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MORPHOLOGICAL IDENTIFICATION AND EVALUATE THE COMBINING ABILITY AND HETEROSIS OF SOME INBRED LINES OF MAIZE AND ITS CROSSES

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ABSTRACT: In 2016 five maize inbred lines were crossed in all possible combinations without reciprocals by using a half diallel crosses mating design to obtain 10 single crosses. Parental inbred lines and their F_1 single crosses were evaluated through 2017 season to evaluate the role of general and specific combining ability, heterosis and the morphological characteristics. A randomized complete block design with three replicates was used. Results showed that mean squares of genotypes, general combining ability (GCA) and specific combining ability (SCA) were highly significant for all studied yield traits. The GCA/SCA ratio was less than unity for all studied traits, this means that these traits are predominantly controlled by non-additive gene action. Positive significant GCA effects were found for all studied traits. Based on GCA estimates, it could be concluded that the best combiners were Inb 209 and Inb 239 for most of studied traits. This result indicated that these inbred lines could be considered as good combiners for improving yield and its attributes. Positive significant SCA effects were found for all studied traits. Based on SCA effects, the best crosses for ear diameter, 100-kernel weigh and kernel number/row was C1; for ear length was C10 and for ear weight/plant, grain weight/plant and shelling percentage was C8. Results showed positive significant heterosis values for all studied yield traits. The best crosses over both their mid-parents and better-parents for ear diameter and 100-kernel weigh was C2; for ear length and kernel number/row was C5; for ear weight/plant and grain weight/plant was C9 and for shelling percentage was C8.

Key words: Maize, morphology, heterosis, half diallel crosses, general combining ability, specific combining ability.

INTRODUCTION

Allard (1960) was the first research worker who found that hybrids were often possessed the most striking and unusual vigor. Since that time, many research workers started a new area of plant breeding to benefit from this phenomenon, which is now known as heterosis. **Abd El-Aal (2002)** evaluated a set of half-diallel crosses among eight inbred lines and the six populations of each cross. He found that heterosis values relative to the better parent were negative and significant for ear length, ear diameter, number of kernel/row and grain weight/plant. **El-Shouny *et al.* (2003)** reported that the GCA and SCA mean squares were highly significant for ear diameter, number of kernel/row and grain weight/plant. Meanwhile, the GCA/SCA ratio was larger than unity for all the studied traits except grain weight/plant,

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indicating that the GCA were important than SCA in the inheritance of these traits. **Shafey *et al.* (2003)** studied 28 F1 hybrids of corn and their eight parental inbred lines and they obtained quite large and medium values of heterosis formost. **Abd El-Maksoud *et al.* (2004)** Estimates of combining ability and heterosis in some maize inbred lines for the important traits. **El-Gazzar (2004)** evaluated 28 F1 hybrids of maize and observed that the calculated values of heterosis were positive and highly significant for all studied vegetative and yield component traits. **Barakat and Osman (2008)** indicated that the tested inbred lines and testers exhibited significant GCA effects vary greatly according to the studied traits. The variance magnitude due to GCA for tested and tester lines was higher than that due to SCA for all studied traits, this indicates that additive genetic variance was the major source of variation responsible for the inheritance of these traits. **Smith and Smith (1989)** in USA stated that morphological traits have long been used to estimate systematic relationship in corn. They added that although morphology has proved useful for classifying corn races and populations, it may not be appropriate for elite breeding germplagm while (**Cooke, 1999**) reported that many of the morphological descriptors used are based on quantitative characters, the expression of which is affected by environmental factors as well as the limited number of useful descriptors of some species. **El-Hawary *et al.* (2003)** reported that the morphological differences among the tested eleven inbred lines in thirty-four characteristics were very clear. Very slight stem zig-zag was found for all studied genotypes, except Gm. 30, Sd. 7 while tassel lateral branches were strongly recurved and Sd. 63 just recurved, Gm. 2 had conical ear shape. They added that all genotypes had white color of top of grain and dorsal side of grain and obtained results showed that all studied genotypes had no differences in anthocyanin coloration of glumes of cob which were absent. **El-Abady (2005)** identified the variability among three inbred lines, two Single Crosses and one Three-Ways cross using morphological characters according to **UPOV (1994)** and found that there were significant differences among the genotypes studied in most of the characters studied. **Badu *et al.* (2017)** studied the advances in genetic enhancement of early and extra-early maize for Sub-Saharan Africa. The aim of this study was to determine the role of general and specific combining ability and heterosis for some agronomic traits. Also the morphological characters were evaluated for identification among maize crosses.

MATERIALS AND METHODS

Two field experiments were carried out at the Farm of the Agronomy Department, Faculty of Agriculture, Mansoura University and laboratories of Seed Technology Department, Field Crops Research Institute A.R.C. Giza, Egypt during 2016 and 2017 summer seasons. In 2016 five maize inbred lines were crossed in all possible combinations without reciprocals by using a half diallel crosses mating design to obtain 10 single crosses. These inbred lines were: Inb 202, Inb 204, Inb 208, Inb 209 and Inb 239. The seeds of all inbred lines were obtained from Maize Research Department, Field Crop Research Institute, Agricultural Research Center (ARC), Ministry of Agriculture and Land Reclamation, Egypt. Name and sources of the studied genotypes are listed in Table 1. Diallel analysis for General and Specific Combining Ability was done. Ten single crosses comprise a half diallel between 5 inbred parents. Data of all 15 genotypes were analyzed as randomized complete blocks with three replicates. General combining ability effects for the inbred parents, specific combining ability effects for cross combinations and their respective standard errors were computed using formulae given in **Griffing (1956)** method 2 model 1 (fixed effects). Showed in Table 2.

The relative importance of GCA to SCA was expressed as follows:

$$K^2GCA/k^2SCA=[(MS_{GCA}-Ms_e)/(P+2)]/(MS_{SCA}-Ms_e)$$

where:

MS = mean squares

P = No. of parents

k^2= The average squares of effects

The studied traits were recorded by visual assessment as follows in Table 3.

Table 1. Names and sources of the genotypes

Code	Name	Source
I1	Inb 202	H-[1] myorten
I2	Inb 204	CP X 888
I3	Inb 208	SD7 X G2-614
I4	Inb 209	SD7 X G2-614
I5	Inb 239	Turk-24
C1	-	Inb 202x204
C2	-	Inb 202x208
C3	-	Inb 202X209
C4	-	Inb 202X239
C5	-	Inb 204X208
C6	-	Inb 204X209
C7	-	Inb 204X239
C8	-	Inb 208X209
C9	-	Inb 208X239
C10	-	Inb 209X239

Table 2. Analysis of variance and expected mean squares for combining ability analysis

SV	df	MS	E.M.S
GCA	P-1	Mg	$\sigma^2_e + (p+2)(1/p-1)\sum g^2 i$
SCA	P(P-1)/2	Ms	$\sigma^2_e + 2/p\ (p-1)\sum i \sum j\ S^2_{ij}$
Error	(r-1)(c-1)	Me	σ^2_e

Where, Me= the error mean squares of the main randomized complete block design divided by number of replications (Me= Me/r). , P= number of parents.

Table 3. Qualitative characters and its degree

Code	Character	Degree	
A1	**Anthocyanin coloration of sheath of first leaf.**	Absent or very weak	1
		Weak	3
		Medium	5
		Strong	7
		Very strong	9
A2	**Shape of tip of first leaf.**	Pointed	1
		Pointed to round	2
		Round	3
		Round to spatulate	4
		Spatulate	5
A3	**Attitude of blade on leaf just above upper ear.**	Straight	1
		Slightly recurved	3
		Recurved	5
		Strongly recurved	7
		Very Strongly recurved	9
A4	**Degree of zig-zag of stem.**	Absent or very slight	1
		Slight	2
		Strong	3
A5	**Anthocyanin coloration of brace roots.**	Absent or very weak	1
		Weak	3
		Medium	5
		Strong	7
		Very strong	9
A6	**Attitude of lateral branches in lower third of tassel.**	Straight	1
		Slightly recurved	3
		Recurved	5
		Strongly recurved	7
		Very Strongly recurved	9
A7	**Spikelets density in middle third of main axis.**	Lax	3
		Medium	5
		Dense	7
A8	**Anthocyanin coloration of anthers in middle third of main axis on fresh anthers**	Absent or very weak	1
		Weak	3
		Medium	5
		Strong	7
		Very strong	9
A9	**Anthocyanin coloration of silks.**	Absent	1
		Present	9
A10	**Ear shape.**	Conical	1
		Conico- Cylindrical	2
		Cylindrical	3
A11	**Grain type in middle third of ear.**	Flint	1
		Flint-like	2
		Intermediate	3
		Dent-like	4
		Dent	5
		Sweet	6
		Pop	7

Table 4. Quantitative characters and its stage

Code	Character	Stage
A12	Angle between blade and stem.	61
A13	Angle between main axis and lateral branches in lower third of tassel.	65
A14	Primary lateral branche number.	65
A15	Time of tassel emergence (day).	65
A16	Time of silk emergence (day).	65
A17	Main axis above lowest side branch length (cm).	71
A18	Main axis above upper side branch length (cm).	71
A19	Tassel branches length (cm).	71
A20	Blade width /cm (leaf of upper ear).	75
A21	Blade length /cm (leaf of upper ear).	75
A22	Ratio height of insertion of upper ear to plant height.	75
A23	Peduncle length (cm).	85
A24	Numbers of rows of grains /plant.	92
A25	Ear diameter (cm).	92
A26	Ear length without husk (cm).	92

RESULTS AND DISCUSSION

Results in Table 5 indicat that mean squares of genotypes, general combining ability mean squares (GCA) and specific combining ability mean squares (SCA) were highly significant for all studied traits. The GCA/SCA ratio was less than unity for all studied traits. This means that these traits are predominantly controlled by non-additive gene action. Similar results were previosly reported by **Hassaballa *et al.* (2002) and El-Morshidy *et al.* (2003)**.

General Combining Ability Effects (g_i)

Results presented in Table 6 regarding estimates of general combining ability effects (gi) for inbred parents for studied traits showed that positive significant GCA effects were found for all studied traits. Based on GCA estimates, it indicated that the best combiners for ear diameter and ear length were inbred lines of Inb 209 and Inb 239; for kernel No./row were Inb 204; Inb 202 and Inb 209; for 100-kernel weight were Inb 204 and Inb 209; for ear weight/plant and grain weight/plant was Inb 209 and for Shelling percentage was Inb 202. These results indicated that these inbred lines could be considered as good combiners for improving yield traits.

Specific Combining Ability Effects (S_{ij})

Results given in Table 7 show (s_{ij}) for all F_1 crosses for all studied traits. Positive significant SCA effects were found in all studied traits for most crosses. Based on SCA effects, all crosses showed positive and significant SCA effects for ear diameter. It is interest to note that, maximum and desirable SCA effects were registered for ear height by C7 (Inb 204 X 239; for ear diameter and 100- kernel weight by C1 (Inb 202 X 204); for kernels/row by C2 (Inb 202 X 208) and as well as for ear yield/plant, grain yield/ plant and shelling (%) by C8 (Inb 208 X 209). So C1, C2, C7 and C8 could be selected and used in breeding programs for improving these traits. This result is in contrast with previous findings by **Hosana *et al.* (2015)** who reported that additive variance effects were more important than non-additive genetic effects. The differences could be attributed to different sets of germplasm and different environments used in these studies.

Table 5. Mean squares of five parental diallel crosses for all studied traits from analysis of variance, for (GCA) and (SCA) of all studied traits

SV	df	Ear length	Ear diameter	Kernels/ row	100-kernel weight	Ear yield/ plant	Grain yield/ plant	Shelling (%)
Genotypes	12	89.9**	3.9**	315.1**	113.7**	12210.1**	9469.9**	306.3**
GCA	6	26.9**	3.1**	243.3**	42.2**	5750.2**	3234.5**	126.7**
SCA	12	114.7**	4.9**	340.9**	139.7**	14789.9**	11966.9**	377.7**
Error	40	1.3**	0.1	5.1	0.6	29.7	46.3	21.6
SCA/GCA	-	0.03	0.08	0.10	0.04	0.07	0.04	0.05

*,** Significant at level probability 0.05 and 0.01, respectively.

Table 6. Estimates of general combining ability effects (gi) for inbred parents for studied traits

Traits / Crosses	Ear length	Ear diameter	Kernels /row	100-kernel weight	Ear yield/plant	Grain yield/plant	Shelling (%)
P1 (Inb202)	-0.391	-0.322**	1.950**	-1.245**	-8.987**	-7.100**	2.320*
P2 (Inb204)	0.387	-0.412**	2.100**	0.671**	0.411	-0.233	0.214
P3 (Inb208)	-0.666*	0.08	-3.979**	0.188	-9.100**	-5.888**	-3.217**
P4 (Inb209)	1.716**	0.397**	1.656**	1.685**	24.546**	19.100**	0.911
P5 (Inb239)	0.912**	0.092*	-1.822**	-1.100**	-6.580**	-5.551**	-0.263
SE (g_i)[1]	0.168	0.028	0.388	0.111	0.899	1.122	0.791
SE (g_i-g_j)[2]	0.270	0.043	0.565	0.201	1.321	1.901	1.222

*,** significant at level probability 0.05 and 0.01, respectively.
1 Standard error for an GCA effect.
2 Standard error for the difference between estimates of GCA effects.

Table 7. Estimates of (sij) for all F1 crosses for all studied traits

Traits / Crosses	Ear length	Ear diameter	Kernels / row	100- Kernel weight	Ear yield/plant	Grain yield/plant	Shelling (%)
C1	2.988**	1.011**	3.866**	5.992**	40.980**	27.840**	-3.367
C2	4.887**	0.924**	9.667**	0.257*	29.999**	24.260**	5.129*
C3	0.077	0.266**	-3.106**	1.370**	-2.100	3.397	1.748
C4	-0.261	0.717**	-0.430ns	4.817**	42.955**	37.719**	2.674
C5	5.100**	0.754**	9.936**	5.342**	40.300**	39.802**	11.169**
C6	1.850**	0.221**	6.988**	2.516**	25.620**	20.492**	0.597
C7	6.102**	0.901**	7.100**	4.278**	50.312**	46.356**	5.735*
C8	3.100**	0.322*	3.010**	2.120**	55.100**	57.869**	12.402**
C9	2.924**	0.601**	6.656**	5.167**	39.300**	32.396**	7.664**
C10	-0.671**	0.201*	-2.010	0.241	8.998**	7.763*	0.981
S.E sca (ij)[1]	0.47	0.070	0.96	0.34	2.32	2.96	2.03
S.E sca (ij-ik)[2]	0.72	0.1	1.52	0.5	3.83	4.44	3.04
S.E sca (ij-kl)[3]	0.62	0.09	1.21	0.46	3.2	4.05	2.78

*,** Significant at level probability 0.05 and 0.01, respectively
1 Standard error for an SCA effect.
2 Standard error for the difference between two SCA effects for a common parent.
3 Standard error for the difference between two SCA effects for a non-common parent.

Heterosis Over Mid-Parents

Results given in Table 8 show percentages of heterosis over mid-parents for all studied traits. Results showed positive significant heterosis values for all studied traits for all crosses except C3 (Inb 202 X 209) and C10 (Inb 209 X 239) for kernel No./row and C1 (Inb 202 X 204) for shelling percentage. The maximum percentage of heterosis over their mid-parents for ear diameter and 100-kernel weight was C1 (Inb 202 X 204); for ear length, kernel No./row and for shelling percentage was C5 (Inb 204 X 208) and for ear weight/plant and grain weight/plant was C9 (Inb 208 X 239), similar results were reported by **Mosa (2003) and Welcker *et al.* (2005)**.

Heterosis Over Better-Parents

Table 9 show percentages of heterosis over better-parents for all studied traits. Results showed positive significant heterosis values over better-parents in all studied traits for most crosses. The highest crosses over their better-parents for ear diameter and 100-kernel weight was C2(Inb 202 X 208); for ear length, kernel No./row and shelling percentage was C5 (Inb 204 X 208); for ear weight/plant and grain weight/plant was C9 (Inb 208 X 239) similar results were reported by **Amiruzza man *et al.* (2010)**.

Morphological Identification

Qualitative characters:

As presented in Table 3 and the obtained results in Table 10, the morphological identification could be described as follows:

Anthocyanin coloration of sheath of first leaf

Inb 202, C1, C2, C3, C4, C5, C6, C8 and C10 were very strong, while Inb 204, Inb 208, Inb 239 and C7 were medium.

Shape of tip of first leaf

Was pointed for all genotypes.

Attitude of blade on leaf just above upper ear

Straight in (Inb 202, C2 and C8), slightly recurved in (Inb 204, Inb 208, Inb 209, C4, C6, C7 and C9) and recurved in (Inb 239, C1, C3, C5 and C10).

Degree of zig-zag of stem

Slight in (Inb 208 and C2) and C10, absent or very slight in (Inb 202, Inb 239, C1, C3, C4, C5, C6, C8, C9 and C10) and absent in (Inb 209 and C7).

Anthocyanin coloration of brace roots

Was strong in all genotypes.

Anthocyanin coloration at base of glume in middle third of main axis

Present only in Inb 209, C3, C8 and C10.

Anthocyanin coloration of glumes excluding the base

Present in all genotypes except Inb 209 was absent.

Attitude of lateral branches in lower third of tassel

Was slightly recurved in all genotypes.

Anthocyanin coloration of anthers in middle third of main axis, on fresh anthers

Very strong in C6 only but Inb 204, Inb 208, Inb 209 and C5 were just strong while Inb 202, Inb239, C1, C4, C7, C8, C9 and C10 were medium but C2 and C3 were weak.

Anthocyanin coloration of cob glumes

Was absent for all studied crosses.

Ear shape

Conical in C1, C5 and C6, while C2, C7 and C8 were conico-cylindrical, whereas C3, C4, C9 and C10 were cylindrical.

Grain type

All studied crosses were dent in middle third of ear.

Anthocyanin coloration of silks

Present only in Inb 239, C4, C7, C9 and C10.

Similar results were reported by **El-Hawary *et al.* (2003) and El-Abady (2005)**.

Table 8. Percentages of heterosis over mid-parents for all studied traits.

Traits Crosses	Ear length	Ear diameter	Kernel No./row	100-Kernel weight	Ear yield/plant	Grain yield/plant	Shelling (%)
C1	100.85**	153.96**	51.69**	102.73**	215.52**	222.16**	2.26
C2	132.37**	105.38**	103.97**	47.27**	255.43**	311.42**	23.66**
C3	23.51**	43.1**	2.01	34.9**	53.48**	71.86**	9.5**
C4	37.66**	90.06**	18.27**	93.9**	226.06**	260.48**	11.39**
C5	182.66**	103.33**	172.42**	36.14**	327.29**	464.85**	38.1**
C6	55.05**	43.41**	57.01**	50.09**	96.91**	118.17**	11.22**
C7	132.3**	104.57**	75.72**	37.43**	277.711**	349.36**	19.24**
C8	72.64**	36.49**	59.49**	29.07**	150.14**	219.07**	40.5**
C9	117.8**	69.43**	113.68**	87.35**	344.29**	479.29**	34.33**
C10	18.1**	31.11**	6.97	31.56**	77.44**	98.82**	12.99**
LSD 5%	1.06	0.16	2.24	0.78	5.58	6.83	4.68
LSD 1%	1.5	0.23	3.17	1.1	7.89	9.65	6.62

*,** Significant at level probability 0.05 and 0.01, respectively.

Table 9. Percentages of heterosis over better-parents for all studied traits

Traits Crosses	Ear length	Ear diameter	Kernel No./row	100- Kernel weight	Ear yield/plant	Grain yield/plant	Shelling (%)
C1	83.0**	74.1**	27.3**	32.9**	164.8**	58.8**	3.11
C2	79.4**	136.6**	29.8**	91.9**	204.1**	194.9**	-3.3
C3	1.4	3.4	-0.8	6.4**	7.2**	23.7**	4.18
C4	32.2**	57.1**	1.8	90.9**	194.2**	205.4**	3.83
C5	144.7**	62.7**	83.7**	79.6**	226.5**	292.9**	20.49**
C6	16.7**	-0.7**	31.3**	18.9**	34.7**	48.9**	10.75**
C7	115.3**	60**	74.7**	82.5**	252.7**	313.2**	17.18**
C8	18.1**	11.9**	-1.6	17.2**	49.4**	82.4**	22.14**
C9	76.9**	64.3**	43.7**	67.4**	257.4**	325.6**	18.99**
C10	-6.1	10.2	-10.1	2.7	17.01**	29.٨**	10.58**
LSD 5%	1.3	0.2	2.6	1.0	6.4	7.9	5.4
LSD 1%	1.7	0.3	3.7	1.3	8.9	11.2	7.6

*,** Significant at level probability 0.05 and 0.01, respectively.

Table 10. Differences in qualitative characters for identified genotypes

Genotype \ Characters	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
I1	9	1	1	1	7	3	5	5	1	1	5
I2	5	1	3	1	7	3	5	7	1	1	5
I3	5	1	3	2	7	3	5	7	1	1	5
I4	9	1	3	1	7	3	5	7	1	1	5
I5	5	1	5	1	7	3	5	5	9	1	5
C1	9	1	5	1	7	3	5	5	1	1	5
C2	9	1	1	2	7	3	5	3	1	2	5
C3	9	1	5	1	7	3	5	3	1	3	5
C4	9	1	3	1	7	3	5	5	9	3	5
C5	9	1	5	1	7	3	5	7	1	1	5
C6	9	1	3	1	7	3	5	9	1	1	5
C7	5	1	3	1	7	3	5	5	9	2	5
C8	9	1	1	1	7	3	5	5	1	2	5
C9	9	1	3	1	7	3	5	5	9	3	5
C10	9	1	5	1	7	3	5	5	9	3	5

For genotypes name see Table (1), for characters name and its degree see Table (2).

Quantitative Characters

The results in Table 11 indicate that the crosses C5, C6, C7, C8 and C10 has a greatest angle between blade and stem (30º). Otherwise the lowest angle was obtained from C2 and C3 (20º). The cross C5 had a greatest angle between main axis and lateral branches in lower third of tassel which was 50º. The lowest angle between main axis and lateral branches in lower third of tassel (15º) was found in C6. C9 gave the highest number (28) of primary lateral branches, while the lowest number (14) was produced from C4. C1 gave the highest number of days of tassel emergence (70 days). The lowest number of days to tassel emergence (59 days) was reported for C9 or C10. **Fayed (2009)** C1 gave the highest number of days to silk emergence (71 days). Meanwhile, the lowest number of days (62) was produced from C9 or C10. **Soliman *et al.* (1995) and El-Batal *et al.* (1996)**. C8 gave the highest length (55 cm) of main axis above lowest side branch length (cm). Meanwhile, the lowest length (32 cm) was produced from C4. **Katta and Abd El-Aty (2002) and El-Abady (2005)**. C10 gave the highest length (29 cm) of main axis above upper side branch. Meanwhile, the lowest length (13 cm) was produced from C3. **Galarreta and Alvarez (2001)**. The tallest ear length without husk (22cm) was given by C6. On the other hand, the shortest ear (16 cm) was produced from C4.

The results in Table 12 indicate that the greatest length of tassel branches was produced from C6 which recorded 26 cm. On the contrary, the lowest length (15 cm) was obtained from C2 and C4. The cross C6 had the longest blade length of leaf upper ear which recorded (108 cm). On the other hand, the shortest blade leaf upper ear was resulted from C4 (83 cm). The highest value of blade width of leaf of upper ear was produced from C6, which were (10 cm), and the lowest value was obtained from C4 (6 cm). **Mowafy (2003)**. The highest ratio height of insertion of upper ear to plant height 0.50 was produced from C9. On the contrary, the lowest ratio (0.41) was obtained from C10. The tallest peduncle was produced from C4, which was 18 cm. The shortest peduncle was produced from C5 (6 cm). C10 gave the highest number of rows of grains/plant (17 rows), Meanwhile, the lowest number was (11 rows) produced from C2. C10 cross produced the maximum ear diameter in middle (4.96 cm). C5 was found to have the minimum ear diameter (3.49 cm) **Banchero *et al.* (2000)**.

Table 11. Angle between blade and stem (º), angle between main axis and lateral branches, primary lateral branches number, time of tassel emergence (day), time of silk emergence (day), main axis above lowest side branch length of tassels (cm) and main axis above upper side branch length of tassels (cm) for identified crosses

Character / Crosses	A12	A13	A14	A15	A16	A17	A18
C1	25	30	22	70	71	49	26
C2	20	35	25	67	68	33	16
C3	20	30	16	67	69	40	13
C4	25	20	14	65	67	32	23
C5	30	50	19	67	69	49	16
C6	30	15	17	67	69	42	26
C7	30	18	17	65	67	46	27
C8	30	30	24	62	65	55	16
C9	25	25	28	59	62	41	21
C10	30	17	20	59	62	45	29
LSD at 0.05	3.21	4.55	3.33	6.81	7.1	5.23	3.55

Table 12. Tassel branches length (cm), blade length cm, blade width/cm, ratio height of upper ear insertion to plant height, peduncle length (cm), numbers of rows of grains/plant, ear diameter in middle (cm) and ear length without husk (cm) for identified crosses

Characters / Crosses	A19	A20	A21	A22	A23	A24	A25	A26
C1	21	98	8	0.44	8	15	4.25	18
C2	15	99	9	0.42	12	11	4.76	19
C3	19	90	8	0.47	9	13	4.63	20
C4	15	83	6	0.44	18	13	4.59	16
C5	19	93	9	0.49	6	14	3.94	17
C6	26	108	10	0.45	8	15	4.24	22
C7	20	84	8	0.49	8	13	4.64	19
C8	20	95	9	0.43	8	15	4.64	20
C9	18	90	9	0.50	12	15	4.78	18
C10	17	87	7	0.41	16	17	4.96	18
LSD at 0.05	2.70	6.10	0.47	0.12	1.34	2.03	0.21	2.21

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تقدير القدرة على التآلف وقوة الهجن والتمييز المورفولوجي لبعض سلالات الذرة الشامية والهجن الناتجة منها

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أقيمت التجارب الحقلية بمزرعة كلية الزراعة جامعة المنصورة في موسمي ٢٠١٦ و ٢٠١٧ في ثلاث مكررات في قطاعات كاملة العشوائية، فى الموسم الأول تم إجراء التهجين بين خمسة سلالات نقية بنظام التزاوج نصف الدائرى للحصول على ١٠ هجن فردية من الذرة الشامية، فى الموسم الثانى تم تقييم الهجن الفردية وآبائها لتقييم دور القدرة العامة والخاصة على التآلف بين السلالات النقية و قوة الهجين لبعض الصفات المحصولية لهجن الذرة الشامية والتمييز المورفولوجى فى مراحل النمو المختلفة وكذلك بعد الحصاد لبعض الصفات المحصولية، ويمكن تلخيص أهم النتائج المتحصل عليها فى الآتى: بينت نتائج الدراسة أن متوسطات مربعات القدرة العامة والخاصة على التآلف كانت معنوية لجميع الصفات المدروسة، أوضحت النتائج أن النسبة بين القدرة العامة والقدرة الخاصة على التآلف كانت أقل من الوحدة لكل الصفات المدروسة وهذا يعنى أن هذه الصفات يتحكم فيها أساساً الفعل الجينى السيادى، أوضحت النتائج وجود تأثير معنوى وموجب للقدرة العامة على التآلف لجميع الصفات المدروسة، وأن أفضل الآباء للقدرة العامة على التآلف هما السلالتين (Inb209,239) لصفات المحصول ومعظم الصفات المدروسة، بينت النتائج وجود تأثير معنوى وموجب للقدرة الخاصة على التآلف لجميع الصفات المدروسة، وأن أفضل الهجن قدرة خاصة على التآلف C1 لصفتى قطر الكوز ووزن ١٠٠ حبة، والهجين C7 لصفة طول الكوز، والهجين C5 لصفة عدد الحبوب بالصف، والهجين C8 لصفات محصول الكيزان والحبوب للنبات ونسبة التفريط، بينت النتائج وجود تأثير معنوى وموجب لقوة الهجين لجميع الصفات المدروسة، وأن أفضل الهجن فى قوة الهجين بالنسبة لمتوسط الآباء وبالنسبة لأفضل الآباء هي الهجين C1 لصفتى قطر الكوز ووزن ١٠٠ حبة، الهجين C5 لصفات طول الكوز وعدد الحبوب بالصف والهجين C9 لصفات محصول الكيزان والحبوب/نبات ونسبة التفريط، أوضحت النتائج أن الهجين C1 تميز بغياب صبغة الأنثوسيانين على غمد الأوراق والسنيبلات المندمجة، وتميز الهجين C2 بأن لون غمد الريشة بصبغة الأنثوسيانين غائب أو خفيف جدا، وتميز الهجين C3 بأن لون غمد الريشة بصبغة الأنثوسيانين قوي جدا، وتميز الهجين C4 بأن صبغة الأنثوسيانين فى الجذور الدعامية قوية جدا وإستقامة فروع السنبلة، وتميز الهجين C5 بأن حافة الورقة الأولى مدببة مائلة للإستدارة والشكل المغزلى للكوز، وتميز الهجين C6 بغياب صبغة الأنثوسيانين على غمد الأوراق، حافة الورقة الأولى ملعقية والنصل مستقيم، وتميز الهجين C7 بأن صبغة الأنثوسيانين فى الجذور الدعامية قوية جدا، وتميز الهجين C9 بأن لون غمد الريشة بصبغة الأنثوسيانين قوي جدا وصبغة الأنثوسيانين فى الجذور الدعامية قوية جدا، كما تميز الهجين C10 بأن لون غمد الريشة بصبغة الأنثوسيانين قوي جدا، حافة الورقة الأولى مدببة مائلة للإستدارة، نصل الورقة منحنى بشدة والسنيبلات المندمجة، أوضحت النتائج أن الهجين C1 سجل أعلى القيم لصفات عدد الأيام حتى طرد السنبلة و ميعاد بزوغ الحريرة، وسجل الهجين C2 أعلى القيم لصفات عدد الأوراق أعلى الكوز العلوى وسجل أقل القيم لصفات الزاوية بين النصل والساق، طول السلامية الحاملة للكوز العلوى، طول الأفرع الجانبية للسنبلة، سجل الهجين C3 أقل القيم لصفات عدد الأوراق/النبات، عدد الأوراق أعلى الكوز العلوى، الزاوية بين النصل والساق وطول المحور الرئيسى للسنبلة فوق أعلى فرع جانبى، سجل الهجين C4 أعلى القيم لصفات عدد الأوراق أعلى الكوز العلوى وسجل أقل القيم لطول النصل، عرض النصل، عدد الأفرع الجانبية الأولية في السنبلة، طول المحور الرئيسى للسنبلة فوق أسفل فرع جانبى، عدد الكيزان و طول الكوز، سجل الهجين C5 أعلى القيم لصفات الزاوية بين النصل والساق والزاوية بين المحور الرئيسي للسنبلة والأفرع الجانبية وسجل أقل القيم لصفة قطر الكوز، تميز الهجين C6 بأعلى القيم لطول النصل، عرض النصل، الزاوية بين النصل والساق، إرتفاع النبات، ارتفاع الكوز العلوى، طول السلامية الحاملة للكوز العلوى، طول الأفرع الجانبية للسنبلة و طول الكوز وسجل أقل القيم لصفة عدد الكيزان، سجل الهجين C7 أعلى القيم لصفات الزاوية بين النصل والساق وعدد الكيزان، وسجل الهجين C8 أعلى القيم لصفات الزاوية بين النصل والساق، طول السلامية الحاملة للكوز العلوى، طول المحور الرئيسى للسنبلة فوق أسفل فرع جانبى وطول حامل الكوز، الهجين C9 سجل أعلى القيم لعدد الأفرع الجانبية الأولية في السنبلة، نسبة إرتفاع الكوز العلوى لإرتفاع النبات وعدد الكيزان، بينما سجل الهجين C10 أعلى القيم لصفات الزاوية بين النصل والساق، طول المحور الرئيسى للسنبلة فوق أعلى فرع جانبى، عدد الكيزان على النبات و قطر الكوز وسجل أقل القيم لصفات ارتفاع النبات، إرتفاع الكوزالعلوى، نسبة إرتفاع الكوز العلوى لإرتفاع النبات، عدد الأيام حتى طرد السنبلة، عدد الأيام حتى بزوغ الحريرة وطول حامل الكوز.

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