RESULTS AND DISCUSSION

4-RESULTS AND DISCUSSION

4.1. Tasselling Date

Table,1 shows that mean square values associated with tasseling date were significant for parental genotypes, F_1 hybrids , and parental genotypes versus its F_1 hybrids. These results indicated the presence of genetic variability among parental genotypes and related F_1 hybrids concerning this character.

Genetic differences in number of days to tasselling among maize germplasm were found (Edmeades *et al*., 2000; Quaranta *et al* ., 2000).

Data presented in Table,2 indicated that the parental genotype M1 had the lowest number of days to tasselling (59.7) followed by M-1-2 (62.7) and M-2-1 (63.7). These results show that the parental genotype M1 can be used as a source for genes contrrolling relatively early tasselling. Non of the F_1 hybrids showed superiority over the parental cultivar M1 concerning early tasselling (Table,2). These results indicate also the importance of the parental genotype M1 in this respect.

Data presented in Table,1 indicate that the mean square values for general and specific combining abilities were significant. In addition, the ratio of general combining ability to the specific combining ability (GCA/SCA) was 1.50 . These results indicate the presence of both the additive and non-additive type of gene actions in the inheritance of this character. However, the additive type of gene action was more important than the non –additive type in the inheritance of tasselling date.

Table 1:Mean square values for tasselling and silking date for the parental genotypes F_1 hybrids parental genotypes versus its F_1 hybrids , general and specific combining ability and the ratio of general combining ability to the specific combining ability

Sources	DF	Tasselling Date	Sliking Date
Rep	2	1.23	0.28
Genotypes	35	5.11**	6.88 **
Parents	7	8.33 **	9.98 **
Hybrids	27	2.78 **	3.99**
Parents vs. Hybrids	1	45.77 **	63.51 **
Error	70	0.96	1.07
General Combinig Ability GCA	7	2.32 *	3.01**
Specific Combining Ability SCA	28	1.55	2.12*
Error	70	0.32	0.36
GCA/SCA		1.50	1.42

* Significant at 5 % level of significance

** Significant at 1 % level of significance

Table 2: Mean of tasselling and silking dates for the plants of different parental genotypes and F_1 hybrids

Genotypes	Tasselling Date	Silking Date
M-1-2	62.7	64.3
M-1-2 X M-1-3	62.0	64.0
M-1-2 X M-2-1	60.7	62.3
M-1-2 X M-2-2	61.3	63.0
M-1-2 X M-2-3	61.3	62.3
M-1-2 X M-2-4	61.7	63.0
M-1-2 X SIO4	60.3	61.7
M-1-2 X M1	61.7	62.7
M-1-3	64.0	66.0
M-1-3 X M-2-1	62.0	64.0
M-1-3 X M-2-2	63.0	65.3
M-1-3 X M-2-3	63.7	65.3
M-1-3 X M-2-4	62.7	64.7
M-1-3 X SIO4	60.0	62.3
M-1-3 X M1	61.3	63.0
M-2-1	63.7	64.7
M-2-1 X M-2-2	63.7	65.7
M-2-1 X M-2-3	63.3	64.7
M-2-1 X M-2-4	61.7	63.3
M-2-1 X SIO4	61.3	62.7
M-2-1 X M1	61.0	62.6
M-2-2	64.0	66.0
M-2-2 X M-2-3	62.3	64.3
M-2-2 X M-2-4	61.7	63.3
M-2-2 X SIO4	61.3	62.3
M-2-2 X M1	61.0	63.3
M-2-3	63.7	65.3
M-2-3 X M-2-4	61.7	63.0
M-2-3 X SIO4	61.7	63.0
M-2-3 X M1	61.7	63.0
M-2-4	64.0	66.0
M-2-4 X SIO4	61.3	63.0
M-2-4 X M1	63.7	65.7
SIO4	65.3	68.0
SIO4 X M1	60.7	61.7
M1	59.7	61.7
LSD 5%	1.6	1.7
LSD 1%	2.1	2.2

The parental genotype M1 had the lowest desirable general combininig ability effect (-0.91) followed by M-1-2 (-0.51), SIO4(-0.14) and M-2-1 (0.16) (Table,3). Such results indicate that these parental genotypes can be, considered as good combiners in forming hybrids with relatively earliness of tasselling.

Data presented in Table,4 indicated that the F_1 hybrid M-1-3XSIO4 had the lowest desirable specific combining ability effect (-1.77) and M-1-2XSIO4 (-1.17) followed by M-2-3XM-2-4 (-1.14), M-1-2XM-2-1 (-1.14) and M-2-2XM-2-4 (-1.11). These results indicate that these F_1 hybrids had relatively high earliness of tasselling . However forming other F_1 hybrids with other parental genotypes combinations could result in obtaining F_1 hybrids with better earliness of tasselling.

The best percentage of better heterosis was associated with the F_1 hybrid M-1-3XSIO4 (-6.3) followed by M-2-2XSIO4 (-4.2) and M-2-4XSIO4 (-4.2). However, the tasselling date of the involved parental genotypes should be considered in order to correctly evaluate such F_1 hybrids concerning tasselling date. In addition, the different F_1 hybrids which showed better parent heterosis (Table,5), indicated that the involved parental genotypes posses different genes controlling tasselling date.

The broad sense heritability estimate (h^2_{bs}) for tasselling date was 82.9% (Table,6). On the other hand the narrow sense heritability estimate (h^2_{ns}) for the same character was 16.7 %. (Table,6) These results indicate that the environmental effects play an important role

Table 3 : General combining ability effects(gi) of different parental genotypes for tassling and silking dates

Parent	Tasselling Date	Silking Date
M-1-2	-0.51**	- 0.67**
M-1-3	0.43*	0.63**
M-2-1	0.16	0.33
M-2-2	0.33*	0.50**
M-2-3	0.36*	0.20
M-2-4	0.29	0.37*
SIO4	-0.14	-0.17
M1	-0.91**	-0.90**
LSD 5 % (gi)	0.33	0.35
LSD 1 % (gi)	0.44	0.47
LSD 5 % (gi-gj)	0.50	0.53
LSD 1 % (gi-gj)	0.67	0.71

Table 4 : Specific combining ability effects(Sij) for tasselling and Silking dates

Crosses	Tasselling Date	Silking Date
M-1-2 X M-1-3	-0.07	0.22
M-1-2 X M-2-1	-1.14*	-0.85
M-1-2 X M-2-2	-0.64	-0.65
M-1-2 X M-2-3	0.67	-1.02
M-1-2 X M-2-4	-0.27	-0.52
M-1-2 X SIO4	-1.17*	-1.32*
M-1-2 X M1	0.93	0.42
M-1-3 X M-2-1	-0.74	-0.48
M-1-3 X M-2-2	0.43	0.39
M-1-3 X M-2-3	0.73	0.69
M-1-3 X M-2-4	-0.21	-0.15
M-1-3 X SIO4	-1.77**	-1.95**
M-1-3 X M1	-0.34	-0.55
M-2-1 X M-2-2	1.03*	1.32*
M-2-1 X M-2-3	0.66	0.62
M-2-1 X M-2-4	- 0.94	-0.88
M-2-1 X SIO4	- 0.84	-1.02
M-2-1 X M1	- 0.41	-0.28
M-2-2 X M-2-3	-0.51	-0.18
M-2-2 X M-2-4	-1.11*	-1.35*
M-2-2 X SIO4	-1.01*	-1.82**
M-2-2 X M1	-0.57	-0.08
M-2-3 X M-2-4	-1.14*	-1.38*
M-2-3 X SIO4	-0.71	-0.85
M-2-3 X M1	0.06	-0.12
M-2-4 X SIO4	-0.97	-1.02
M-2-4 X M1	2.13**	2.39**
SIO4 X M1	-0.44	-1.08*
LSD 5 % (Sij)	1.01	1.08
LSD 1 % (Sij)	1.35	1.43
LSD 5 % (Sij-sik)	1.51	1.59
LSD 1 % (Sij-sik)	2.01	2.12
LSD 5 % (Sij-skL)	1.42	1.50
LSD 1 % (Sij-skL)	1.89	2.00

Table 5 : Percentage of heterosis in the F_1 generation over betterparent for tasselling and silking dates

Crosses	Tasselling Date	Silking Date
M-1-2 X M-1-3	-1.1	-0.5
M-1-2 X M-2-1	-3.2**	-3.1**
M-1-2 X M-2-2	-2.2*	-2.0*
M-1-2 X M-2-3	-2.2*	-3.1**
M-1-2 X M-2-4	-1.6*	-2.0*
M-1-2 X SIO4	-3.8**	-4.0**
M-1-2 X M1	3.4	1.6
M-1-3 X M-2-1	-2.7*	-1.1
M-1-3 X M-2-2	-1.6	-1.1
M-1-3 X M-2-3	0.0	0.0
M-1-3 X M-2-4	-2.0	-1.9
M-1-3 X SIO4	-6.3**	-5.6**
M-1-3 X M1	2.7	2.1
M-2-1 X M-2-2	0.0	1.5
M-2-1 X M-2-3	-0.6	0.0
M-2-1 X M-2-4	-3.1**	-2.2*
M-2-1 X SIO4	-3.8**	-3.1**
M-2-1 X M1	2.2	1.5
M-2-2 X M-2-3	-2.2	-1.5
M-2-2 X M-2-4	-3.6**	-4.1**
M-2-2 X SIO4	-4.2**	-5.6**
M-2-2 X M1	2.2	2.6
M-2-3 X M-2-4	-3.1**	-3.5**
M-2-3 X SIO4	-3.1**	-3.5
M-2-3 X M1	3.4	2.1
M-2-4 X SIO4	-4.2**	-4.5**
M-2-4 X M1	6.7*	6.5*
SIO4 X M1	1.7*	0.0

Table 6 : The Broad (h^2_{bs}) and narrow (h^2_{ns}) sense heteability estimates for tasselling and silking dates.

Characteres	Heritability %	
	Broad Sense h^2_{bs}	Narrow Sense h^2_{ns}
Tasseling Date	82.9	16.7
Silking Data	85.6	14.5

in the expression of the tasselling date character. Based on these results, selection for early tasselling date in the segregating generations shoud be pre formed in replicated experiment to reduce the environmental effects on the expression of this characer.

4.2. Silking Date

The results presented in Table.1 show that mean square values associated with silking date were significant for parental genotypes, F_1 hybrids, and parental genotypes versus its F_1 hybrids These results indicated the presence of genetic variability among parental genotypes and related F_1 hybrids concerning silking date Genetic differences concerning number of days to silking have been reported in sweet corn (Tracy, 1990; Quaranta *et al.*, 1999) and in maize (Soliman and Sadek, 1999; Edmeades *et al.*, 2000; Quaranta *et al.*,2000).

The results presented in Table.2 indicated that the parental genotype M1 had the lowest number of days to silking (61.7) while the parental genotype SIO4 had the highest number of days to silking (68.0). These results indicated that the parental genotype M1 can be used as a source for genes controlling relatively early silking. Non of the F_1 hybrids exceeded the parental cultivar M1 concerning earliness of sliking (Table.2). However, there were no significant differences concerning silking date between each of the F_1 hybrids M-1-2XSIO4 (61.7), SIO4XM1 (61.7), M-1-2XM-2-1 (62. 3), M-1-2XM-2-3 (62. 3), M-1-3XSIO4 (62.3), M-2-1XSIO4 (62. 7), M-2-2 XM1 (63.3), M-2-3XSIO4 (63.0), M-2-3XM1 (63.0) and M-2-3X M-2-4 (63.0) and the parental genotype M1(61.7). These results indicate also the importance of the parental genotype M1 in this respect.

The results in (Table.1) show that the mean square values for general and specific combining abilities were significant. In addition, the ratio of general combining ability to the specific combining ability (GCA/SCA) was 1.42. These results indicate the presence of both the additive and non-additive type of gene actions. However, the additive type of gene action was more important than the non-additive type in the, inheritances of silking date. General and specific combining abilities for number of days to silking in maize have been reported by Revilla *et al.* (1999).

Similar results were obtained in sweet corn by Singh *et al.* (1983) and Garcia *et al.* (1999) and in maize by Nevada and Cross (1990) and Paul and Debanth (1999) . In addition, Choudhary *et al.* (2000) reported that both additive and non-additive types of gene actions are involved in the inheritance of number of days to silking in sweet corn. On the other hand, Suneetha *et al.* (2000) working on maize, found that non-additive type of gene action was more important in the inheritance of this cheracter.

The parental genotype M1 had the most desirable general combining ability effect (-0.91) followed by M-1-2 (-0.67) and SIO4 (-0.17) (Table.3). Such results indicate that these parental genotypes can be considered as good combiners in forming hybrids with relatively early silking.

The results presented in Table,4 indicat that F_1 hybrid M-1-3X SIO4 had the most desirable specific combining ability effect (-1.95) followed by M-2-2XSIO4 (-1.82), M-2-3XM-2-4 (-1.38) and M-1-2 XSIO4 (-1.32). These results indicate that such F_1 hybrids had relatively early silking. However, forming other F_1 hybrids with other parental genotype combinations could result in obtaining F_1 with better earliness of silking.

The best percentage of better parent heterosis was associated with the F_1 hybrids M-1-3XSIO4 and M-2-2XSIO4 (-5.6)followed by M-2-4XSIO4 (-4.5), M-2-2XM-2-4 (-4.1), and M-1-2XSIO4 (-4.0). However, the silking date of the involoved parental genotypes should be considered in order to correctly evaluate such F_1 hybrids concerning data of silking. In addition, the different F_1 hybrids which showed better parent hetersis (Table,5) indicated that the involved parental genotypes posses different genes contralling date of silking.

The broad sense heritability estimate(h^2_{bs})for silking date were 85.6% (Table,6). In addition, the narrow sense heritability estimate (h^2_{ns}) was 14.5% (Table,6). These results indicate the environmental effects play an important role in the inheritance of silking date. The role of the environmental effects on the experssion of silking date character has been reported in maize (Edmeades *et. al*., 2000; Mickelson *et al*., 2001). Based on these results selection for early silking in the segregating generations should be pre formed in replicated experments to reduce the environmental effects on the expression of this character.

4.3.Plant height

Data in Table,7 indicates that mean square values associated with plant height were significant for parental genotypes, F_1 hybrids, and parental genotypes versus its F_1

hybrids. These results indicated the presence of genetic variabilty among parantal genotypes and related F_1 hybrids. Genetic differences in plant height were observed among sweet corn germplasm (Tracy, 1990, Quaranta *et al.*, 1999) and maize germplasm (Agrama *et al.*, 1999; Soliman and Sadik, 1999 ; Quaranta *et al* ., 2000).

Data presented in Table,8 indicated that the parental genotype SIO4 had the highest plant height (136.7 cm) followed by M-1-2 (136.7 cm), M-2-2 (140.0 cm), M-2-3 (150.0 cm), M-2-1 (153.3 cm), M-2-4 (155.0 cm) and M-1-3 (160.0 cm) and M1(195.0). Such genetic variability in plant height can be very useful in breeding programs of sweet corn.

Table,7 shows that the mean square values for general and specific combining abilities were significant. Also, the ratio of general combining ability to the specific combining ability (GCA/SCA) was 0.85 (Table,7). These results indicated the presence of both the additive and non-additive type of gene actions. Significant general and specific combining abilities for plant height have been reported in maize, by Revilla *et al.*, 1999; and ChenYanHui *et al.*, 2000. In addition, the presence of both additive and non-additive type of gene action in the inheritance of this character has been reported in sweet corn (Tracy, 1990) and in maize (Zelek,2000). However the non-additive type of gene action was more important than the additive type in the inheritance of plant height. Similar results have been reported by Harvil *et al.* (1978), Singh *et al.*(1983) and Garcia *et al* . (1999) on sweet corn and by Paul and Debanth (1999) in maize , who found that additive type of gene action was more important in

Table 7: Mean square values for plant height and position of ear on the plant for the parental genotypes F_1 hybrids, parental genotypes versus its F_1 hybrids, general and specific combining ability and the ratio of general combining ability to the specific combining ability

Sources	DF	Plant height	position of ear on plant
Rep	2	409.00	42.37
Genotypes	35	1119.22**	375.42**
Parents	7	1083.33**	227.98**
Hybrids	27	447.74**	232.75**
Parents vs. Hybrids	1	19500.44**	5259.51**
Error	70	72.60	45.69
General Combinig Ability GCA	7	328.03**	101.49**
Specific Combining Ability SCA	28	384.34**	131.05**
Error	70	24.20	15.23
GCA/SCA		0.85	0.77

** Significant at 1 % level of significance

Table 8: Mean of plant height and positiion of ear on plant for the plants of the different parental genotypes and its F_1 hybrids

Genotypes	Plant height (cm)	position of ear on plant (cm)
M-1-2	136.7	50.0
M-1-2 X M-1-3	193.3	66.7
M-1-2 X M-2-1	170.0	60.0
M-1-2 X M-2-2	190.0	63.3
M-1-2 X M-2-3	176.7	56.7
M-1-2 X M-2-4	170.0	63.3
M-1-2 X SIO4	196.7	76.7
M-1-2 X M1	176.7	66.7
M-1-3	160.0	53.3
M-1-3 X M-2-1	193.3	70.0
M-1-3 X M-2-2	196.7	80.0
M-1-3 X M-2-3	190.0	76.7
M-1-3 X M-2-4	183.3	70.0
M-1-3 X SIO4	203.3	83.3
M-1-3 X M1	200.0	60.0
M-2-1	153.3	46.7
M-2-1 X M-2-2	166.7	66.7
M-2-1 X M-2-3	166.7	53.3
M-2-1 X M-2-4	190.0	68.3
M-2-1 X SIO4	200.0	70.0
M-2-1 X M1	173.3	60.0
M-2-2	140.0	50.0
M-2-2 X M-2-3	173.3	60.0
M-2-2 X M-2-4	180.0	53.3
M-2-2 X SIO4	195.0	83.3
M-2-2 X M1	176.7	73.3
M-2-3	150.0	60.0
M-2-3 X M-2-4	183.3	66.7
M-2-3 X SIO4	196.7	80.0
M-2-3 X M1	173.3	66.7
M-2-4	155.0	43.3
M-2-4 X SIO4	206.7	76.7
M-2-4 X M1	176.7	56.7
SIO4	136.7	40.0
SIO4 X M1	200.0	76.7
M1	195.0	66.7
LSD 5%	13.8	11.0
LSD 1%	18.4	14.6

the inheritance of plant height. On the other hand, Suneetha *et al.* (2000) found the non-additive type of gene action was more important in the inheritance of this character. The parental genotype M-2-4 had the lowest general combining ability effect (-0.6) followed by M-1-2 (-6.0), M-2-2 (-4.8) as shown in (Table,9). While, the highest general combining ability effects were associated with the parental genotype M-1-3 (7.4), SIO4 (6.5) and M1 (6.0), Table (9). Such variation can help the sweet corn breeder in selecting the best combiners to form F_1 hybrid with the desirable plant height, e.g. short or tall. However, F_1 hybrids with short plants are prefered, comparining to those with tall plants for the purpose of intercropping or mechanical harvesting.

The results presented in Table,10 indicated that each of the F_1 hybrids M-2-4XM1 and M-2-1XM1 had the lowest specific combinig ability effect (-7.22) followed by M-2-3XM1 (-5.56), M-2-1XM-2-3 (-3.22) and each of M-2-1XM-2-2 and M-2-2XM1 (-3.06) (Table,10) On the other hand, the highest specific combining ability effects were associated with the F_1 hybrids M-1-2XM-2-2 (22.28), M-2-4XSIO4 (22.28), and M-2-1XSIO4 (18.94). Such information are of great values for sweet corn breeder to form a certain hybrid with a certain plant height.

Considering the shortest parent is the better parent, it can be mentioned that no valuable better parent heterosis was found (Table,11) this result was expected since non of the F_1 hybrids was shortes than any of the involoved parental lines (Table,8).It is worth mentioing here that, the preference of certain plant height, e.g. tall or, short depends on certain factors such as

Table 9 : General combining ability effects(gi) of different parental genotypes for plant height and position of ear on plant

Parent	Plant height	position of ear on plant
M-1-2	-6.0**	-2.5*
M-1-3	7.4**	3.5**
M-2-1	-4.0**	-3.7**
M-2-2	-4.8**	0.1
M-2-3	-4.6**	0.1
M-2-4	-0.6	-3.7**
SIO4	6.5**	4.8**
M1	6.0**	1.5
LSD 5 % (gi)	2.9	2.3
LSD 1 % (gi)	3.9	3.1
LSD 5 % (gi-gj)	4.4	3.5
LSD 1 % (gi-gj)	5.8	4.6

Table 10 : Specific combining ability effects(Sij) for plant heightand position of ear on plant

Crosses	Plant height	position of ear on plant
M-1-2 X M-1-3	13.44**	1.44
M-1-2 X M-2-1	1.44	1.94
M-1-2 X M-2-2	22.28**	1.44
M-1-2 X M-2-3	8.78	-5.22
M-1-2 X M-2-4	-1.88	5.28
M-1-2 X SIO4	17.61**	10.11**
M-1-2 X M1	-1.88	3.44
M-1-3 X M-2-1	11.44*	5.94
M-1-3 X M-2-2	15.61**	12.11**
M-1-3 X M-2-3	8.78	8.78*
M-1-3 X M-2-4	-1.88	5.94
M-1-3 X SIO4	10.94*	10.78**
M-1-3 X M1	8.11	-9.22*
M-2-1 X M-2-2	-3.06	5.94
M-2-1 X M-2-3	-3.22	-7.39*
M-2-1 X M-2-4	16.11**	11.44**
M-2-1 X SIO4	18.94**	4.61
M-2-1 X M1	-7.22	-2.06
M-2-2 X M-2-3	4.28	-4.56
M-2-2 X M-2-4	6.94	-7.39*
M-2-2 X SIO4	14.78**	14.11**
M-2-2 X M1	-3.06	7.44*
M-2-3 X M-2-4	10.11*	5.94
M-2-3 X SIO4	16.28**	10.78**
M-2-3 X M1	-5.56	0.78
M-2-4 X SIO4	22.28**	11.28**
M-2-4 X M1	-7.22	-5.39
SIO4 X M1	8.94*	6.11
LSD 5 % (Sij)	8.87	7.04
LSD 1 % (Sij)	11.82	9.37
LSD 5 % (Sij-sik)	13.13	10.41
LSD 1 % (Sij-sik)	17.49	13.87
LSD 5 % (Sij-skl)	12.38	9.82
LSD 1 % (Sij-skl)	16.48	13.08

Table11: Percentage of better parent heterosis in the F_1 generation for plant hieght and position of ear on plant

Crosses	Plant height	position of ear on plant
M-1-2 X M-1-3	41.4**	33.4**
M-1-2 X M-2-1	24.4**	28.5*
M-1-2 X M-2-2	38.9**	26.6*
M-1-2 X M-2-3	29.3**	13.4**
M-1-2 X M-2-4	24.4**	46.2**
M-1-2 X SIO4	43.9**	91.7**
M-1-2 X M1	29.3	33.4
M-1-3 X M-2-1	26.1**	49.9**
M-1-3 X M-2-2	40.5**	60.0**
M-1-3 X M-2-3	26.7**	43.9**
M-1-3 X M-2-4	18.3**	61.7**
M-1-3 X SIO4	48.7**	108.3**
M-1-3 X M1	25.0**	12.6
M-2-1 X M-2-2	19.1**	42.8**
M-2-1 X M-2-3	11.1*	14.1
M-2-1 X M-2-4	23.9**	57.7**
M-2-1 X SIO4	46.3**	75.0**
M-2-1 X M1	13.0	28.5
M-2-2 X M-2-3	23.8**	20.0
M-2-2 X M-2-4	28.6**	23.1
M-2-2 X SIO4	39.3**	108.3**
M-2-2 X M1	26.2	46.6**
M-2-3 X M-2-4	22.2**	54.0**
M-2-3 X SIO4	43.9**	100.0**
M-2-3 X M1	15.5	11.2
M-2-4 X SIO4	51.2**	91.7**
M-2-4 X M1	14.0	30.9
SIO4 X M1	46.3**	91.7**

earliness and method of harvesting.Chalyk and Chebotar.A (1999) reported that plants of maize hybrids exceeded the tallest parents by 28.4 % -34.5%

The broad sense heriterability estimate (Table.12) (h^2_{bs})for plant height was 93.3%. However the narrow sense heritability (h^2_{ns}) for the same character was –6.2%. These results indicate that the environmental effects play an important role in the inheritance of plant height in maize has been reported (El-Hosary *et al.*, 1988; Chalyk and Chebotar. 1999; Cullu *et al.*, 1999; Silva, 2000; Mickelson *et al.*, 2001) On the other hand, Agrama *et al.*, 1999 reported relatively high narrow sense heritability for plant height in maize. Based on the results of the present study, selection for plant height in the segrgating generation should be performed in replicated experments to reduce the environmental effects on the expression of plant height. Rubino and Davis (1990) were successful in decreasing plant height in maize through selection in the segregating generation.

4.4. Position of 1st ear on plant (ear height)

Data presented in Table.7 show that mean square values associated with position of ear on plant (ear height) were significant for parental genotype, F_1 hybrids, and parental genotypes versus its F_1 hybrids. These results indicated the presence of genetic variability among parental genotypes and related F_1 hybrids concerning this character.

Data presented in Table.8 show that the parental genotype SIO4 had the lowest position of ear on plant (40.0 cm) followed in ascending order, by M-2-4 (43.3 cm), M-2-1 (46.7 cm), M-1-2

Table 12 : The Broad (h^2_{bs}) and narrow (h^2_{ns}) sense heteability estimates for plant height and position of ear on plant

Characteres	Heritability %	
	Broad Sense h^2_{bs}	Narrow Sense [k] h^2_{ns}
Plant height	93.3	-6.2
Position of ear on plant	87.2	-9.9

K
The narrow sense heritability h^2_{ns} estimates were less than zero. These unexpected values were obtained because the mean square of specific combining ability was larger than that of the general combining ability because the non- additive type of gene action was more important than the additive type in the inheritance of these characters

and M-2-2 (50.0 cm). M-1-3 (53.3 cm). M-2-3 (60.0 cm) and M1 (66.7 cm). These results indicated that such variation can be useful in breeding programs of sweet corn.

The mean square values for general and specific combining abilities were significant for ear position (Table.7) .Significant general and specific combining abilities for position of ear on plant have been reported in sweet corn (Tracy.1999) and in maize (chen Yan Hui *et al*.2000). In addition, the ratio of general combining ability to the specific combining ability (GCA/SCA) was 0.77 (Table.7). These results indicate the presence of both the additive and non-additive type of gene actions. However, the non- additive type of gene action was more important than the additive type in the inheritance of ear height Similar results were report by Nestares et al.(1999) who found that the non-additive type of gene action was more important in the inheritane of this charater.On the contrary. Harvi *et al*.(1978) Garcia *et al*. (1999),and Paul and Debanth (1999) reported that the additive type of gene action was more important in the in the inheritance of this character in maize.

The parental genotype M-2-1 and M-2-4 had the lowest general combining ability effects (-3.7), while SIO4 (4.8), and M-1-3 (3.5) had the highest values (Table.9). These results indicate that these parental genotypes can be useful in forming hybrids with certain desired position of ear on plant.

The results presented in Table.10 indicated that the F_1 hybrid M-1-3XM1 had the lowest specific cmbining ability effect (-9.22) while M-2-2XSIO4 had the highest value (14.11).

These results indicate the possibility of forming hybrids with the desited position of ears on sweet corn plant.

Considering the parent with the lower ear position (ear height) is the better parent. It can be mentioned that non of the F_1 hybrids showed better parent heterosis (Table,11).this result was epected because non of the F_1 hybrids had less ear position than any of the involoved parental lines (Table,8). It is worth mentioning here that other characters such as earliness of silking and tasseling should be considered along with position of ear on plant when selecting for this character.

Data presented in Table,12 indicated that the broad sense hetability estimate (h^2_{bs}) for position of ear on plant was 90.3 %. On the other hand the narrow sense heritability (h^2_{ns}) for the same character was -3.2%. These results indicate that the environmental effects play an important role in the inheritance of this character. Based on these results selection for ear position in the segregating generation should be performed in replicated experments to reduce the environmental effects on the expression of this character. The role of the environmental effects on the expression of this character in maize has been reported (Chen *et al*., 2000).

4.5. Weight of fresh husked ears/plant

Mean square values assosiated with weight of fresh husked ears/plant were signifiicant for parental genotypes, F_1 hybrids, and parental genotypes versus its F_1 hybrids Table,13. These results indicate the presence of gentic Variability among parental genotypes and related F_1 hybrids concerning this character.

Table 13 : Mean square values for weight of fresh husked and huskless of green ears/plant and dry weight of 100 gram of fresh kernels for the parental genotypes, F_1 hybrids,parental genotypes versus its F_1 hybrids, general and specific combining ability

Sources	DF	Weight of fresh husked ears/plant	Weight of fresh huskless ears/plant	Dry weight of 100 gram fresh kerenels
Rep	2	1038.00	2962.50	2.58
Genotypes	35	33771.02**	20187.82**	151.08**
Parents	7	30420.84**	20154.16**	212.45**
Hybrids	27	5608.66**	5066.11**	97.96**
Parents vs. Hybrids	1	817606.12**	428709.88**	1155.78**
Error	70	735.86	932.74	4.77
General Combinig Ability GCA	7	5788.00**	3841.5**	37.95**
Specific Combining Ability SCA	28	12624.26**	7451.2**	53.46**
Error	70	245.28	310.91	1.59
GCA/SCA		0.46	0.52	0.71

** Significant at 1 % level of significance

Table,14 shows that the parental genotype M1 had the highest weight of fresh husked ears/plant (533.3 g) followed by M-2-1 (291.7 g), M-2-2 (266.7 g), M-2-4 (263.3 g), M-1-3 (250.0 g) M-2-3 (250.0 g), M-1-2 (243.3 g) and SIO4 (218.3 g). These results indicated that the parental genotype M1 can be used as a source for genes controlling relatively high weight of fresh husked ears/plant . The F_1 hybrids M-1-2XM-1-3, M-1-2XM-2-1, M-2-3XSIO4, M-2-3 XM1, M-2-4XSIO4, M-2-4XM1 and SIO4XM1 exceeded the parental cultivar M1 concerning this character. However, the difference between each of these F_1 hybrids and the parental genotype M1 was not significant (Table,14). These results indicated also the importance of the parental genotype M1 as a source for genes controlling high weight of fresh husked ears/plant.

The mean square values for general and specific combining abilities were significant (Table,13) . In addition, the ratio of general combining ability to the specific combining ability (GCA/SCA) was 0.46 (Table,13) These results indicated the presence of both the additive and non-additive type of gene actions. However, the non- additive type of gene action was more important than the additive type in the inheritance of weight of fresh husked ear/plant.It has been reported by Nestares *et al.*, (1999) that non-additive type of gene action was more important in the inheritance of green ear yield components in sweet corn . In addition Nass *et al.*, (2000), found that the non-additive type of gene action was more important than the additive type in the inheritance of ear yield /plant in maize.

Table14: Mean of weight fresh ears/plant with and without husk and dry weight of fresh grains for the different parental genotypes and F_1 hybrids

Genotypes	Weight of husked (g) fresh ears/plant	Weight of huskless (g) fresh ears/plant	Dry weight of fresh (g) kernels
M-1-2	243.3	195.0	73.3
M-1-2 X M-1-3	546.7	428.3	53.6
M-1-2 X M-2-1	563.3	426.7	72.9
M-1-2 X M-2-2	536.7	426.7	62.2
M-1-2 X M-2-3	466.7	336.7	54.5
M-1-2 X M-2-4	503.3	390.0	58.9
M-1-2 X SIO4	533.3	426.7	63.5
M-1-2 X M1	496.7	375.0	52.0
M-1-3	250.0	198.3	64.8
M-1-3 X M-2-1	463.3	351.7	61.1
M-1-3 X M-2-2	513.3	396.7	49.8
M-1-3 X M-2-3	513.3	370.0	62.5
M-1-3 X M-2-4	506.7	393.3	58.4
M-1-3 X SIO4	453.3	346.7	56.1
M-1-3 X M1	496.7	386.7	65.1
M-2-1	291.7	233.3	72.4
M-2-1 X M-2-2	493.3	370.0	56.4
M-2-1 X M-2-3	460.0	326.7	59.4
M-2-1 X M-2-4	493.3	376.7	67.7
M-2-1 X SIO4	473.3	336.7	62.5
M-2-1 X M1	440.0	333.3	56.6
M-2-2	266.7	198.3	69.0
M-2-2 X M-2-3	406.7	300.0	63.8
M-2-2 X M-2-4	426.7	300.0	64.1
M-2-2 X SIO4	440.0	310.0	69.1
M-2-2 X M1	493.3	366.7	68.8
M-2-3	250.0	195.0	64.5
M-2-3 X M-2-4	506.7	393.3	66.0
M-2-3 X SIO4	566.7	443.3	63.3
M-2-3 X M1	533.3	396.7	68.8
M-2-4	263.3	205.0	61.9
M-2-4 X SIO4	536.7	426.7	57.3
M-2-4 X M1	535.0	383.3	62.4
SIO4	218.3	161.7	73.7
SIO4 X M1	570.0	430.0	55.2
M1	533.3	423.3	57.6
LSD 5%	44.1	49.6	3.6
LSD 1%	58.7	66.1	4.7

Table15: General combining ability effects (gi) of the different parental genotypes for weight of fresh green ears/plant with and without husk and dry weight of 100 gram fresh grains

Parents	Weight of husked (g) fresh ears/plant	Weight of huskless (g) fresh ears/plant	Dry weight of fresh (g) kernels
M-1-2	6.2*	10.3	1.2**
M-1-3	-7.8	-2.7	-2.9**
M-2-1	-10.1*	-7.9	3.1**
M-2-2	-22.8**	-23.1**	0.6
M-2-3	-11.8*	-14.0**	0.1
M-2-4	-3.6	-2.4	-0.7*
SIO4	-6.1	-2.4	0.8*
M1	56.0**	42.1**	-2.2**
LSD 5 % (gi)	9.2	10.4	0.7
LSD 1 % (gi)	12.3	13.8	0.9
LSD 5 % (gi-gj)	13.9	15.7	1.1
LSD 1 % (gi-gj)	18.6	20.9	1.5

Data in (Table.15) show that the parental genotype M1 had the highest desirable general combining ability effect (56.0) . such results indicate that this parental genotype M1can be considered as a good combiner in forming hybrids with relatively high weight of fresh husked ears/plant. On the contrary. the other parental genotypes proved to be unsuitable combiners in this respect.

The results presented in Table.16 show that the F_1 hybrid M-2-3XSIO4 had the highest desirable specific combining ability effect (132.22) folowed by M-1-2XM-2-1 (114.88). and M-1-2XM-2-2 (100.88). Non of the F_1 hybrids which involved the parental genotype M1 showed desirable specific combining ability effects. These results indicated that the parental genotypes involved in forming such F_1 hybrids with the parental genotype M1 were not suitable.

Data presented in (Table.17) indicated that the highest percentage of better parent heterosis was associated with the F_1 hybrid M-2-3XSIO4 (126.7 %) followed by M-1-2XSIO4 (119.1 %) . M-1-2XM-1-3 (118.7 %) . M-1-3XM-2-3 (105.3 %) and M-2-4X SIO4 (103.8 %). However. the weight of fresh husked ears/plant of the involved parental genotypes should be considered in order to correctly evaluate such F_1 hybrids concerning this character. because showhing such data as percentages will not reveal the real value of there F_1 hybrids. On the other hand. the different F_1 hybrids which showed better parent heterosis (Table.17). indicate that the involved parental genotypes possess different genes controlling whight of fresh husked ears/plant.

Table 16 : Specific combining ability effects (Sij) for weight of fresh ears/plant (with and without husk) and dry weight of 100 gram

Crosses	Weight of husked fresh ears/plant(g)	Weight of huskless fresh ears/plant(g)	Dry weight of fresh kernels(g)
M-1-2 X M-1-3	95.88**	76.63**	-7.52**
M-1-2 X M-2-1	114.88**	80.13**	5.70**
M-1-2 X M-2-2	100.88**	95.29**	-2.55*
M-1-2 X M-2-3	19.89	-3.70	-9.73**
M-1-2 X M-2-4	48.38**	37.96*	-4.56**
M-1-2 X SIO4	80.89**	74.63**	-1.44
M-1-2 X M1	-17.94	-12.53	-9.91**
M-1-3 X M-2-1	28.88*	18.13	-1.90
M-1-3 X M-2-2	91.56**	78.39**	-10.72**
M-1-3 X M-2-3	80.56**	42.63**	2.46**
M-1-3 X M-2-4	65.72**	54.29**	-0.76
M-1-3 X SIO4	14.89	7.63	-4.64**
M-1-3 X M1	-3.94	3.13	7.38**
M-2-1 X M-2-2	73.89**	56.79**	-10.22**
M-2-1 X M-2-3	29.56*	4.46	-6.74**
M-2-1 X M-2-4	54.72**	42.79**	2.42*
M-2-1 X SIO4	37.22*	32.79*	-4.35**
M-2-1 X M1	-58.27**	-45.03**	-7.22**
M-2-2 X M-2-3	-11.11	-7.03	0.17
M-2-2 X M-2-4	0.72	-18.70	1.33
M-2-2 X SIO4	16.56	-8.70	4.75**
M-2-2 X M1	7.72	3.46	7.48**
M-2-3 X M-2-4	69.72**	65.63**	3.72**
M-2-3 X SIO4	132.22**	115.63**	-0.55
M-2-3 X M1	36.72*	24.46	7.97**
M-2-4 X SIO4	94.05**	87.29**	-5.68**
M-2-4 X M1	30.22*	-0.54	2.44**
SIO4 X M1	67.72**	46.13**	-6.34**
LSD 5 % (Sij)	28.26	31.81	2.27
LSD 1 % (Sij)	37.63	42.37	3.03
LSD 5% (Sij-sik)	41.81	47.07	3.36
LSD 1% (Sij-sik)	55.68	62.69	4.48
LSD 5% (Sij-skl)	39.42	44.38	3.17
LSD 1% (Sij-skl)	52.49	59.10	4.22

Table 17: Percentage of better parent heterosis in the F_1 hybrids for weight of fresh ears/plant (with and without husk) and dry weight of 100 gram kernels

Crosses	Weight of husked Fresh ears/plant(g)	Weight of huskless fresh earsplant(g)	Dry weight of fresh kernels(g)
M-1-2 X M-1-3	118.7**	115.9**	-33.3**
M-1-2 X M-2-1	93.1**	82.9**	-9.2
M-1-2 X M-2-2	101.2**	115.1**	-22.6**
M-1-2 X M-2-3	86.7**	72.6**	-32.1**
M-1-2 X M-2-4	91.1**	90.2**	-26.7**
M-1-2 X SIO4	119.1**	118.8**	-20.9**
M-1-2 X M1	-6.9**	-11.4*	-35.2**
M-1-3 X M-2-1	58.9**	50.7**	-23.9**
M-1-3 X M-2-2	92.5**	100.0**	-27.8**
M-1-3 X M-2-3	105.3**	86.6**	-3.5
M-1-3 X M-2-4	92.4**	91.9**	-9.9**
M-1-3 X SIO4	81.3**	74.8**	-23.9**
M-1-3 X M1	-6.9**	-8.7**	0.5
M-2-1 X M-2-2	69.1**	58.6**	-29.8**
M-2-1 X M-2-3	57.7**	40.0**	-26.0**
M-2-1 X M-2-4	69.1**	61.4**	-15.7
M-2-1 X SIO4	62.3**	57.1**	-22.2**
M-2-1 X M1	-17.5	-21.3	-29.5**
M-2-2 X M-2-3	52.5**	51.3**	-7.5
M-2-2 X M-2-4	60.0**	46.3**	-7.1
M-2-2 X SIO4	65.0**	56.3**	-6.2
M-2-2 X M1	-7.5**	-13.4*	-0.3**
M-2-3 X M-2-4	92.4**	91.9**	2.3
M-2-3 X SIO4	126.7**	127.4**	-14.1**
M-2-3 X M1	0.0	-6.3**	6.7**
M-2-4 X SIO4	103.8**	108.1**	-22.3**
M-2-4 X M1	0.3**	-9.4**	0.8
SIO4 X M1	6.9**	1.6**	-25.1**

The results presented in Table, 18 indicated that the broad sense heritabilty estimate.(h^2_{bs}) for weight of fresh husked ears/plant was 97.5 %. On the other hand, the narrow sense hertability (h^2_{ns}) for the same character was –27.6 % These results indicate that the environmental effects play an important role in the inheritance and expression of this character. Based on these results selection for high weight of fresh husked ears/plant in the segregating generation should be performed in replicated experiments to reduce the environmental effects on the expression of this character. The role of the environmental effects on the expression of this character in sweet corn has been reported by Saleh *et al.*,(1994) who found that broad sense heritability estimates for ear yield /plant ranged from low to intermediate.

4.6. Weight of fresh huskless ears/plant

The results presented in Table, 13 show that mean square values associated with weight of huskless fresh ears/plant were significant for parental genotypes, F_1 hybrids, and parental genotypes versus its F_1 hybrids. These results indicated the presence of genetic variability among parental genotypes and related F_1 hybrids concerning this character. Genetic differences among sweet corn germplasm concerning ear weight /plant has been reported (Mani *et al.*, 1999).

Table, 14 shows that the parental genotype M1 had the highest weight of huskless fresh ears/plant (423.3g) followed by M-2-1 (233.3g), M-2-4 (205.0g), M-2-2 (198.3g), M-1-3 (198.3g), M-1-2 (195.0g), and M-2-3 (195.0g).These results

Table 18 : The Broad (h^2_{bs}) and narrow (h^2_{ns}) sense heteability estimates for weight of husked and huskless fresh ears/plant and dry weight of fresh kernels

Characteres	Heritability %	
	Broad Sense h^2_{bs}	Narrow Sense [k] h^2_{ns}
Weight of husked fresh ears/plant	97.5	-27.6
Weight of huskless fresh ears/plant	94.8	-24.0
Dry Weight of fresh kernels	96.6	-13.1

k

The narrow sense heritability h^2_{ns} estimates were less than zero. These unexpected values were obtained because the mean square of specific combining ability was larger than that of the general combining ability, because the non- additive type of gene action was more important than the additive type in the inheritance of these characters.

indicated that the parental genotype M1 can be used as a source for genes controlling relatively high weight of fresh huskless ears/plant. In addition, data in (Table,14) show that the F_1 hybrids M-1-2XM-1-3, M-1-2XM-2-1, M-1-2XM-2-2, M-1-2XSIO4, M-2-3XSIO4, M-2-4XSIO4 and SIO4XM1 exceeded the parental cultivar M1 concerning weight of huskless fresh ears/plant. However, the differences were not significant.

Data in Table,13 indicated the mean square values for general and specific combining abilities were significant . In addition, the ratio of general combining ability to the specific combining ability (GCA/SCA) was 0.52 (Table,13). These results indicate the presence of both the additive and non additive type of gene actions. However, the non–additive type of gene action was more important than the additive type in the inheritance of weight of huskless fresh ears/plant. The presence of both the additive and non-additive types of gene actions effects on the inheritance of huskless green ear yield has been reported by Parentoni *et al*. (1991).

The results presented in Table,15 show that the parental genotype M1 had the highest desirable general combining ability effect (42.1) followed by M-1-2 (10.3). Such results indicate that these parental genotypes can be considered as good combiners in forming hybrids with relatively high weight of huskless fresh ears/plant.

Data in Table,16 indicated that the F_1 hybrid M-2-3XSIO4 had the highest desirable specific combining ability effect (115.6) followed by M-1-2XM-2-2 (95.29), M-2-4XSIO4 (87.29) and M-1-2 XM-2-1 (80.13). These results indicate that such F_1 hybrids had relatively higher weight of fresh huskless ears/plant.

The highest percentage of better parent heterosis was associated with the F_1 hybrids M-2-3XSIO4 (127.4 %) followed by M-1-2XSIO4 (118.8 %), M-1-2XM-1-3 (115.9 %), M-1-2XM-2-2 (115.1 %), M-2-4XSIO4 (108.1 %) and M-1-3XM-2-2 (100.0 %). (Table,17). However, the weight of fresh huskles ears/plant of the involved parental genotypes should be considered in order to correctly evaluate such F_1 hybrids concerning this character. In addition, the different F_1 hybrids which showed better parent heterosis, indicate that the involve parental genotypes posses different genes controlling weight of fresh huskless ears/plant.

The broad sense hetability estimate presented in (Table, 18) (h^2_{bs}) for weight of fresh huskless ears/plant was 94.8 % . On the other hand, the narrow sense heritability estimate (h^2_{ns}) for the same character was -24.0%. These results indicate that the evironmental effects play an important role in the inheritance of this character. Based on these results, selection for high weight of fresh huskless ears/plant in the segregating generation should be preformed in replicated experiment to reduce as much as possible the environmental effects on the expression of this character.

4.7. Dry weight of fresh kernels

The results presented in Table,13 indicated that mean square values associated with dry weight of 100 grams of fresh kernels were significant for parental genotype versus its F_1

hybrids. These results indicated the presence of genetic variability among parental genotypes and related F_1 hybrids concererning dry weight of fresh kernels. Gentic differences in grain moisture content were observed among sweet corn germplasm (Tracy, 1990; Wong *et al.*, 1994) and maize germplasm (Bernardo *et al.*, 1999; Golob and Plestenjak, 1999; Quaranta *et al.*, 1999 ; Quaranta *et al.*, 2000).

Data presented in Table,14 show that both the parental genotypes SIO4 (73.7gm) and M-1-2 (73.3gm) had the highest dry weight of fresh grains followed by M-2-1 (72.4gm), M-2-2 (69.0gm), M-1-3 (64.8 gm), M-2-3 (64.5 gm), M-2-4 (61.9gm) and M1 (57.6gm). These results indicated that each of the parental genotypes SIO4, M-1-2 and M-2-1 can be used as source for genes controlling high dry weight of fresh grains. Non of the hybrids exceded the parental cultivar M-2-1 concerning dry weight of fresh grains.

The mean square for general and specific combining abilities were significant (Table,13). In addition, the ratio of general combining ability to the specific combining ability (GCA/SCA) was (0.71) (Table,13). These results indicate the presence of both the additive and non-additive type of gene actions. However, the non-additive type of gene action was slightly more important than the additive type in the inheritance of dry weight of fresh kernels.On the contrary, Ayrault *et al.*, (1999) found that the addiative type of gene action effects on the inheritance of grain moisture content in maize was more important than the additive type.

Results presented in Table.15 show that the parenal genotype M-2-1 had the highest desirable general combining ability effect (3.1), followed by M-1-2 (1.2) Such results indicate that these parental genotypes can be, relatively, considered as good combiners in forming hybrids with relatively high dry weight of fresh grains.

Data presented in Table.16 indicated that the F_1 hybrid M-2-3 XM1 had the highest desirable specific combining ability effect (7.97) followed by M-2-2XM1 (7.48), M-1-3XM1 (7.38), M-1-2X M-2-1 (5.70), and M-2-2XSIO4 (4.75) These results indicate that such F_1 hybrids had relatively high dry weight of fresh grains. However, forming other F_1 hybrids with other parental genotype combinations could result in obtaining F_1 hybrids with higher dry weight of fresh kernels.

The highest percentage of better parent heterosis was associated with the F_1 hybrid M-2-3XM1 (6.7 %) (Table.17). However, dry weight of fresh kernels of the involved parental genotypes should be considered in order to correctly evaluate such F_1 hybrid concerning dry weight of fresh grains. Furthermore, this F_1 hybrid M-2-3XM1 which showed better parent heterosis, indicate that the involved parental genotypes posses different genes controlling dry weight of fresh grains.

The broad sense hetability (h^2_{bs}) for dry weight of fresh grain was 96.6%, while the narrow hetriability (h^2_{ns})for the same character was −13.6% (Table.18) These values were obtained because the mean square of specific combining ability were considerably larger than that of the general combining ability, because the non-additive type of gene action was more important than the additive type in the inheretance. in this character (Table,13). Furthermore, these results indicate that the envirionmental effects play an important role in the inheritance of this character. Similar conclusion has been reached by Kumar and Singh (2000). Based on these results, selection for high dry weight of fresh grains in the segregating generation should be performed in replicated experiments to reduce the environmental effects on the expression of this character. Different results were obtained by Bernardo (2001), who reported relatively high narrow sense heritability (42-55%) for grain moisture content in maize.

4.8. Ear length

Mean square values associated with ear length were significant for the parental genotypes, F_1 hybrids, and parental genotypes versus its F_1 hybrids (Table,19). These results indicated the presence of genetic variability among parental genotypes and related F_1 hybrids concerning this character.

The results presented in Table,20 indicated that the parental genotype M1 had the highest ear length (21.7 cm) followed by M-2-2 (16.7 cm), M-1-2 (16.3 cm), M-2-1 (15.7 cm), M-2-3 (14.7 cm) . M-2-4 (14.0 cm), M-1-3 (13.3 cm) and SIO4 (12.0 cm). These results indicated that the parental genotype M1 can be used as a source for genes controlling ear length. Non of the F_1 hybrids exceeded the parental cultivar M1 concerning ear length (Table,20). However; there were no significant differences in ear length between each of the F_1 hybrids M-1-2 X M-2-3 (21.0 cm), SIO4 X M1 (20.0 cm) and the parental genotype M1 (21.7 cm). (Table,20) . These results

Table 19: Mean square values for ear length and number of rows/ear for the parental genotypes, F_1 hybrids parental genotypes versus its F_1 hybrids , general and specific combining ability and the ratio of general combining ability to the specific combining ability

Sources	DF	Ear length	Number of rows/ear
Rep	2	0.18	2.48
Genotypes	35	14.24**	7.24**
Parents	7	25.70**	16.92**
Hybrids	27	8.28**	3.62**
Parents vs. Hybrids	1	95.00**	37.46**
Error	70	1.02	0.57
General Combinig Ability GCA	7	6.20**	4.06**
Specific Combining Ability SCA	28	4.38**	2.00*
Error	70	0.34	0.19
GCA/SCA		1.4	2.0

*Significant at 5 % level of significance
** Significant at 1 % level of significance

Table 20 : Mean of ear length and number rows/ear for the plants of the different parental genotypes and its F_1 hybrids

Genotypes	Ear length(cm)	Number of rows/ear
M-1-2	16.3	17.3
M-1-2 X M-1-3	17.0	17.3
M-1-2 X M-2-1	18.0	18.0
M-1-2 X M-2-2	16.0	16.0
M-1-2 X M-2-3	21.0	15.3
M-1-2 X M-2-4	17.7	16.0
M-1-2 X SIO4	20.3	18.0
M-1-2 X M1	18.3	17.3
M-1-3	13.3	14.7
M-1-3 X M-2-1	18.3	16.7
M-1-3 X M-2-2	16.0	18.0
M-1-3 X M-2-3	16.7	17.3
M-1-3 X M-2-4	16.3	16.0
M-1-3 X SIO4	18.3	16.0
M-1-3 X M1	16.7	18.0
M-2-1	15.7	18.0
M-2-1 X M-2-2	18.0	18.0
M-2-1 X M-2-3	15.3	16.0
M-2-1 X M-2-4	18.7	16.7
M-2-1 X SIO4	19.3	16.0
M-2-1 X M1	18.0	17.3
M-2-2	16.7	12.7
M-2-2 X M-2-3	16.0	18.0
M-2-2 X M-2-4	15.7	18.0
M-2-2 X SIO4	20.0	16.7
M-2-2 X M1	17.0	17.3
M-2-3	14.7	17.3
M-2-3 X M-2-4	15.3	17.3
M-2-3 X SIO4	19.7	14.7
M-2-3 X M1	16.3	17.3
M-2-4	14.0	14.0
M-2-4 X SIO4	18.3	14.0
M-2-4 X M1	19.3	16.0
SIO4	12.0	12.0
SIO4 X M1	20.0	18.0
M1	21.7	17.3
LSD 5%	1.6	1.2
LSD 1%	2.2	1.6

indicate also the importance of the parental genotype M1 in this respect.

The mean square values of general and specific combining abilities were significant (Table.19). In addition, the ratio of general combining ability to the specific combining ability (GCA/SCA) was 1.42 (Table.19). These results indicate the presence of both the additive and non-additive type of gene actions. However, the additive type of gene action was more important than the non–additive type in the inheritance of ear length.Similar conclusion was obtained by Pal and Prodhan (1994) who reported that the effect of non-additive type of gene action on the inheritance of ear length in maize was more important than that of the additive type. In addition, Singh *et al.*, (1983) and, Zelek (2000) reported the presence of both the additive and non-additive type of gene actions in the inheritance of this character in Maize.

The parental genotype M1 had the highest desirable general combining ability effect (1.40) followed by M-1-2 (0.53), SIO4 (0.50) and M-2-1 (0.13). (Table.21). Such results indicate that these parental genotypes M1, M-1-2 and SIO4 can be, considered as relatively good combiners in forming hybrids with relatively long ears.

The results presented in Table.22 show that the F_1 hybrid M-1-2XM-2-3 had the highest desirable specific combining ability effect (3.77) followed by M-2-2XSIO4 (2.57), M-2-3XSIO4 (2.47) and M-1-2XSIO4 (2.00). (Table.22). These results indicate that such F_1 hybrids had relatively high ear length. However, forming other F_1 hybrids with other parental

Table21: General combining ability effects (gi) for ear length and number of rows/ear for the different parental genotypes

Parents	Ear length	Number of rows/ear
M-1-2	0.53**	0.40**
M-1-3	-0.97**	0.00
M-2-1	0.13	0.60**
M-2-2	-0.37*	-0.13
M-2-3	-0.60**	0.20
M-2-4	-0.63**	-0.67**
SIO4	0.50**	-0.13
M1	1.40*	0.73**
LSD 5 % (gi)	0.34	0.26
LSD 1 % (gi)	0.46	0.34
LSD 5 % (gi-gj)	0.52	0.39
LSD 1 % (gi-gj)	0.69	0.52

Table22:Specific combining ability effects(S_{ij}) for ear length and number number of rows/ear in the different hybrids

Crosses	Ear length	Number of rows/ear
M-1-2 X M-1-3	0.14	0.42
M-1-2 X M-2-1	0.04	0.48
M-1-2 X M-2-2	-1.46**	-0.79*
M-1-2 X M-2-3	3.77**	-1.79**
M-1-2 X M-2-4	0.47	-0.25
M-1-2 X SIO4	2.00**	2.22**
M-1-2 X M1	-0.90	-0.32
M-1-3 X M-2-1	1.90**	-0.45
M-1-3 X M-2-2	1.87**	1.62**
M-1-3 X M-2-3	0.04	0.62
M-1-3 X M-2-4	0.64	0.15
M-1-3 X SIO4	1.50**	0.62
M-1-3 X M1	-1.06*	0.75
M-2-1 X M-2-2	0.94	1.02*
M-2-1 X M-2-3	-1.50**	-1.32**
M-2-1 X M-2-4	1.87**	0.22
M-2-1 X SIO4	1.40**	0.02
M-2-1 X M1	-0.83	-0.52
M-2-2 X M-2-3	-0.33	1.42**
M-2-2 X M-2-4	-0.63	2.28**
M-2-2 X SIO4	2.57**	1.42**
M-2-2 X M1	1.33*	0.22
M-2-3 X M-2-4	-0.73	1.28**
M-2-3 X SIO4	2.47**	-0.92*
M-2-3 X M1	-1.76**	-0.12
M-2-4 X SIO4	1.17*	-0.72
M-2-4 X M1	1.27*	-0.59
SIO4 X M1	1.47**	1.88**
LSD 5 % (Sij)	1.05	0.79
LSD 1 % (Sij)	1.40	1.05
LSD 5 % (Sij-sik)	1.55	1.17
LSD 1 % (Sij-sik)	2.07	1.55
LSD 5 % (Sij-skl)	1.47	1.01
LSD 1 % (Sij-skl)	1.95	1.47

genotype combinations may result in obtaining F_1 hybrids with higher ear length.

The highest percentage of better parent heterosis was associated with the F_1 hybrid M-1-3XSIO4 (37.5 %) followed by M-2-3XSIO4 (34.1%), M-2-4XSIO4 (30.9 %), M-1-2XM-2-3 (28.5 %) and M-1-2XSIO4 (24.5 %). (Table.23) . However, the ear length value of the involved parental genotypes should be considered to correctly evaluate such F_1 hybrids concerning ear length. In addition, the different F_1 hybrids which showed better parent heterosis, indicate that the involved parental genotypes posses different genes controlling ear length.

The broad sense heritability estimate (h^2_{bs}) for ear length was 93.3 % (Table.24). On the other hand the narrow sense heritability (h^2_{ns}) for the same character was 14.2 %. Similar results were obtained by Hema *et al.*, (1999), working on maize, who estimated the narrow sense heritability for ear length by 13 % .These results indicate the environmental effects play an important role in the inheritance of ear length. Based on these results, selection for ear length in the segregation generation should be performed in replicated experiments to reduce the environmental effects on the expression of this character.

4.9.Number of rows /ear

The results presented in Table.19 indicated that mean square values associated with number of rows/ear were significant for parental genotypes, F_1 htybrids, and parental genotypes versus its F_1 hybrids. These results indicated the presence of genetic variability among parental genotypes and related F_1 hybrids.

Table 23: Percentage of better parent heterosis in the F_1 generation for ear length and number of rows /ear

Crosses	Ear length	Number of rows/ear
M-1-2 X M-1-3	4.0**	0.0
M-1-2 X M-2-1	10.2*	0.0
M-1-2 X M-2-2	-3.9	-7.7
M-1-2 X M-2-3	28.5**	-11.5**
M-1-2 X M-2-4	8.2**	-7.7
M-1-2 X SIO4	24.5**	3.8**
M-1-2 X M1	-15.4	0.0
M-1-3 X M-2-1	17.0**	-7.4
M-1-3 X M-2-2	-3.9	22.7**
M-1-3 X M-2-3	13.6**	0.0
M-1-3 X M-2-4	16.7**	9.1**
M-1-3 X SIO4	37.5**	9.1**
M-1-3 X M1	-23.1	3.8**
M-2-1 X M-2-2	8.0*	0.0
M-2-1 X M-2-3	-2.1	-11.1**
M-2-1 X M-2-4	19.1**	-7.4
M-2-1 X SIO4	23.4**	-11.1
M-2-1 X M1	-16.9	-3.7
M-2-2 X M-2-3	-3.9	3.8**
M-2-2 X M-2-4	-5.9	28.6**
M-2-2 X SIO4	20.0**	31.6**
M-2-2 X M1	-21.5**	0.0
M-2-3 X M-2-4	4.5	0.0
M-2-3 X SIO4	34.1**	-15.4
M-2-3 X M1	-24.6*	0.0
M-2-4 X SIO4	30.9**	0.0
M-2-4 X M1	-10.8*	-7.7
SIO4 X M1	-4.6**	3.8**

Table24:The Broad (h^2_{bs}) and narrow (h^2_{ns}) sense heteability estimates for ear length and number of rows / ear

Character	Heritability %	
	Broad Sense h^2_{bs}	Narrow Sense h^2_{ns}
Ear length	93.3	14.2
Number of rows/ear	93.2	29.1

Data presented in Table.20 indicated that the parental genotype M-2-1 had the highest number of rows/ear (18.0) followed by M-1-2, M-2-3, and M1 (17.3), M-2-4 (14.0), M-2-2 (12.7), and SIO4 (12.0). These results indicated that the parental genotype M-2-1, M-1-2, M-2-3 and M1 can be used as sources genes controlling high number of rows /ear. Non of the F_1 hybrids exceeded the parental cultivar M-2-1 concerning number of rows/ear (Table.20). However, there were no significant differences concerning number of rows/ear between each of the F_1 hybrids M-1-2XM-1-3, M-1-2X M-2-1, M-1-2XSIO4, M-1-2XM1, M-1-3XM-2-2, M-1-3XM1, M-2-1XM-2-2, M-2-1XM1, M-2-2XM-2-3, M-2-2XM-2-4, M-2-2XM1, M-2-3XM-2-4, M-2-3XM1, and SIO4XM1 and parental genotype M-2-1 (Table.20). These results indicate also the importance of the parental genotypes M-2-1, M-1-2, M-2-3, and M1.as sourcer for genes controlling high number of kernel rows/ear.

The mean square values of general and specific combining abilities were significant (Table.19). In addtion, the ratio of general combining ability to the specific combining ability (GCA/SCA) was (2.03) (Table.19). Significant general and specific combining abilities for number of rows/ ear in maize were previously detected by El–Hosary *et al.*, (1988) and Chen Yan Hui *et al.*, (2000).These results indicate the presence of both the additive and non-additive type of gene actions . However, the additive type of gene action was more important than the non–additive type in the inheritance of number of rows/ear. Similar result was obtained by Nevado and Cross (1990), working on maize, who found that the additive type of gene action in the inheritance of this character. On the contrary, Pal and Prodhan (1994) reported that the non-additive type of gene action was more important in the inheritance of number of rows/ ear in maize. In addition, Choudhary *et al.*, (2000), reported the presence of both the additive and non-additive type of gene actions in the inheritance of this character in sweet corn.

Data in Table,21 indicated that the parental genotype M1, had the highest desirable general combining ability effect (0.73) followed by M-2-1 (0.60) and M-1-2 (0.40) . Such results indicate that these parental genotypes can be considered as relatively good combiners in forming hybrids with relatively high number of rows/ear.

Table,22 show that the F_1 hybrid M-2-2XM-2-4 had the highest desirable specific combining ability effect (2.28) followed by M-1-2XSIO4 (2.22), SIO4XM1 (1.88), M-1-3XM-2-2 (1.62), M-2-2 XSIO4 (1.42), M-2-3XM-2-4 (1.28), and M-2-1XM-2-2 (1.02) . These results indicate that these F_1 hybrids had relatively high number of rows /ear.

Data presented in Table,23 indicated that the highest percentage of better parent heterosis was associated with the hybrids, M-2-2XSIO4 (31.6%) followed by M-2-2XM-2-4 (28.6%) and M-1-3XM-2-2 (22.7%) However, the number of rows/ear of the involved parental genotypes should be considered in order to correctly evaluate the previous F_1 hybrids concenrning this character . In addition, the different F_1 hybrids which showed better parent heterosis (Table,23), indicate that the involved parental genotypes posses different genes controlling number of rows /ear.Higher estimate of narrow sense heritability

(46 %) was calculated by Hema et al. (1999) for number of rows /ear in maize.

The broad sense heritability estimate (h^2_{bs}) for number of rows/ear was 93.2 % (Table.24). On the other hand, the narrow sense heraitbility (h^2_{ns}) for the same character was 29.1 %. These results indicate the non-additive type of gene action and the environmented effects have an important role in the inheritance of number of rows/ear. Such information should be considered when breeding sweet corn to improve number of rows per ear.

4.10.Pecentage of total sugars content in kernels at harvesting time

Data presented in Table.25 indicated that mean square values for percentage of total sugars content in kernels directly after harvest were significant for parental genotypes F_1 hybrids and parental genotypes versus its F_1 hybrids. These results indicated the presence of genetic variability among parental genotypes and related F_1 hybrids.Bonte and Juvik (1990), Wong *et al*.,(1994) and Danesshavar and Dickinson (1999) reported genetic difference among sweet corn germplasm concerning sugars content of kernels.

The results presented in Table.26 show that the parental genotype M-1-2 had the highest percentage of total sugars content in kernels at harvesting time (14.2%), followed by M-2-4 (13.4 %), M-2-3 (13.1 %), M1 (12.1 %), M-2-1 (11.0 %), SIO4 (10.7 %), M-1-3 (10.4 %) and M-2-2 (9.9 %). These results indicated that the parental genotype M-1-2 can be used as a source for genes controlling relatively high total sugars content

Table 25: Mean square values for percentage of total sugars seed content at harvesting time and values of kernel sugars reduction percentage after 4days of green ear- storage at room temperature ($30\pm3C^0$) for the parental genotypes, F_1 hybrids, parental genotypes versus its F_1 hybrids, general and specific combining ability, and the ratio of general combining ability to the specific combining ability.

Sources	DF	Percentage of total sugars seed content at harvesting	Percentage of total sugars reduction after 4 days
Rep	2	1.92	125.15
Genotypes	35	10.98**	1150.55**
Parents	7	7.50**	615.20**
Hybrids	27	12.24**	1319.25**
Parents vs. Hybrids	1	1.50	343.27**
Error	70	0.13	9.80
General Combinig Ability GCA	7	6.75**	459.78**
Specific Combining Ability SCA	28	2.98**	364.45**
Error	70	0.04	3.27
GCA/SCA		2.26	1.26

**Significant at 1 % level of significance

Table 26:Mean of percentage of total sugars content in kernels directly after harvesting and percentage of reduction after 4 days of storage at room temperature

Genotypes	Percentage of total sugars Content in kernels at harvesting	Percentage of total sugars reduction after 4days
M-1-2	14.2	30.7
M-1-2 X M-1-3	13.6	41.9
M-1-2 X M-2-1	13.4	19.9
M-1-2 X M-2-2	11.8	64.9
M-1-2 X M-2-3	12.9	31.7
M-1-2 X M-2-4	13.4	22.4
M-1-2 X SIO4	10.6	77.2
M-1-2 X M1	12.3	47.1
M-1-3	10.4	27.8
M-1-3 X M-2-1	14.5	74.4
M-1-3 X M-2-2	12.9	9.2
M-1-3 X M-2-3	11.4	20.9
M-1-3 X M-2-4	7.7	72.5
M-1-3 X SIO4	6.7	59.5
M-1-3 X M1	7.7	52.6
M-2-1	11.0	28.7
M-2-1 X M-2-2	13.9	67.6
M-2-1 X M-2-3	13.8	50.8
M-2-1 X M-2-4	12.8	28.6
M-2-1 X SIO4	12.0	56.7
M-2-1 X M1	13.7	23.3
M-2-2	9.9	10.5
M-2-2 X M-2-3	12.8	38.2
M-2-2 X M-2-4	11.4	35.1
M-2-2 X SIO4	11.2	8.4
M-2-2 X M1	11.5	22.3
M-2-3	13.1	25.1
M-2-3 X M-2-4	13.6	12.1
M-2-3 X SIO4	12.6	16.6
M-2-3 X M1	12.5	24.7
M-2-4	13.4	47.7
M-2-4 X SIO4	13.6	31.6
M-2-4 X M1	14.0	28.5
SIO4	10.7	43.8
SIO4 X M1	12.0	15.7
M1	12.1	22.0
LSD 5%	0.6	11.5
LSD 1%	0.8	15.4

in kernels. No significant differences were observed between total sugars content in fresh kernels of each the F_1 hybrids M-1-3XM-2-1 (14.51 %), M-2-1XM-2-2 (13.9%), M-2-1XM-2-3 (13.8 %), M-2-1XM1(13.7 %), M-2-4XM1(14 %) and the parental genotype M-1-2 (14.2 %)

The results presented in Table,25 indicated that the mean square values for general and specific combining abilities were significant. The ratio of general combining ability to the specific combining ability (GCA/SCA) was 2.26 (Table,25). These results indicate the presence of both the additive and non-additive type of gene actions. However, the additive type of gene action was more important than the non–additive type in the inheritance of total sugars content in kernels of fresh sweet corn ears.

The results presented in Table,27 indicated that the parental genotype M-1-2 had the highest desirable general combining ability effect (0.78) followed by M-2-1 (0.76), M-2-3 (0.72) and M-2-4 (0.47). Such results indicate that these parental genotypes can be considered as good combiners in forming hybrids with relatively high total sugars in kernels of fresh sweet corn ears.

Data presented in Table,28 indicated that the F_1 hybrid M-1-3 XM-2-1 had the highest desirable specific combining ability effect (3.08) followed by M-1-3XM-2-2 (2.56), M-1-2XM-1-3 (2.16) and M-2-1XM-2-2 (1.41). These results indicated that such F_1 hybrids had relatively high total sugars content in kernels directily after harvesting. However, forming hybrids with other

Table 27: General combining ability effects (g_i) for percentage of total sugars content in kernels at harvesting time and percentage of reduction after 4 days of storage at room temperature for diferent parental genotypes

Parents	Percentage of total sugars seed content after harvesting	Percentage of reduction after 4 days
M-1-2	0.78**	4.38**
M-1-3	-1.40**	3.99**
M-2-1	0.76**	10.38**
M-2-2	-0.33**	-5.59**
M-2-3	0.72**	-7.75**
M-2-4	0.47**	0.35
SIO4	-0.85**	3.07**
M1	-0.14*	-8.80**
LSD 5 % (gi)	0.12	1.06
LSD 1 % (gi)	0.16	1.42
LSD 5 % (gi-gj)	0.15	1.60
LSD 1 % (gi-gj)	0.25	2.14

Table28: Specific combining ability effects(S_{ij}) for percentage of total sugers seed content directly after harvesting and percentage of reduction after 4 days of storage at room temperature

Crosses	Percentage of total sugar seed content at harvesting	Percentage of reduction after 4 days
M-1-2 X M-1-3	2.16**	-2.38
M-1-2 X M-2-1	-0.20	-30.66**
M-1-2 X M-2-2	-0.71**	30.24**
M-1-2 X M-2-3	-0.67**	-0.77
M-1-2 X M-2-4	0.09	-18.22**
M-1-2 X SIO4	-1.43**	33.92**
M-1-2 X M1	-0.40*	15.60**
M-1-3 X M-2-1	3.08**	24.16**
M-1-3 X M-2-2	2.56**	-25.04**
M-1-3 X M-2-3	0.01	-11.15**
M-1-3 X M-2-4	-3.44**	32.32**
M-1-3 X SIO4	-3.12**	16.60**
M-1-3 X M1	-3.53**	-2.30
M-2-1 X M-2-2	1.41**	26.94**
M-2-1 X M-2-3	0.29	12.34**
M-2-1 X M-2-4	-0.49*	-18.03**
M-2-1 X SIO4	0.06	7.42**
M-2-1 X M1	1.02**	-14.00**
M-2-2 X M-2-3	0.34	15.67**
M-2-2 X M-2-4	-0.81**	4.50**
M-2-2 X SIO4	0.31	-24.91**
M-2-2 X M1	-0.10	0.80
M-2-3 X M-2-4	0.34	-16.39**
M-2-3 X SIO4	0.66**	-14.59**
M-2-3 X M1	-0.15	5.40**
M-2-4 X SIO4	1.91**	-7.68**
M-2-4 X M1	1.60**	1.10
SIO4 X M1	0.92**	-14.30**
LSD 5 % (Sij)	0.37	3.26
LSD 1 % (Sij)	0.50	4.34
LSD 5 % (Sij-sik)	0.56	4.83
LSD 1 % (Sij-sik)	0.74	6.43
LSD 5 % (Sij-skl)	0.53	4.55
LSD 1 % (Sij-skl)	0.69	6.06

parental genotype combinations may result in obtaining better F_1 hybrids.

The results presented in Table,29 indicated that the highest percentage of better parent heterosis values were associated with the F_1 hybrid M-1-3XM-2-1 (31.82 %) followed by M-1-3XM-2-2 (24.04 %) and M-2-1XM-2-2 (26.36 %). The total sugars kernel content of the involved parental genotypes should be considered to correctly evaluate such hybrids concerning this character .It has been reported by Liu *et al.*, (1996) that no heterosis concerning total sugars content was observed in crosses among different sweet corn hybrids. In addition, the diffeent F_1 hybrids which showed better parent heterosis Table(29), indicate that the involved parental genotypes posses different genes controlling this character.

Data presented in Table.30 show that the broad sense heritability estimate (h^2_{bs}) for total sugar content in fresh ears was 99.0 % . On the other hand the narrow sense heritability (h^2_{ns}) for the same character was 34.9%. These results indicated that the non-additive effects of gene action and the environmental effects play an important role in the inheritance of this character. Based on these results selection for high level of total sugars content in kernels of fresh ears in the segregating generations should be performed in replicated experiment to reduce the environmental effects on the exspression of this character.It has been reported by Azanza *et al.*,(1996). That sugars content of sweet corn kernels was a quantitive character. On the contrary, Liu *et al.* (1996) found that sugar content in kernels of sweet corn was controlled by a pair of recessive

Table29:Percentage of better parent heterosis in the F_1 generation for percentage of seed sugar content at harvesting time and reduction after 4 days of storage at room temperature

Crosses	Percentage of total sugars seed content at harvesting	Percentage of reduction after 4 days of storage
M-1-2 X M-1-3	-4.22**	36.23*
M-1-2 X M-2-1	-5.63**	-62.02
M-1-2 X M-2-2	-16.90	111.17**
M-1-2 X M-2-3	-9.16*	3.25
M-1-2 X M-2-4	-5.63	-53.14**
M-1-2 X SIO4	-25.59**	76.33**
M-1-2 X M1	-13.38**	53.14**
M-1-3 X M-2-1	31.82**	41.53**
M-1-3 X M-2-2	24.04**	-66.75
M-1-3 X M-2-3	-12.98	-24.48
M-1-3 X M-2-4	-42.54**	51.96**
M-1-3 X SIO4	-37.38**	35.92**
M-1-3 X M1	-42.15**	3.24**
M-2-1 X M-2-2	26.36**	28.59**
M-2-1 X M-2-3	5.60**	-3.39**
M-2-1 X M-2-4	-4.48*	-45.66
M-2-1 X SIO4	9.39**	7.93**
M-2-1 X M1	13.22**	-55.61
M-2-2 X M-2-3	-2.29**	52.19**
M-2-2 X M-2-4	-14.93	-26.39
M-2-2 X SIO4	4.67**	-80.75**
M-2-2 X M1	-4.96	1.52
M-2-3 X M-2-4	1.49**	-74.72**
M-2-3 X SIO4	-3.82*	-62.10**
M-2-3 X M1	-4.58	-1.59
M-2-4 X SIO4	1.49**	-33.79*
M-2-4 X M1	4.48**	-40.22
SIO4 X M1	-0.83*	-64.08**

Table 30: The Broad (h^2_{bs}) and narrow (h^2_{ns}) sense heriteability estimates for percentage of sugars seed content directly after harvesting and percentage of reduction after 4 days of storage room temperature

Characteres	Heritability %	
	Broad Sense h^2_{bs}	Narrow Sense h^2_{ns}
Percentage of total sugars seed content after harvesting	99.0	34.9
Percentage of total sugars seed content reduction after 4 days	99.2	9.5

genes. However, the important role of the environomental effects in the inhertance of this character has been reported (Wong *et al*., 1994 and 1995) In addition, Mazur *et al*. (1999) was successful in improving sugar contet in kernels of sweet corn.

4.11.Percntage of kernel sugars reduction:

Significant differences were detected among the different parental genotypes concerning the percentage of kernel sugars reduction after 4 days of storage at room temperature (30 ±3°C), (Table,25).Variations were observed among sweet corn germplasm concerning sugars content of kernels under cold storage (El-Seidy ,2001).

The lowest percentage of kernel sugars reduction was associated with the parental genotype M-2-2 (10.5 %) followed, in ascending order, by M1 (22.0 %), M-2-3 (25.1 %), M-1-3 (27.8 %) , M-2-1 (28.7 %), M-1-2 (30.7 %), SIO4 (43.81) and M-2-4 (47.7 %) , (Table,26). Based on these results, the parental genotype M-2-2 can be considered the best source for genes controlling slow reduction in kernel sugars under the condition of storage at room temperature. Unfortunately, this parental inbred line, i.e., M-2-2, had the lowest percentage of total sugars in fresh kernels, i.e., 9.9 % (Table,26). In addition, the parental line which had the highest percentage of total sugars in fresh kernels, i.e., M-1-2 (14.2 %), it had the highest ratio of sugars reduction in kernels stored at room temperature (Table,26). However, this will not reduce the value of both inbred lines, i.e., M-2-2 and M-1-2 as breeding materials since the possible association between the high percentage of total sugars in fresh kernels and high percentage of total sugars reduction in kernels stored at room temperature (30±3°C) can be broken in the segregating generations of crosses between sweet corn genotypes. In addition, the evaluation and selection based on total sugars reduction in fresh kernels stored at room temperature condition is considered a very strong selection pressure since the common method of storing fresh sweet corn ears after harvest is under cold temperature. Brecht *et al.*, (1990) found that storing sweet corn ears for 9 days at 5 ^{0}C resulted in significant decrease in kernels sugars content. In addition , Olsen *et al* . (1990), reported that storing of sweet corn ears at 18^{0}C for 10 days resulted in decreasing total sugars content of kernels.

The results presented in Table,25 indicate the significance of both the general and specific combining abilities . In addition, the ratio of the general to specific combining ability was 1.26 (Table,25). These results indicate the presence of both the additive and non-additive types of gene actions effects on the inheritance of reduction rate in kernel sugars content under the condition of storing sweet corn green ears at room temperature. However, the additive type is more important in the inheritance of this character.No reports have been found concerning the inheritance of sugars reduction rate in *Zea mays* kernels under the different storage conditions.

The most desirable general combining ability effects (gi) were associated with the parental genotypes M1 (-8.80), M-2-3 (-7.75), and M-2-2 (-5.59) (Table,27) which indicates that these parental genotyps can be considered as good combiners to form sweet corn hybrids characterized by slow kernel-sugar reduction under the condition of room temperature.

The F_1 hybrids M-1-2XM-2-1 (-30.66), M-1-3XM-2-2 (-25.04), and M-2-2XSIO4 (-24.91) had the highest desirable specific combining ability effects (Table,28). Such F_1 hybrid are expected to have relatively long shelf life due to the slow decrease in total sugar content of kernels under the condiition of green ear–storge at room temperature.

Baed on the values of the better parent heterosis presented in (Table,29), the F_1 hybrids which showed practical value concening slow sugar reduction in kerenls of green ears stored at room temperature were M-2-3XM-2-4 (-74.72 %), M-1-3XM-2-2 (-66.75 %), SIO4XM1 (-64.08 %), M-2-3XSIO4 (-62.10 %), M-1-2XM-2-1 (-62.02 %), M-2-1XM1 (-55.61 %), and M-1-2XM-2-4 (-53.14 %). The broad sense heritability for percentage of total sugar reduction in kernels of green ear stored at room temperature (30±3° C) for 4 days was 99.2%, while the value of the narrow sense heritability for the same character was 9.5 %. (Table,30). The very low norrow sense heritability estimate indicate the importance of the environmental effects on the expression of this character. Based on these results, the suggested method to achieve progress in improving this character is to select based on family mean basis in replicated experiments under different storage temperatures. This will lead to obtaining lines, open polinated cultivars and/or F_1 hybrids with slow total sugar reduction in kernels of green–sweet corn ears under different storage temperatures.It is worth mentioning here that many other factors could affect rate of sugars reduction in kernels of sweet corn in addition to the gentic control (Hannah *et al.*, 1993), such as harvesting time or seed maturity (Bar and

Schaffer, 1993; Kim *et al.*, 1994 Wong *et al.*, 1994; Borowski *et al.*, 1995; Suksoon *et al.*, 1999) and moisture content of kernels (Borowski *et al.*, 1995) . Such factors should also be considered in sweet corn breeding programs to improve such characters.

4.12.Percentage of starch seed content in kernels at harvesting time

Results presented in Table,31 showed that the mean square values for percentage of starch seed content measured directly after harvesting were significant for parental genotypes, F_1 hybrids, and parents versus its F_1 hybrids which indicated the presences of genetic variation among such genotypes concerning this character. Genetic differences in kernel starch content have been observed among sweet corn germplasm (Bonte and Jurik, 1990; Wong *et al.*, 1994; Baneshavar and Dickinson, 1999) and maize germplasm (Golob and Plestenjak , 1999).

The lowest percentage of starch seed content was associated with the parental genotype M-2-1 (6.1%), followed by, in ascending order, M-2-3 (8.4%), M-1-2 (8.4 %), M-2-4 (11.1 %), M-1-3 (11.6%), M1 (12.7 %), M-2-2 (13.4%), and SIO4 (16.0%), (Table,32). It is worth mentioning here, that the low percentage of starch seed content accompanied by high percentage of sugar seed content is considered as a desirable quality characteristic in sweet corn. Some of the obtained F_1 hybrids were significantly less in starch seed content than the parental genotypes (Table,32). The lowest percentage of starch seed content values measured directly after harvesting of ears were associated with the F_1 hybrids , M-1-2 XM-2-4 (3.0 %), M-2-1XM-2-2 (3.2 %), and M-2-1XSIO4 (4.5 %), (Table,32).

Table31: Mean square values for percentage of strach seed content at harvesting time and percentage of increase after 4 days of storage at room temprature for the different parental genotypes, F_1 hybrids and parental genotypes versus F_1 hybrids, general and specific combining ability and ratio of general combining ability to the specific combining ability

Sources	DF	Percentage of starch seed content at harvesting	Percentage of increase starch after 4 days of storage at room temperature
Rep	2	4.40	210.85
Genotypes	35	32.40**	1818.42**
Parents	7	31.13**	1450.55**
Hybrids	27	32.57**	1979.46**
Parents vs. Hybrids	1	36.87**	45.08**
Error	70	1.46	50.56
General Combinig Ability GCA	7	20.35**	365.97**
Specific Combining Ability SCA	28	8.41**	16.93**
Error	70	0.48	16.86
GCA/SCA		2.41	21.60

** Significant at 1 % level of significance

Table 32 : Mean of percentage of starch seed content directly after harvesting time and percentage of increase after 4 days of storage at room temperature for the different parental genotypes and its hybrids

Genotypes	Percentage of seed strach content at harvesting time	Percentage of increase after 4 days of storage
M-1-2	8.4	90.1
M-1-2 X M-1-3	10.0	70.3
M-1-2 X M-2-1	11.3	55.6
M-1-2 X M-2-2	10.3	86.7
M-1-2 X M-2-3	9.0	57.5
M-1-2 X M-2-4	3.0	91.3
M-1-2 X SIO4	4.9	91.5
M-1-2 X M1	10.1	93.0
M-1-3	11.6	46.2
M-1-3 X M-2-1	11.3	93.1
M-1-3 X M-2-2	12.0	19.6
M-1-3 X M-2-3	10.9	34.1
M-1-3 X M-2-4	11.3	67.2
M-1-3 X SIO4	18.0	32.6
M-1-3 X M1	13.7	43.0
M-2-1	6.1	91.5
M-2-1 X M-2-2	3.2	45.9
M-2-1 X M-2-3	9.9	84.6
M-2-1 X M-2-4	7.8	81.8
M-2-1 X SIO4	4.5	81.4
M-2-1 X M1	7.8	87.5
M-2-2	13.4	63.3
M-2-2 X M-2-3	10.5	65.6
M-2-2 X M-2-4	10.0	56.5
M-2-2 X SIO4	12.2	28.8
M-2-2 X M1	13.3	33.5
M-2-3	8.4	42.4
M-2-3 X M-2-4	10.7	26.9
M-2-3 X SIO4	9.1	38.7
M-2-3 X M1	11.0	38.1
M-2-4	11.1	68.9
M-2-4 X SIO4	7.1	88.8
M-2-4 X M1	5.4	79.6
SIO4	16.0	34.6
SIO4 X M1	9.3	36.9
M1	12.7	44.2
LSD 5%	2.0	11.6
LSD 1%	2.6	15.4

However, as mentioned before, sugar seed content should be considered in the same time in order to judge such F_1 hybrids correctly.

The results presented in Table.31 indicate the significance of both the general and specific combining abilities for starch seed conten measured directly after harvesting. In addition the ratio of general to specific combining ability was 2.41 These results indicate the presence of both the additive and non-additive type of gene actions in the inheritance of starch seed content measured directly after harvesting. However, the additive type of gene action is more important in this respect.

The desirable general combining ability effects (gi) were associated the parental inbred lines M-2-1 (-2.09), M-1-2 (-1.34), and M-2-4 (-1.14), (Table.33). These results indicate that these parental genotypes can be considered as good combiners in forming hybrids with low starch seed content measured directly after harvesting of green ears.

The highest desirable specific combining ability effects (Sij) were associated with the F_1 hybrids M-2-1XM-2-2 (-5.50), M-1-2X SIO4 (-4.47), M-1-2XM-2-4 (-4.41) and M-2-1XSIO4 and M-2-4X M1 (-4.12), (Table.34). Such F_1 hybrids will have low starch seed content measured directly after harvesting of green ears.

The F_1 hybrids which showed relatively high better parent heterosis were M-1-2XM-2-4 (-64.3%), M-2-4XM1 (-51.4 %), M-2-1XM-2-2 (-47.5%), M-1-2XSIO4 (-41.7 %), and M-2-4XSIO4 (-36.0 %), (Table.35).These F_1 hybrids will have low

Table 33: General combining ability effects (g_i) of the different parental genotypes for percentage of starch seed content measured directly after harvesting and percentage of increase after 4 days of starage at room temperature.

Parents	Percentage of strach seed content at harvesting time	Percentage of increase after 4 days of storage at room temperature
M-1-2	-1.34**	19.15**
M-1-3	2.17**	-10.03**
M-2-1	-2.09**	16.09**
M-2-2	0.96**	-8.89**
M-2-3	-0.10	-12.19**
M-2-4	-1.14**	7.78**
SIO4	0.84**	-8.44**
M1	0.71**	-3.40**
LSD 5 % (gi)	0.41	2.42
LSD 1 % (gi)	0.55	3.22
LSD 5 % (gi-gj)	0.62	3.65
LSD 1 % (gi-gj)	0.82	4.86

Table 34: Specific combining ability effects (S_{ij}) for percentage of starch seed content measured directly after harvest and percentage of reduction after 4 days of storage at room temperature for the different F_1 hybrids

Crosses	Percentage of strach Seed content at harvesting time	Percentage of increase after 4 days of storage at room temperature
M-1-2 X M-1-3	-0.65	-0.45
M-1-2 X M-2-1	4.91**	-41.01**
M-1-2 X M-2-2	0.82	15.09**
M-1-2 X M-2-3	0.58	-10.82**
M-1-2 X M-2-4	-4.41**	3.04
M-1-2 X SIO4	-4.47**	19.43**
M-1-2 X M1	0.84	33.90**
M-1-3 X M-2-1	1.32*	25.73**
M-1-3 X M-2-2	-0.97	-22.87**
M-1-3 X M-2-3	-1.04	-5.04
M-1-3 X M-2-4	0.40	8.05*
M-1-3 X SIO4	5.18**	-10.33**
M-1-3 X M1	0.98	-4.80
M-2-1 X M-2-2	-5.50**	-22.64**
M-2-1 X M-2-3	2.22**	19.39**
M-2-1 X M-2-4	1.11	-3.41
M-2-1 X SIO4	-4.12**	12.37**
M-2-1 X M1	-0.70	13.40**
M-2-2 X M-2-3	-0.20	25.33**
M-2-2 X M-2-4	0.29	-3.71
M-2-2 X SIO4	0.53	-15.19**
M-2-2 X M1	1.73**	-15.50**
M-2-3 X M-2-4	2.08**	-30.01**
M-2-3 X SIO4	-1.47*	-2.03
M-2-3 X M1	0.47	-7.60*
M-2-4 X SIO4	-2.46**	28.09**
M-2-4 X M1	-4.05**	13.90**
SIO4 X M1	-2.15**	-12.60**
LSD 5 % (Sij)	1.25	7.40
LSD 1 % (Sij)	1.67	9.86
LSD 5 % (Sij-sik)	2.47	10.96
LSD 1 % (Sij-sik)	1.75	14.59
LSD 5 % (Sij-skl)	1.76	10.33
LSD 1 % (Sij-skl)	2.33	13.76

Table 35: Percentage of better parant heterosis for starch seed content measured directly after harvest and percentage of storage increase after 4 days of storage at room temperature for the different F_1 hybrids

Crosses	Percentage of seed starch at harvesting time	Percentage of increase after 4days of storage at room temperature
M-1-2 X M-1-3	19.0	52.2
M-1-2 X M-2-1	85.2**	-38.3**
M-1-2 X M-2-2	22.6	36.9
M-1-2 X M-2-3	7.1	35.6
M-1-2 X M-2-4	-64.3**	32.5*
M-1-2 X SIO4	-41.7**	164.5**
M-1-2 X M1	20.2	110.4**
M-1-3 X M-2-1	85.2**	101.5**
M-1-3 X M-2-2	3.4	-57.6**
M-1-3 X M-2-3	29.8	-19.6
M-1-3 X M-2-4	1.8	45.5
M-1-3 X SIO4	55.2**	-5.8
M-1-3 X M1	18.1	-2.7
M-2-1 X M-2-2	-47.5**	-27.5**
M-2-1 X M-2-3	62.3**	99.5**
M-2-1 X M-2-4	27.9	18.7
M-2-1 X SIO4	-26.2**	135.3**
M-2-1 X M1	27.9	97.9**
M-2-2 X M-2-3	25.0	54.7*
M-2-2 X M-2-4	-9.9*	-10.7
M-2-2 X SIO4	8.9*	-16.8**
M-2-2 X M1	4.7	-24.2**
M-2-3 X M-2-4	27.4	-36.6**
M-2-3 X SIO4	8.3**	11.8
M-2-3 X M1	30.9	-10.1
M-2-4 X SIO4	-36.0**	156.6**
M-2-4 X M1	-51.4**	80.1**
SIO4 X M1	-26.8**	6.6**

starch seed content directly after harvesting green ears. However, other characteristics such as sugars seed conten should be considered before recommending any one of these F_1 hybrids.

The broad sense heritability estimate (h^2_{bs}) for starch seed content, measured directly after harvesting was 96.3 % while the narrow sense heritability estimate(h^2_{ns}) was 36.2% (Table, 36). These results indicate that the expression of this character is highly influenced by the non-additive type of gene action and the environmental conditions.It has been reported by Azanza *et al.*, (1996) that starch content of sweet corn kernels is a quantitive character Such information is of great value in sweet corn breeding programs.

4.13.Percentage of starch increase in kernels of fresh ears stored at room temperature

The results presented in Table,31 indicate significant differences among the parental genotypes concerning the percentage of starch increase in kernels of fresh green ears stored at room temperature (30±3°C) for 4 days. It is worth mentioning here that the slow rate of starch increase in kernels of sweet corn ears after harveset is considered one of the sweet corn quality characteristics. El-Seidy (2001) observed differences among sweet corn germplasm concerning starch content of kernels under cold storage.

The percentage of starch increase in the parental genotype ranged from 34.6 % (SIO4) to 91.5 % (M-2-1), (Table 32). The relatively low percentage of starch increase associated with the parental genotype SIO4 (34.6 %) was accompanied by high percentage of sugar reduction (43.8 %) in kernels of green ears

Table 36 :The Broad (h^2_{bs}) and narrow (h^2_{ns}) sense heritability estimates for starch seed content measured directly after harvesting and percentage of starch increase after 4 days of storage at room temperature

Characteres	Heritability %	
	Broad Sense h^2_{bs}	Narrow Sense h^2_{ns}
Percentage of starch seed content at harvesting time	96.3	36.2
Percentage of increase after 4 days of storage at room temperature	98.0	56.8

stored at room temperature (30±3°C) for 4 days (Table.32). In addition, the above intermediate value of starch reduction percentage found in kernels of the parental genotype M-2-2 (63.3%) was acomparied by low percentage of sugar reduction (13.4%) after 4 days of storing the fresh green ears at room temperature (Table.32). These results indicate that the rates of sugar reduction and starch increase in kernels of green ears after harvest are under different genetic control. Based on these results, rates of both sugar reduction and starch increase should be both considered during selection for improved shelf life in sweet corn for rate of starch increase in kernels of sweet corn green ears stored at room temperature.

Mean square values for general and specific combining abilities were significant (Table.31). The ratio of general combining ability to the specific combining ability for the same characters was greater than (21.60). (Table.31). These results indicate the persence of both additive and non-additive type of gene actions in the inheritance of starch increase rate in kernels of green sweet corn ears after harvest. However, the additive type is more important than the non-additive type in the inheritance of this character.

The desirable general combining ability effects were associated with the parental genotypes M-2-3 (-12.19), M-1-3 (-10.03), M-2-2 (-8.89), and SIO4 (-8.44), (Table.33). These results indicate that the previously mentioned parental genotypes can be considered as good combiners in forming hybrids with slow starch increase rate in kernels after harvest of green sweet corn ears.

The F_1 hybrids which showed relatively high desirable specific combining ability effects were M-1-2XM-2-1 (-41.01), M-2-3X M-2-4 (-30.01), M-2-1XM-2-2 (-22.64), M-2-2XM1 (-15.50),and M-2-2XSIO4 (-15.19), (Table.34). Furthermore, relatively high better parent heterasis values were associated with the F_1 hybrids M-1-3XM-2-2 (-57.6%), M-1-2XM-2-1 (-38.3 %), M-2-3XM-2-4 (-36.6%), M-2-1XM-2-2 (-27.5 %), M-2-2XM1 (-24.2%), M-1-3X M-2-3 (-19.6 %) , and M-2-2XS104 (-16.8 %), (Table, 35). Such F_1 hybrids are expected to have relatively long shelf life due to the slow rate of starch increase in kernels of green sweet corn ears stored at room temperature (30±3°C) for 4 days . It is worth mentioning here that level of starch content of sweet corn kernels depends on harvesting time or degree of kernel maturity (Suksoon, *et al.*, 1999).

The broad and narrow sense heritability estimates were 98.0% and 56.8 %, respectively, (Table.36). These results indicate the great influence of the environmental conditions on the rate of starch increaase in kernels of green sweet corn ears after harvest. In addition, selection for slow rate of starch increase in kerenls of green sweet ears should be performed based on family mean basis in replicated experiments under different storage temperature.

It has been reported by Hannah *et al.*, (1993) that convertion of sucrose to starch in sweet corn is under genetic control. In addition, Wong *et al.*, (1994) found that rate of convertion of endosperm sugars to starch after harvest was under genetic control. These findings support the results found in the present study. Such information are of great value in sweet corn breeding programs to improve the shef life of sweet corn ears.

4.14.Correlation Study:

The simple correlation coefficient (r) values presented in (Table,37) indicate positive correlation between weight of fresh husked ears/plant and each of plant height (r=0.88) , ear position on the plant (r=0.63), and ear length (r=0.81). In addition, negative correlation between weight of fresh husked ears/ plant and each of dry weight of 100 g fresh kernels (-0.49), number of days to tasselling (-0.84) and number of days to silking (-0.76). Such relationship should be considered by sweet corn breeders when selecting for high yield per plant.

The high positive correlation between number of days to silking and number of days to tasseling (r=0.94) (Table, 37) is a desirable correlation since selection for close silking and tasselling dates will lead to lines with well developed ears.

Positive correlation was observed between plant height and each of ear position (r=0.69) and ear length (r=0.63), (Table, 37) Such information are of great value in breeding programs of sweet corn.

Positive correlation coefficients were detected between percentage of total sugars in fresh kernels and each of ear position (r=0.67) and ear length (r=0.50), (Table,37) while , negative correlation coefficients were observed between percentage of total sugars content in fresh kernels and each of number of days to tasselling (r =-0.48) and number of days to silking (r=-0.42) (Table , 37). The positive correlation between the morphological characters observed in the present study, i.e., ear position and the percentage of total sugars in the fresh kernels will ease the selection for high sugars content of kernels in the segregating genrations. Based on these results, selection for early tasselling and silking will be accomparied by indirect selection for high sugars content of kerenls because of the correlation observed among these characters. In addition, selection for high total sugars in kerenls of newly harvested sweet corn in the segregating genertion will be accompanied by indirect selection for low rate of total sugars reduction in kerenls of grain sweet corn ears stored at room temperature (30±3°C) for 4 days because of the simple correlation observed between these two characters (r =-0.76) (Table.37) It is worth mentioning here that sugars content of kernels is considered the most important quality characteristic of sweet corn (Hassan, 1989) . In addition sugars seed content was found to have negative correlation with field emergence (Azanza *et al.*, 1996) Moreover, simple negative correllation was observed between percentage of starch content of kernels and each of percentae of starch increase in kernels of green sweet corn ears stored at room temperature (30±3°C) for 4 days (r=-0.69). (Table.37). Such information are of great value for sweet corn breeding programs to improve quality. However, path analysis needs to be performed in the future on F_2 populations of the sweet corn F_1 hybrids obtained in the present study in oder to calculate accurate parameters in this respect.

Table (37) Simple correlation coefficients between the different studied characters [K]

Chracter	2	3	4	5	6	7	8	9	10	11	12
3	0.94**										
4	-0.71**	-0.63**									
5	-0.69**	-0.61**	0.70**								
6	0.39	0.28	-0.63**	-0.48*							
7	-0.55**	-0.65**	0.39	0.52**	0.11						
8	-0.86**	-0.79**	0.63**	0.69**	-0.29	0.41*					
9	-0.48*	-0.42*	0.19	0.67**	-0.31	0.27	0.50**				
10	0.31	0.21	-0.16	-0.62**	.0.35	0.10	-0.46**	-0.76**			
11	0.21	0.34	0.13	-0.12	-0.39	-0.33	-0.30	-0.25	0.26		
12	-0.01	-0.18	-0.25	-0.28	0.59**	0.42*	0.09	-0.13	0.33	-0.69**	
1	-0.84**	-0.76**	0.88**	0.63**	-0.49*	0.38	0.81**	0.26	-0.22	0.04	-0.15

k:

1-Weight of fresh husked ear / plant
2-Tasselling Date
3-Silking Date
4-Plant height
5-Position of 1st ear on plant (ear height)
6-Dry weight of fresh kernels
7-Number of rows/ear
8-Ear length
9-Percentage of total sugars content in kernels at harvesting time
10-Percnetage of sugars reduction in kernels of fresh ears stored at room temperature
11-Percentage of starch seed content in kernels at harvesting time
12-Percentage of starch increase in kernels of fresh ears stored at room temperature
* Significant at 1 % level of significance
**Significant at 1 % level of significance