40	-0.44	-222.88**	-337.55**	-159.78**	-240.07**
P 2	-1.96**	-1.83	1.45	-0.78	145.90*	177.87	172.18**	165.31*
P 3	-1.08	-0.34	0.30	-0.37	-239.33**	-159.10	-97.12**	-165.18*
P 4	3.61**	1.83	2.19*	2.54**	602.78**	358.93**	286.52**	416.08**
P 5	-1.00	-0.46	-0.33	-0.60	-175.15**	-127.06	-160.26**	-154.16*
P 6	0.36	2.10*	0.95	1.14	-352.64**	-124.93	-60.53**	-179.37**
P 7	2.43**	0.97	-0.41	1.00	191.05**	246.11**	70.94**	169.37*
P 8	-0.63	-2.15*	-2.60**	-1.79*	72.67	-28.33	-63.69**	-6.45
P 9	-0.63	0.88	1.45	0.57	-118.62	73.15	-27.93	-73.23
P 10	-0.93	-0.25	-2.62**	-1.27	96.22	67.22	39.67*	67.70
SE(gi)	0.52	0.73	0.59	0.62	49.64	68.30	14.08	53.08
SE(gi-gj)	0.77	1.09	0.88	0.92	73.99	101.81	20.99	79.12

D1= (5 May), D2 =(5 June) and D3= (5 July) planting dates.
*and ** denote significant differences at 0.05 and 0.01 levels of probability, respectively.
P1 (L3), P2 (L6), P3 (L 22), P4 (L24), P5 (L27), P6 (L58), P7 (L61), P8 (L63), P9 (L85) and P10 (L90).

$P_4 \times P_7$ at early and recommended planting dates, P1×P4 and P3×P6 at early planting date, P4×P5 at recommended planting and P3×P4 at late planting. For No. of rows/ ear, the best crosses were; P1×P6 and P2×P3 at recommended and late plantings, P1×P5 at early and recommended planting and P4×P8 and P8×P10 at early planting date. The crosses which exhibited significant SCA effects for No. of kernels/ row were P2×P3, P2×P6, P5×P8, P5×P10, P6×P8 and P6×P10 at the three planting dates and their combined analysis as well as seventeen crosses at one to three environments. For 100-kernels weight, the best crosses were P1×P8, P2×P7 and P2×P8 at early planting, P1×P4 and P1×P9, P6×P8 and P7×P10 at late planting. For grain yield / plant, the crosses were P2×P3 and P3×P4 at the three planting dates and their combined data and P1×P4, P2×P5 and P5×P10 at early and late planting dates and the combined data as well as 12 crosses at one or two planting dates. These crosses are considered as good F_1 hybrids for these traits at respective planting dates and could be selected and used in maize breeding programs for improving these traits. However, the best F_1hybrids for grain yield/plant were P2×P3 and P3×P4, since both gave high SCA effects at different environments and involved good × low general combiner parents. Therefore both crosses can offer good possibility for improving grain yield of maize.

Performance of experimental hybrids relative to check cultivar

Data of grain yield/plant and its components for F_1 crosses as well as the check cv .S.C.10 at the three planting dates and their combined data are listed in (Table 4) .As shown in this table yield and its components were significantly affected by dates of planting. However, the studied traits exhibited the best performance at early planting date and then began to decrease gradually with delay in planting date. Reduction on late planting was as much as in grain yield/plant which reached 55.33 %relative to the early planting date. 100-kerenal weight was the most affected yield component by delaying planting recording 31.07 %reduction which considered to be the main component caused greater reduction in grain yield / plant on late planting date .Meanwhile, the least affected components by delaying of planting were No .of rows/ear recoding 3.06 %reduction followed by No .of ears/10plant (11.00%) and No .of kernels / row (15.78%), suggesting that these traits are less sensitive to delay in planting date than the other grain yield components. Effects and reduction caused by delaying planting date on maize grain yield and its components has been studied by several authors as El-Hosary (198ٍ8), Ali *et al* (1994), Sedhom (1994), Hanyiat, El-Nimer *et al* (1997), Gouda *et al* (1998), Al-Ahamed *et al* (2004) and Mahfouz (2004) who found reduction by delay in planting date from May to July .The cross P1×P4 yielded higher ears than the check cv. S.C.10 by 1.34 ears across the three planting dates. The cross P4×P8 was significantly higher than the check cv. in No. of rows / ear by 1.3 rows at

Table 3. Specific combining ability effects for the studied traits of the 45F$_1$ maize crosses at three planting dates and their combined data.

Crosses	Number of ears/10 plants				Number of rows /ear			
	D1	D2	D3	Combined	D1	D2	D3	Combined
P1 × P2	2.08**	0.04	1.67	1.27**	0.42	0.03	0.58	0.34
P1 × P3	-1.87**	-1.04	-0.66	-1.19*	0.18	-0.33	-1.06**	-0.40
P1 ×P4	1.88**	0.84	0.34	1.02	0.16	-0.42	0.24	-0.01
P1 ×P 5	-1.12*	-0.45	-0.41	-0.66	0.99**	0.69*	-0.20	0.49
P1 ×P6	-1.08*	0.21	0.22	-0.21	0.33	0.68*	1.01**	0.67
P1 ×P7	-1.20*	0.18	-0.03	-0.35	-0.86*	-0.55	-0.18	-0.53
P1 ×P8	0.21	-0.04	-0.28	-0.04	-0.67	-0.24	-0.34	-0.42
P1 ×P9	0.17	-0.04	-0.41	-0.09	-0.41	0.15	-0.12	-0.13
P 1×P10	0.92	0.30	-0.45	0.26	-0.14	0.00	0.06	-0.03
P2 ×P3	1.09*	2.38**	-0.49	0.99	-0.19	1.02**	0.68*	0.50
P2 ×P4	-1.83**	-1.41**	-0.15	-1.13*	0.33	-0.40	-0.17	-0.08
P2 ×P5	1.84**	1.30	-0.24	0.97	0.09	-0.36	0.60	0.11
P2 ×P6	0.88	0.97	0.05	0.63	-0.04	-0.51	-0.06	-0.20
P2 ×P7	-0.24	-0.08	-0.20	-0.17	-0.02	-0.01	0.09	0.02
P2 ×P8	-1.16*	-0.96	-0.12	-0.74	-0.11	0.45	-0.58	-0.08
P2 ×P9	-1.54**	-1.29	-0.24	-1.02	0.29	0.16	-0.13	0.11
P 2×P10	-1.12*	-0.95	-0.28	-0.78	-0.78*	-0.39	-1.01**	-0.73
P3 ×P4	-0.12	-0.17	1.18	0.30	0.08	0.57	0.61	0.42
P3 ×P5	0.21	-0.79	0.09	-0.16	-0.15	-0.52	-0.23	-0.30
P3 ×P6	1.92**	-0.79	-0.28	0.28	0.11	-0.33	-0.56	-0.26
P3 ×P7	-0.87	-0.83	0.13	-0.52	0.66	-0.10	-0.08	0.16
P3 ×P8	0.21	0.30	-0.12	0.13	-0.62	0.09	0.51	-0.01
P3 ×P9	-0.16	-0.04	0.43	0.08	0.04	-0.19	-0.15	-0.10
P3 ×P10	-0.41	0.96	-0.28	0.09	-0.09	-0.21	0.28	-0.01
P4 ×P5	-0.04	1.42*	0.10	0.49	-0.57	0.13	-0.40	-0.28
P4 ×P6	-0.33	-0.24	-0.29	-0.29	0.62	-0.29	0.14	0.16
P4 ×P7	1.88**	1.71**	-0.53	1.02	-0.43	0.08	-0.39	-0.25
P4 ×P8	-1.37*	-1.16	-0.45	-0.99	0.70*	0.53	0.38	0.54
P4 ×P9	-0.07	-0.83	-0.24	-0.38	0.03	-0.15	-0.13	-0.08
P 4×P10	0.00	-0.16	0.06	-0.03	-0.91**	-0.04	-0.29	-0.41
P5 ×P6	-0.99	-0.54	-0.03	-0.52	-0.14	0.82	-0.43	0.08
P5 ×P7	-0.46	-0.58	0.05	-0.33	-0.12	0.26	-0.16	-0.01
P5 ×P8	0.30	-0.45	0.13	-0.01	0.06	-1.03**	0.17	-0.27
P 5×P9	0.59	0.22	0.01	0.27	-0.61	-0.12	0.17	-0.19
P5 ×P10	-0.33	-0.12	0.30	-0.05	0.46	0.14	0.48	0.36
P6 ×P7	-0.41	-0.58	0.01	-0.33	0.01	-0.42	0.38	-0.01
P6 ×P8	0.34	0.21	0.09	0.22	-0.61	-0.11	-0.35	-0.35
P6 ×P9	-0.04	0.88	-0.03	0.27	-0.08	-0.25	-0.62	-0.32
P6 ×P10	-0.29	-0.12	0.26	-0.05	-0.21	0.39	0.48	0.22
P7 ×P8	0.21	0.84	0.18	0.41	0.48	0.26	0.20	0.31
P7 ×P9	0.17	-0.16	0.05	0.02	0.08	0.38	0.32	0.26
P7 ×P10	0.93	-0.50	0.34	0.26	0.21	0.09	-0.18	0.04
P8 ×P9	0.92	0.96	0.46	0.78	-0.01	0.03	0.25	0.09
P8 ×P10	0.34	0.30	0.09	0.24	0.79*	0.01	-0.24	0.19
P9×P10	-0.04	0.30	-0.03	0.08	0.66	0.00	0.42	0.36
SE(Sij)	0.53	0.65	0.36	0.53	0.33	0.31	0.31	0.32
SE(Sij-Sik)	0.79	0.98	0.55	0.79	0.49	0.46	0.46	0.48
SE(Sij-Skl)	0.73	0.91	0.50	0.73	0.46	0.42	0.42	0.44

Table 3. Cont.

crosses	Number of kernels /row				100 -kernel weights			
	D1	D2	D3	Combined	D1	D2	D3	Combined
P1 × P2	2.78*	0.75	3.25	2.26	-3.22**	0.25	1.06	-0.64
P1 × P3	-7.92**	-7.45**	-6.39**	-7.25**	-1.77	-1.43	-2.58	-1.92
P1 ×P4	3.60**	0.67	7.44**	3.90*	0.55	1.09	4.35**	2.00
P1 ×P 5	-9.78**	-9.09**	-9.43**	-9.43**	-1.85	-3.22	-2.49	-2.52
P1 ×P6	-9.45**	-5.54**	-1.11	-5.37**	1.94	0.17	-0.66	0.48
P1 ×P7	6.20**	7.53**	3.28	5.67**	1.22	0.46	-1.52	0.06
P1 ×P8	6.32**	1.61	2.62	3.52*	3.35*	3.97	-1.99	1.78
P1 ×P9	3.09*	5.64**	-1.80	2.31	-0.64	-0.05	5.80**	1.70
P 1×P10	5.16**	5.89**	2.15	4.40*	0.40	-1.24	-1.98	-0.94
P2 ×P3	2.92*	5.75**	8.50**	5.72**	-1.22	-0.21	0.61	-0.27
P2 ×P4	-4.76**	-1.73	-2.69	-3.06	-3.86**	-3.56	-1.88	-3.10
P2 ×P5	4.07**	6.64**	4.39*	5.03**	-0.81	0.90	0.02	0.04
P2 ×P6	8.79**	4.27*	5.71**	6.26**	-2.60	-0.98	-0.94	-1.51
P2 ×P7	-2.43	-3.88	-6.38**	-4.23*	3.00*	0.68	2.11	1.93
P2 ×P8	-6.10**	-7.72**	-11.62**	-8.48**	5.25**	1.71	-1.04	1.97
P2 ×P9	1.26	0.78	4.14*	2.06	2.08	1.21	-0.88	0.80
P 2×P10	-6.54**	-4.85*	-5.30**	-5.56**	1.39	0.00	0.93	0.78
P3 ×P4	4.28**	5.81**	1.68	3.92*	0.98	6.51	-1.04	2.15
P3 ×P5	-9.04**	-9.34**	-8.18**	-8.85**	-1.80	-3.57	-1.40	-2.26
P3 ×P6	-10.58**	-8.73**	-8.72**	-9.35**	0.83	-3.59	-0.31	-1.02
P3 ×P7	6.54**	1.93	6.72**	5.06**	-0.95	-0.01	0.22	-0.25
P3 ×P8	5.67**	8.15**	3.35	5.72**	0.70	-1.90	2.03	0.27
P3 ×P9	2.90*	2.65	-0.82	1.58	0.02	1.85	2.66	1.51
P3 ×P10	5.23**	1.23	3.87*	3.44	3.22*	2.35	-0.20	1.79
P4 ×P5	2.96*	1.77	4.18*	2.97	1.08	0.41	2.48	1.32
P4 ×P6	4.42**	3.45	5.23**	4.37*	2.65	4.28*	-0.85	2.02
P4 ×P7	-5.60**	-6.10**	-3.46	-5.07**	2.70	0.55	3.69	2.31
P4 ×P8	-2.48	-2.27	-2.70	-2.48	-1.76	-3.18	-1.29	-2.08
P4 ×P9	-3.51**	-0.17	-6.03**	-3.24	-0.60	-2.30	-5.58**	-2.83
P 4×P10	1.09	-1.38	-3.64	-1.31	-1.73	-3.80	0.11	-1.81
P5 ×P6	-11.62**	-8.64**	-10.97**	-10.41**	1.97	-0.41	2.18	1.25
P5 ×P7	7.09**	2.35	2.08	3.84*	0.32	0.78	-3.97*	-0.96
P5 ×P8	6.75**	6.04**	4.11*	5.63**	-0.84	-0.53	1.71	0.11
P 5×P9	2.45	2.01	4.00*	2.82	-0.68	1.64	1.54	0.83
P5 ×P10	7.12**	8.26**	9.83**	8.40**	2.63	4.01	-0.08	2.19
P6 ×P7	2.68*	5.04*	-0.33	2.46	-4.86**	-2.01	-2.52	-3.13
P6 ×P8	4.74**	4.46*	5.03**	4.75**	-0.69	-0.73	3.42*	0.67
P6 ×P9	4.24**	-0.51	0.66	1.47	0.40	2.25	0.79	1.15
P6 ×P10	6.77**	6.21**	4.49*	5.82**	0.37	1.02	-1.12	0.09
P7 ×P8	-4.34**	1.92	3.87*	0.48	-1.86	1.95	0.25	0.11
P7 ×P9	-7.18**	-4.18*	-4.77*	-5.38**	2.13	-0.38	-2.10	-0.12
P7 ×P10	-2.98*	-4.54*	-1.00	-2.84	-1.69	-2.04	3.84*	0.04
P8 ×P9	1.02	-3.81	5.17**	0.79	-1.13	-2.60	-1.91	-1.88
P8 ×P10	-11.58**	-8.38**	-9.84**	-9.94**	-3.03*	1.31	-1.18	-0.97
P9×P10	-4.29**	-2.41	-0.55	-2.42	-1.58	-1.62	-0.33	-1.18
SE(Sij)	1.28	2.01	1.85	1.74	1.35	1.93	1.56	1.63
SE(Sij-sik)	1.92	3.01	2.78	2.61	2.03	2.89	2.33	2.45
SE(Sij-Skl)	1.78	2.79	2.57	2.42	1.88	2.67	2.16	2.26

Table 3. Cont.

crosses	Grain yield \ plant			
	D1	D2	D3	Combined
P1 × P2	329.8*	74.1	269.6**	224.5
P1 × P3	-694.3**	-4029*	-272.2**	-456.5**
P1 ×P4	565.6**	278.6	279.4**	374.5**
P1 ×P 5	-547.5**	-406.3*	-240.0**	-397.9**
P1 ×P6	-319.8*	-186.7	-35.2	-180.6
P1 ×P7	-58.1	256.3	15.3	71.2
P1 ×P8	314.2*	125.1	-19.9	139.8
P1 ×P9	38.6	-3.3	15.6	17.0
P 1×P10	371.5**	265.2	-12.5	208.1
P2 ×P3	292.6*	601.4**	158.5**	350.8*
P2 ×P4	-665.8**	-439.6*	-278.6**	-461.3**
P2 ×P5	424.0**	357.8	142.3**	308.0*
P2 ×P6	241.1	98.5	130.2**	156.6
P2 ×P7	136.6	-171.9	-12.3	-15.9
P2 ×P8	-222.9	-270.0	-318.8**	-270.6
P2 ×P9	-135.2	50.8	125.5**	13.7
P 2×P10	-400.2**	-301.1	-216.5**	-305.9*
P3 ×P4	316.8*	533.0**	229.0**	359.6*
P3 ×P5	-541.0**	-590.6**	-250.1**	-460.6**
P3 ×P6	-144.0	-454.1*	-243.7**	-280.6*
P3 ×P7	53.4	-125.2	107.8**	12.0
P3 ×P8	227.1	143.8	198.3**	189.8
P3 ×P9	138.6	-7.1	10.9	47.5
P3 ×P10	350.7**	301.7	61.5	238.0
P4 ×P5	121.8	355.3	165.0**	214.0
P4 ×P6	220.0	249.0	1.2	156.7
P4 ×P7	225.0	20.1	-17.5	75.9
P4 ×P8	-401.2**	-255.5	-193.1**	-283.3*
P4 ×P9	-191.3	-229.8	-221.3**	-214.1
P 4×P10	-190.9	-511.1**	35.9	-222.0
P5 ×P6	-447.7**	-58.1	-193.7**	-233.1
P5 ×P7	151.6	34.9	-96.3*	30.1
P5 ×P8	293.4*	-157.8	214.4**	116.6
P 5×P9	162.3	220.1	45.1	142.5
P5 ×P10	383.1**	244.7	213.3**	280.4*
P6 ×P7	-246.8	-124.5	-90.5*	-153.9
P6 ×P8	276.4*	74.7	268.8**	206.6
P6 ×P9	200.2	114.6	60.0	124.9
P6 ×P10	220.8	286.6	102.7**	203.4
P7 ×P8	-89.7	394.7*	130.7**	145.2
P7 ×P9	-192.7	-110.9	-83.1*	-128.9
P7 ×P10	20.7	-173.5	45.8	-35.7
P8 ×P9	169.1	11.5	-1.6	59.7
P8 ×P10	-566.4**	-66.5	-278.9**	-303.9*
P9×P10	-189.4	-46.0	48.7	-62.2
SE(Sij)	130.51	179.58	37.02	139.56
SE(Sij-Sik)	195.77	269.33	55.53	209.34
SE(Sij-Skl)	181.25	249.38	51.41	193.81

D1= (5 May), D2 (= 5 June) and D3 =(5 July) planting dates.
*and ** denote significant differences at 0.05 and 0.01 levels of probability, respectively.
P1(L3), P2 (L6), P3 (L 22), P4 (L24), P5 (L27), P6 (L58), P7 (L61), P8 (L63), P9 (L85) and P10 (L90).

Table 4. Performance of the maize crosses for the studied traits at the three planting dates and their combined data.

Genotypes			Number of ears/10plant				Number of rows /ear			
			D1	D2	D3	Combined	D1	D2	D3	Combined
P1 X P2			15.33	12.33	12.33	13.33	12.93	12.40	12.80	12.71
P1 X P3			10.67	10.33	10.00	10.33	11.07	10.13	9.33	10.18
P1 X P4			15.33	13.33	11.33	13.33	12.40	11.33	12.00	11.91
P1 X P5			11.67	11.00	10.00	10.89	11.73	11.33	10.13	11.07
P1 X P6			10.67	11.00	10.67	10.78	10.80	11.20	11.20	11.07
P1 X P7			10.67	11.67	10.33	10.89	11.33	11.07	11.07	11.16
P1 X P8			11.00	10.33	10.00	10.45	11.87	12.53	12.17	12.19
P1 X P9			11.33	10.33	10.00	10.56	11.20	11.60	11.20	11.33
P1 X P10			12.67	11.00	10.00	11.22	11.87	11.87	12.00	11.91
P2 X P3			14.00	14.67	10.00	12.89	12.80	13.60	13.20	13.20
P2 X P4			12.00	12.00	10.67	11.56	14.67	13.47	13.73	13.96
P2 X P5			15.00	13.67	10.00	12.89	12.93	12.40	13.07	12.80
P2 X P6			13.00	12.67	10.33	12.00	12.53	12.13	12.27	12.31
P2 X P7			12.00	12.33	10.00	11.44	14.27	13.73	13.47	13.82
P2 X P8			10.00	10.33	10.00	10.11	14.53	15.33	14.07	14.65
P2 X P9			10.00	10.00	10.00	10.00	14.00	13.73	13.33	13.6
P2 X P10			11.00	10.67	10.00	10.56	13.33	13.60	13.07	13.33
P3 X P4			13.00	12.33	12.00	12.44	12.80	12.53	12.67	12.67
P3 X P5			12.67	10.67	10.33	11.22	11.07	10.33	10.40	10.60
P3 X P6			13.33	10.00	10.00	11.11	11.07	10.40	9.93	10.47
P3 X P7			10.67	10.67	10.33	10.55	13.33	11.73	11.47	12.18
P3 X P8			10.67	10.67	10.00	10.44	12.40	13.07	13.33	12.93
P3 X P9			10.67	10.33	10.67	10.56	12.13	11.47	11.47	11.69
P3 X P10			11.00	11.67	10.00	10.89	12.40	11.87	12.53	12.27
P4 X P5			13.33	14.00	10.67	12.67	12.00	12.27	11.60	11.96
P4 X P6			12.00	11.67	10.33	11.33	12.93	11.73	12.00	12.22
P4 X P7			14.33	14.33	10.00	12.89	13.60	13.20	12.53	13.11
P4 X P8			10.00	10.33	10.00	10.11	15.07	14.80	14.57	14.81
P4 X P9			11.67	10.67	10.33	10.89	13.47	12.80	12.87	13.05
P4 X P10			12.33	11.67	10.67	11.56	12.93	13.33	13.33	13.20
P5 X P6			10.67	10.33	10.00	10.33	10.67	11.73	10.00	10.80
P5 X P7			11.33	11.00	10.00	10.78	12.40	12.27	11.33	12.00
P5 X P8			11.00	10.00	10.00	10.33	12.93	12.13	12.93	12.67
P5 X P9			11.67	10.67	10.00	10.78	11.33	11.73	11.73	11.60
P5 X P10			11.33	10.67	10.33	10.78	12.80	12.40	12.67	12.62
P6 X P7			10.33	10.33	10.00	10.22	12.27	11.47	11.73	11.82
P6 X P8			10.00	10.00	10.00	10.00	12.00	12.93	12.27	12.40
P6 X P9			10.00	10.67	10.00	10.22	11.60	11.47	10.80	11.29
P6 X P10			10.33	10.00	10.33	10.22	11.87	12.53	12.53	12.31
P7 X P8			10.00	11.33	10.00	10.44	14.80	14.40	13.87	14.35
P7 X P9			10.33	10.33	10.00	10.22	13.47	13.20	12.80	13.16
P7 X P10			11.67	10.33	10.33	10.78	14.00	13.33	12.93	13.42
P8 X P9			10.00	10.33	10.33	10.22	13.73	14.00	14.00	13.91
P8 X P10			10.00	10.00	10.00	10.00	14.93	14.40	14.13	14.49
P9 X P10			10.00	10.00	10.00	10.00	13.87	13.07	13.60	13.51
Ch .S.C10			10.67	10.67	10.33	10.56	13.33	13.87	13.33	13.51
Mean			11.55	11.16	10.28	10.99	12.73	12.52	12.34	12.53
LSD	Genotype	5%	1.68	2.08	1.69	0.96	1.05	0.97	1.00	0.57
		1%	2.23	2.76	2.23	1.27	1.39	1.28	1.33	0.75
	Date	5%				0.24				0.18
		1%				0.32				0.98
	Inter	5%				1.65				0 98
		1%				2.16				1.29
Reduction%					11.00				3.06	

Table 4-Cont

Genotypes	Number of kernels /row				100 kernel weight			
	D1	D2	D3	Combined	D1	D2	D3	Combined
P1 X P2	43.47	38.60	38.60	40.22	26.47	26.05	23.97	25.50
P1 X P3	27.87	25.53	24.53	25.98	28.80	25.86	19.18	24.62
P1 X P4	46.33	39.80	44.07	43.40	35.81	30.55	28.00	31.45
P1 X P5	26.60	23.73	19.53	23.29	28.79	23.94	18.64	23.79
P1 X P6	26.80	27.60	29.33	27.91	33.94	29.89	21.75	28.52
P1 X P7	48.47	48.27	42.27	46.33	35.30	29.06	19.53	27.96
P1 X P8	53.60	41.67	36.25	43.84	34.37	29.45	16.87	26.90
P1 X P9	47.60	44.60	32.47	41.56	30.38	28.46	28.70	29.18
P1 X P10	48.27	47.80	40.13	45.40	31.12	26.14	16.86	24.71
P2 X P3	44.27	45.20	46.07	45.18	27.54	26.01	24.22	25.92
P2 X P4	43.53	43.87	40.60	42.67	29.59	24.83	23.62	26.01
P2 X P5	46.00	45.93	40.00	43.98	28.03	26.99	23.00	26.01
P2 X P6	50.60	43.87	42.80	45.75	27.60	27.68	23.32	26.20
P2 X P7	45.40	43.33	39.27	42.66	35.27	28.21	25.01	29.50
P2 X P8	46.73	38.80	28.67	38.07	34.46	26.12	19.67	26.75
P2 X P9	51.33	46.20	45.07	47.53	31.29	28.65	23.88	27.94
P2 X P10	42.13	43.53	39.33	41.67	30.31	26.31	21.62	26.08
P3 X P4	47.67	46.53	40.53	44.91	35.31	36.39	23.31	31.67
P3 X P5	28.00	25.07	23.00	25.36	27.92	24.01	20.43	24.12
P3 X P6	26.33	26.00	23.93	25.42	31.91	26.55	22.80	27.09
P3 X P7	49.47	44.27	47.93	47.22	32.20	29.01	21.97	27.73
P3 X P8	53.60	49.80	39.20	47.53	30.79	24.00	21.59	25.46
P3 X P9	48.07	43.20	35.67	42.31	30.11	30.78	26.27	29.05
P3 X P10	49.00	44.73	44.07	45.93	33.02	30.14	19.34	27.50
P4 X P5	46.93	42.33	41.07	43.44	35.49	30.16	26.20	30.61
P4 X P6	48.27	44.33	43.60	45.40	38.42	36.59	24.14	33.05
P4 X P7	44.27	42.33	43.47	43.36	40.54	31.74	27.33	33.21
P4 X P8	52.40	45.53	38.87	45.60	33.03	24.89	20.16	26.02
P4 X P9	48.60	46.53	36.18	43.77	34.18	28.80	19.91	27.63
P4 X P10	51.80	48.27	42.27	47.44	32.76	26.17	21.53	26.82
P5 X P6	25.87	25.93	19.73	23.84	33.13	29.61	24.66	29.14
P5 X P7	50.60	44.53	41.33	45.49	33.55	29.67	17.15	26.79
P5 X P8	55.27	47.53	38.00	46.93	29.33	25.25	20.64	25.08
P5 X P9	48.20	42.40	38.53	43.04	29.49	30.44	24.52	28.15
P5 X P10	51.47	51.60	48.07	50.38	32.50	31.68	18.83	27.67
P6 X P7	46.07	47.53	40.40	44.67	29.73	29.44	19.88	26.35
P6 X P8	53.13	46.27	40.40	46.60	30.85	27.61	23.63	27.36
P6 X P9	49.87	40.20	36.67	42.24	31.93	33.62	25.04	30.20
P6 X P10	51.00	49.87	44.20	48.35	31.61	31.25	19.06	27.31
P7 X P8	50.07	51.33	47.80	49.74	31.75	29.16	19.10	26.67
P7 X P9	44.47	44.13	39.80	42.80	35.73	29.86	20.80	28.80
P7 X P10	47.27	46.73	47.27	47.09	31.62	27.06	22.67	27.12
P8 X P9	57.67	43.82	44.37	48.62	29.42	24.52	18.80	24.24
P8 X P10	43.67	42.20	33.07	39.65	27.22	27.30	15.46	23.33
P9 X P10	48.20	47.07	43.00	46.09	28.67	27.40	20.35	25.47
Ch .S.C.10	48.47	43.27	40.87	44.20	36.21	36.46	28.18	33.62
Mean	45.75	42.43	38.53	42.24	31.90	28.56	21.99	27.48
LSD Genotype 5%	4.09	6.39	5.55	3.17	4.32	6.14	5.19	2.97
LSD Genotype 1%	5.41	8.47	7.35	4.19	5.73	8.13	6.88	3.92
LSD Date 5%				0.80				0.74
LSD Date 1%				1.06				0.98
LSD Inter 5%				5.43				5.10
LSD Inter 1%				7.14				6.70
Reduction%			15.78				31.07	

Table 4.Cont.

Genotypes	Grain yield/plant			
	D1	D2	D3	Combined
P1 X P2	215.63	129.74	112.33	152.57
P1 X P3	74.70	48.34	31.21	51.42
P1 X P4	284.90	168.29	124.74	192.65
P1 X P5	95.80	51.21	28.12	58.38
P1 X P6	100.82	73.38	58.58	77.59
P1 X P7	181.36	154.78	76.77	137.64
P1 X P8	206.75	114.21	59.79	126.92
P1 X P9	160.06	96.90	66.92	107.96
P1 X P10	214.84	137.78	70.86	141.16
P2 X P3	210.27	200.31	107.48	172.69
P2 X P4	198.64	148.02	102.14	149.60
P2 X P5	229.82	179.16	99.55	169.51
P2 X P6	193.78	153.44	108.32	151.85
P2 X P7	237.71	163.50	107.21	169.47
P2 X P8	189.92	126.25	63.10	126.42
P2 X P9	179.55	153.85	111.10	148.17
P2 X P10	174.54	132.69	83.66	130.30
P3 X P4	258.38	211.58	125.97	198.64
P3 X P5	94.81	50.62	33.38	59.60
P3 X P6	116.75	64.48	43.99	75.07
P3 X P7	190.86	134.48	92.29	139.21
P3 X P8	196.40	133.94	87.88	139.40
P3 X P9	168.42	114.36	72.72	118.50
P3 X P10	211.11	159.28	84.53	151.64
P4 X P5	245.29	197.01	113.25	185.18
P4 X P6	237.36	186.59	106.85	176.93
P4 X P7	292.23	200.81	118.13	203.72
P4 X P8	217.78	145.81	87.10	150.23
P4 X P9	219.64	143.89	87.86	150.46
P4 X P10	241.16	129.80	120.33	163.77
P5 X P6	92.80	107.29	42.68	80.92
P5 X P7	207.10	153.69	65.56	142.12
P5 X P8	209.44	106.97	83.17	133.20
P5 X P9	177.20	140.29	69.82	129.10
P5 X P10	220.77	156.78	93.40	156.98
P6 X P7	149.51	137.97	76.12	121.20
P6 X P8	189.99	130.44	98.59	139.67
P6 X P9	163.24	129.95	81.29	124.83
P6 X P10	186.79	161.19	92.32	146.76
P7 X P8	207.75	199.54	97.93	168.41
P7 X P9	178.32	144.50	80.12	134.32
P7 X P10	221.15	152.28	99.77	157.73
P8 X P9	202.66	129.30	74.81	135.59
P8 X P10	150.60	135.53	53.84	113.33
P9 X P10	169.17	133.10	90.17	130.81
Ch .S.C10(	223.63	193.67	140.82	185.84
Mean	191.07	139.49	85.36	138.64
LSD Genotype 5%	41.59	57.22	44.47	25.44
LSD Genotype 1%	55.11	75.82	58.92	33.54
LSD Date 5%				6.51
LSD Date 1%				8.55
LSD In..r 5%				4[illegible]20
LSD In..r 1%				58.09
Reduc..on %			55.33	

D1= (5 May), D2 (= 5 June) and D3 =(5 July) planting dates.
*and ** denote significant differences at 0.05 and 0.01 levels of probability, respectively.
P1(L3), P2 (L6), P3 (L 22), P4 (L24), P5 (L27), P6 (L58), P7 (L61), P8 (L63), P9 (L85) and P10 (L90)

combined analysis. The two crosses; $P_1 \times P_4$ and $P_4 \times P_7$ significantly superiored the check cv. by 51.27 and 58.60g at early planting date.

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القدرة على التآلف لعشرة سلالات من الذرة الشامية المستنبطة حديثا وأداء هجنها تحت ثلاثة مواعيد زراعة

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استخدمت فى فى هذه الدراسة عشرة سلالات تربية داخلية من الذرة الشامية مستنبطة حديثا بقسم المحاصيل – كلية الزراعة – جامعة عين شمس وهى L3 (P1), L6 (P2), L 22(P3), L24 (P4), L27 (P5), L58 (P6), L61 (P7), L63 (P8), L85 (P9) and L90 (P10). فى موسم ٢٠٠٦ تم عمل تهجينات دائرية (دون العكسية) بين سلالات التربية الذاتية وتم الحصول على حبوب ٤٥ هجين فردى. وفى موسم ٢٠٠٧ زرعت الهجن الفردية مع الصنف التجارى هجين فردى ١٠ فى ثلاث مواعيد زراعة مختلفة هى ٥ مايو (ميعاد مبكر) – ٥ يونيو (الميعاد الموصى به) و٥ يوليو (ميعاد متاخر) لتقييم اداء الهجن والقدرة الائتلافية (العامة والخاصة)للصفات المحصول ومكوناته. خصصت تجربة حقلية لكل ميعاد زراعة على حده وصممت كل تجربة فى قطاعات كاملة العشوائية بثلاث مكررات و ذلك بمحطة البحوث والتجارب الزراعية للمركز القومى للبحوث بشلقان- محافظة القليوبية. وتم أخذ القراءات على محصول الحبوب للنبات الفردى ومكوناته وهى عدد الكيزان / ١٠ نباتات ، عدد الصفوف/ كوز، عدد الحبوب فى الصف، وزن الـ ١٠٠ حبة وذلك على ١٠ نباتات فردية محاطة اختيرت عشوائيا من كل قطعة تجريبية. تم تحليل البيانات احصائيا ووراثيا لكل ميعاد على حده والتحليل التجميعى للمواعيد الثلاثة. وتشير اهم النتائج الى ما يلى :

١. كان تباين كل من مواعيد الزراعة والهجن وكذلك تفاعل الهجن مع المواعيد معنويا لكل الصفات المدروسة ماعدا عدد الكيزان / ١٠نباتات فى الميعاد المتاخر،كما كان تباين القدرة العامة والخاصة على الائتلاف عالى المعنوية لكل الصفات المدروسة عدا القدرة العامة والخاصة لعدد الكيزان/١٠ نباتات فى الميعاد المتاخر والقدرة الخاصة لعدد الصفوف / كوز للتحليل التجميعى ووزن الـ ١٠٠ حبة فى الميعاد الموصى به مما يشير الى اهمية كل من التاثير المضيف وغير المضيف فى وراثة هذه الصفات. وكانت النسبة ما بين $\delta^2GCA\ /\delta^2SCA$ اكبر من الوحدة فى صفة عددالصفوف فى الكوز فى مواعيد الزراعة الثلاثة بينما كانت النسبة اقل من الوحدة لعدد الحبوب فى الصف ووزن الـ١٠٠ حبة (ما عدا الميعاد الموصى به) ومحصول النبات الفردى فى المواعيد الثلاثة والتحليل التجميعى. وفيما يخص التفاعل بين القدرة العامة على الائتلاف ومواعيد الزراعة كان عالى المعنوية لكل الصفات المدروسة ما عدا عدد الصفوف / كوز ووزن الـ ١٠٠ حبة- فيما كان تفاعل القدرة الخاصة على الائتلاف × مواعيد الزرعة غير معنوى لكل الصفات تحت الدراسة مما يشير الى حساسية تباين — القدرة العامة للمواعيد مقارنة بتباين القدرة الخاصة على الائتلاف.
٢. اظهرت السلالة P4 قدرة عامة عالية على الائتلاف لكل الصفات المدروسة فى ميعادين او فى الثلاثة مواعيد ، وكذلك السلالات P2و P7وP10 لثلاثة صفات عبر المواعيد المختلفة ، والسلالات P8,P6,P5,P1 لصفة او صفتين فى ميعاد زراعة او ميعادين.

٣. اظهرت نتائج تاثيرات القدرة الخاصة على الائتلاف ان الهجن التى تمثل اهمية للمربى هى P1×P2 لعدد الكيزان / ١٠ نباتات وP4×P8، P8×P10 لعدد الصفوف / كوز ،
P5×P8،P5×P10،P6×P8،وP6×P10 لعدد الحبوب / الصف وكذلك الهجن
P2×P7،P1×P4،وP7×P10 لوزن الـ ١٠٠ حبة و الهجن P2×P3وP3×P4 لمحصول النبات الفردى.

ادى التاخير فى ميعاد الزراعة حتى ٥ يوليو الى حدوث نقص معنوى فى محصول الحبوب ومكوناته مقارنة بميعاد الزراعة المبكر ، وتباين اداء الهجن التجريبية مقارنة بالهجين الفردى ١٠ فى مواعيد الزراعة الثلاثة واظهر الهجينين P1×P4 وP4×P7 فى الميعاد الاول تفوقا معنويا فى المحصول عن صنف المقارنة بمقدار ٥١.٢٧ و ٥٨.٦٠ جم على الترتيب.

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