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ESTIMATION OF GENERAL AND SPECIFIC COMBINING ABILITY IN F_1 HYBRIDS FOR GRAIN YIELD AND ITS COMPONENTS IN GRAIN SORGHUM [*SORGHUM BICOLOR* (L.) MOENCH].

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ABSTRACT

Ten exotic cytoplasmic male sterile lines (C.M.S.) and two restorer lines viz local 162 as tall variety and NES 2412 as a shorts dual purpose variety were grown at Al-Azhar Univ. Assiut Exp. Farm in 1998 season. The ten C.M.S. lines were top crossed with the two restorer to develop 20 top crosses [ten with local 162 and ten with NES 2412]. These top crosses with the two restorer lines and the two check varieties [Giza 15 and Dorado] were evaluated in completely randomized block design with 4 replications in two locations at Assiut and Sohag Governorates in 1999 season. The characters studied included i.e., plant height, days to 50% blooming, panicle width, panicle length, 1000-grain weight and grain yield. Analysis of variance detected highly significant differences among genotypes for all studied traits. Generally, the 20 F_1 hybrids involving NES 2412 and Local 162 showed wide range of heterosis with negative and positive values of the studied traits.

Estimates of variance components revealed that significant G.C.A. and S.C.A. for most studied traits indicating that both additive and non-additive genetic variances were important for the inheritance of these traits but, for days to 50% blooming and panicle width, non additive variance play a major role for the inheritance of these traits. General and specific combining ability effects of the parental lines for the studied traits as well as the best combiner with the lines for the studied traits were discussed.

INTRODUCTION

In Egypt, grain sorghum (*Sorghum bicolor* (L.) Moench) is the fourth major cereal crop after wheat, maize and rice. The cultivated area is about 335 thousand feddans producing 705 thousand tons with an average of 2.1 tons/feddan (Agric. Economic Year Book, 1995). Most of these areas are concentrated in Upper Egypt at Assiut and Sohag Governorates.

The development of hybrids in Egypt is still dependent on exotic cytoplasmic male sterile and restorer lines from U.S.A. or ICRISAT. Such lines have to evaluated for adaptation and agronomic before testing their combining ability and heterotic response. Based on testes of general and specific combining abilities, good combiner lines which can contribute to hybrid vigour are identified.

Several studies on grain sorghum have been carried out over the world. Since the discovery of cytoplasmic male sterility in grain sorghum by Stephense and Holland in 1954. In Egypt, interest in hybrid sorghum only began in the 1980 when cytoplasmic male sterile lines were introduced from the U.S.A.

Cytoplasmic male sterile lines (C.M.S.), their maintainers and fertility restorer lines of grain sorghum were studied by many workers i.e., Fayed

(1975), Spivakov (1980), Patel *et al*. (1983), Hugar and Goud (1986), Dabholkar and Sarode (1988) and Manickam and Das (1994).

Estimates the general and specific combining ability effects and identify the parental lines of the best hybrids have been studied in grain sorghum by several investigators, i.e., Ali *et al*. (1981), Gao (1984), Berenji (1988), Patel *et al*. (1990) and Sakhare *et al*. (1992). Mahmoud (1997) study thirty exotic cytoplasmic male sterility lines (C.M.S.) and two restorer lines. He found that highly significant differences among all genotypes for studied traits i.e., plant height, panicle length, panicle wids, 1000-grain weight and grain yield/fed. The additive genetic variance were important for all studied traits except for yield where the non-additive variance play a major role in the inheritance of this trait.

The main objectives of this study is to estimate the general and specific combining ability effects, determine the heterosis as a best criterian for producing hybrids and identify the parental lines of the best hybrids among ten introduced cytoplasmic male sterile (C.M.S.) lines and fertility restorer lines NES 2412 and Local 162 of grain sorghum.

MATERIALS AND METHODS

Ten introduced cytoplasmic male sterile (C.M.S.) lines (A-lines) numbered from A-1 to A-10 and two fertility restorer R-lines (NES 2412 and Local 162) of grain sorghum were grown at Assiut Univ. Exp. Farm in 1998 season. These lines were obtained from the corn and Sorghum Research Section, Agri. Research Center, Ministry of Agriculture. The origin and the code number of these lines are presented in Table 1. The ten C.M.S. lines were top crossed with the restorers NES 2412 and Local 162 to develop. Ten top crosses with the two restorers (NES 2412 and Local 162) and the two check varieties (Giza 15 and Dorado) were evaluated in completely randomized block design with 4 replications in two locations at Assiut and Sohag Governorates in 1999 season. Plot size was one row with 5 meters long and 70 cm apart. Sowing was done in hills spaced 20 cm thinning was done to two plants per hill after three weeks from sowing at both locations. Cultural practices followed the recommendations for growing grain sorghum production in Egypt in both locations.

The following agronomic traits were measured on a random sample of ten guarded plants in each plot:

1 - Plant height (cm): measured from soil surface to the top of the panicle.
2 - Days to 50% flowering: number of days from sowing date until 50% of the plants showed their heads.
3 - Panicle width (cm): the maximum width of the panicle.
4 - Panicle length (cm): was estimated as an average of ten panicles from the lowest panicle branch to the tip of the panicle.
5 - 1000-grain weight (grams): one thousand kernel were counted, weighted and recorded in grams.
6 - Grain yield (ardab/feddan): ten guarded plants were harvested, over air dried, threshed and grains was cleaned and weighted. Average grain weight per panicle was calculated and used to estimate grain yield per feddan according to the following equation:

Table 1: Origin and code number of the parental genotypes.

Male sterile C.M.S. lines	Origin	Code No.
ICSA-3	India	AL1
ICSA-4	“	AL2
ICSA-5	“	AL3
ICSA-6	“	AL4
ICSA-7	“	AL5
ICSA-8	“	AL6
ICSA-9	“	AL7
ICSA-10	“	AL8
ICSA-13	“	AL9
ICSA-16	“	AL10
Restorer lines:		
NES 2412	From the ear East sorghum nursery through Dr. L.R. House of the Ford Foundation Organization in 1972	RL1
Local 162	Was selected by Sorghum Section, A.R.C.	RL2

$$\text{Grain yield (ardab/fed.)} = \frac{\text{Average grain yield/plant x No. of stant/plot x 4200 m}^2}{(\text{Plot area})^2 \text{ x 1000 x 140}}$$

Estimates of general combining ability effects for the parents and testers, and specific combining ability effects for hybrids were estimated according to Singh and Chaudhry 1977 as follows:
Estimation of general combining ability effects
- General combining ability females (g.c.a.$_f$)

$$g.c.a._f = \frac{Xi..}{mrL} - \frac{X...}{fmrL}$$

were: m = No. of males tester
f = No. of female (lines)
r = No. of replications
L = No. of locations

General combining ability males (g.c.a.$_m$)

$$g.c.a._m = \frac{X.J..}{frL} \quad \frac{X...}{fmrL}$$

Estimation of specific combining ability effect:

$$S.C.A. (S_{ij}) = \frac{Xij..}{rL} - \frac{Xi...}{rLm} - \frac{XJ..}{rLf} + \frac{X...}{rLfm}$$

Estimation of variance components for general and specific combining ability were calculated according to Cockerham, 1956.

Heterosis percentage was expressed as the percentage increase of the F_1 performance over test parents, as described by Bhatt, 1971.

RESULTS AND DISCUSSION

The combined analysis over two locations revealed highly significant differences among all genotypes for all studied traits Table 2. The interactions between the genotypes and locations were highly significant for days to 50% blooming, panicle width and grain yield and significant only for 1000 grain weight. On the other hand, the interaction between genotypes and location was insignificant for plant height. The combined average for ten crosses and the two restorer lines (NES 2412 and Local 162) and the two check varieties (Giza 15 and Dorado) are presented in Table 3. The mean of ten crosses were exceeded significantly restorer line NES 2412 and check variety Dorado for studied traits i.e., plant height, panicle length, panicle width and grain yield. Also, the mean of ten crosses were earlier than both restorer line Local 162 and check variety Giza 15.

Table 2: Combined mean squares for the analysis of variance of genotypes for the studied traits over two locations.

Source of Variance	d.f	Mean of squares					
		Plant height (cm)	Days to 5% blooming	Panicle width (cm)	Panicle length (cm)	1000-grain weight (g)	Grain yield ard/fed.
Location (L)	1	12152.55**	319.95**	0.01	17.05**	75.3**	224.05**
Resp/location	6	44.80	3.55	1.99	0.35	0.30	0.25
Genotypes (G)	23	70.10**	30.10**	60.90**	97.55**	1.20**	25.6**
L x G	23	19.60	3.15**	3.05**	4.44**	0.21*	3.00**
Error	138	20.95	0.65	0.60	0.95	0.11	0.55

***, ** Significantly at 0.05 and 0.01 probability levels, respectively.**

Most hybrids had significantly smaller panicle width and less 1000-grain weight than both restorer (Local 162) and check variety Giza 15. Otherwise all hybrids had significantly longer panicle length than tester Local 162, but had significantly shorter panicle length than check variety Giza 15.

Mean heterosis over two locations is summarized in Table 4. Heterosis among the 10 hybrids involving Local 162 restorer line and the 10 cytoplasmic male sterile lines showed that most hybrids had negative heterosis for all the studied traits except panicle length, which positive and highly significant heterosis was obtained for panicle length trait.

With respect to the crosses involving NES 2412 tester, the heterosis was positive and significant for plant height, panicle width, panicle length and grain yield. On the other hand the heterosis for days to 50% blooming and 1000-grain weight was negatively and significant. Generally the F_1 crosses showed wide range of heterosis with negative and positive values for most studied traits. Such results are in agreement with those obtained by Mostafa (1979), Niu *et al*. (1985), France *et al*. (1986) and Mahmode (1997).

The magnitude of the heterosis depend on the nature and magnitude of cross-pollinated and level of inbreeding coefficients. The heteosis for the crosses among open pollinated varieties of cross pollinated crops without inbreeding coefficient is less than that among lines with inbreeding coefficient equal one (breed true). However, in sorghum the hybrid vigor would vary greatly from cross to another depending on the genetical differences between the two parental lines. Many investigations have shown that hybrid vigor in sorghum is not high enough to encourage hybrid production like maize. However, in recent years several other investigators have shown that hybrid vigor could be utilized efficiently in hybrid production particularly, after the discovery of cytoplasmic male sterile lines and developing a wide range of genetical variation among cytoplasmic male sterile lines and restorer lines.

Table 3: Mean performance of F_1 crosses, testers and check varieties over two locations for the studied traits.

Male (RL)	Female (C.M.S.)	Traits					
		Plant height (cm)	Days to 50% blooming	Panicle width (cm)	Panicle length (cm)	1000-grain weight (g)	Grain yield ard/fed
N.E.S. 2412	AL-1	220.27	64.33	6.61	31.28	29.70	22.61
	AL-2	199.20	66.10	6.17	28.67	27.40	21.96
	AL-3	197.23	65.90	6.44	30.17	28.00	26.26
	AL-4	211.10	65.40	6.45	32.00	29.77	23.17
	AL-5	201.40	65.27	6.34	31.39	28.87	21.86
	AL-6	187.77	65.67	6.28	29.11	30.63	24.04
	AL-7	213.07	64.93	5.50	30.50	27.60	23.11
	AL-8	198.86	65.33	6.06	30.17	30.10	21.95
	AL-9	198.07	65.17	6.11	29.56	29.80	24.65
	AL-10	213.33	64.43	6.39	29.39	29.17	24.95
Mean		204.03	65.25	6.23	30.22	29.10	23.46
Local 162	AL-1	289.43	58.30	6.61	22.78	38.33	24.27
	AL-2	273.90	59.17	6.94	20.39	37.90	25.61
	AL-3	280.27	59.93	6.67	20.78	38.93	26.25
	AL-4	287.80	59.90	6.89	22.78	39.57	22.74
	AL-5	295.83	59.13	7.00	22.00	38.77	22.83
	AL-6	281.40	60.57	6.94	21.78	40.07	24.55
	AL-7	286.93	59.60	7.17	22.55	38.80	22.67
	AL-8	291.93	60.07	6.70	21.22	38.43	26.48
	AL-9	293.33	59.57	6.72	21.39	38.67	25.97
	AL-10	293.60	60.47	6.84	23.50	37.93	25.06
Mean		287.44	59.67	6.85	21.92	38.74	24.64
Testers:							
Local 162		292.60	61.30	7.50	17.80	44.50	25.80
NES 2412		146.00	70.50	5.40	20.60	37.00	15.25
Checks:							
Giza 15		327.90	63.60	8.40	25.70	50.70	32.00
Dorado		152.00	65.20	5.40	27.00	27.00	20.50
$L.S.D._{05}$		7.42	1.31	1.26	1.58	0.54	1.20

Estimates of variance components for general and specific combining ability and their interactions with locations are presented in Table 5. Data indicated that variance component for males were positive and significant for all the studied traits, while variance component among females were positive and significant for plant height, panicle length, 1000-grain weight and grain yield, but were negative and insignificant for days to 50% blooming and panicle width. The variance components among full sibs σ^2 sca were positive and significant for all studied traits except 1000-grain weight. Average of the variance of half sibs for both parents were positive and significant for all traits except days to 50% blooming and panicle width.

Table 4: Mean heterosis of F_1 top crosses as a percentage of the test parents for the studied traits over two locations.

Male (A.L.)	Female (C.M.S.)	Traits					
		Plant Height (cm)	Days to 50% blooming	Panicle width (cm)	Panicle length (cm)	1000-grain weight (g)	Grain yield ard/fed
With N.E.S. 2412	AL-1	50.87**	-8.75**	22.41**	51.83**	-19.73**	48.26**
	AL-2	36.44**	-6.24**	14.26**	39.17**	-25.95**	44.00**
	AL-3	35.09**	-6.52**	19.26**	46.46**	-24.32**	72.20**
	AL-4	44.59**	-7.23**	19.44**	55.34**	-19.54**	51.93**
	AL-5	37.94**	-7.42**	17.41**	52.38**	-21.97**	43.34**
	AL-6	28.61**	-6.85**	16.30**	41.31**	-17.22**	57.64**
	AL-7	45.94**	-7.90**	1.85	48.06**	-25.40**	51.54**
	AL-8	36.21**	-7.33**	12.22	46.45**	-18.65**	43.93**
	AL-9	35.66**	-7.56**	13.15*	43.49**	-19.46**	61.64**
	AL-10	46.12**	-8.61**	18.33**	42.67**	-21.16**	63.61**
With Local 162	AL-1	-1.08	-4.89**	-11.87	27.98**	-13.86**	-5.93**
	AL-2	-6.39	-3.47**	-7.47	14.55**	-14.83**	-0.74
	AL-3	-4.21	-2.23	-11.07	16.74**	-12.52**	1.74
	AL-4	-1.64	-2.28*	-8.13	27.98**	-11.08**	-11.86**
	AL-5	1.10	-3.54**	-6.67	23.59**	-12.88**	-11.51**
	AL-6	-3.82	-1.19	-7.47	22.36**	-9.95**	-4.84**
	AL-7	-1.94	-2.77*	-4.40	26.68**	-12.81**	-12.13**
	AL-8	-0.23	-2.01	-10.67	19.21**	-13.64**	2.63
	AL-9	0.25	-2.82*	-10.40	20.17**	-13.10**	0.66
	AL-10	0.34	1.35	-8.80	32.02**	-14.76**	-2.87
Test parents:							
	NES 2412	146.00	70.50	5.40	20.60	37.00	15.25
	Local 162	292.60	61.30	7.50	17.80	44.50	25.80

The significant estimate of both g.c.a. and s.c.a. variances for most studied traits indicated that both additive and non-additive genetic variances were important for the inheritance of these traits, but for days to 50% blooming and panicle width, non-additive variance play a major role for the inheritance of these traits. With respect to 1000-grain weight, the additive variance was more important in the inheritance of this trait. These findings are in line with those obtained by Beil and Atkins, 1967; Chaudhary *et al*. (1983) and Mahmoud, 1997. Hugar *et al*. (1986) reported that additive gene action was important for all vegetative characters except, plant height. Non-additive gene action was important for days to maturity and plant height. Both additive and non-additive gene action were important for days to 50% flowering and 1000-grain weight.

General combining ability effects of the parental lines for the studied traits are presented in Table 6. The C.M.S. lines No. 1, 2, 7, 9 and 10 had significant and positive general combining ability effects for grain yield and one or more of other studied traits. For the testers, general combining ability effects of NES 2412 was negative and significant for all the studied traits, but positive for Local 162. Generally, the Line 1 could be considered good general combiner for plant height, days to 50% blooming, panicle length and grain yield and Line 2 for days to 50% blooming, panicle width and grain yield, and Line 6 for panicle length and 1000-grain yield and Line 7 for days to 50% blooming, panicle width and grain yield and Line 10 for days to 50% blooming, 1000 grain weight and grain yield. Similar results were obtained by Mostafa, 1979; Sahib *et al*., 1986 and Mahmod, 1997 as they could differential the best combining lines for grain sorghum through line x tester or diallel analysis and find the better combiners to be utilized in hybrid production.

Table 5: Estimates of variance components for general and specific combining ability and their interactions with locations.

Source of variance	Traits					
	Plant height (cm)	Days to 50% blooming	Panicle width (cm)	Panicle length (cm)	1000-grain weight (g)	Grain yield ard/fed
σ^2 g.c.a.$_m$	1737.05*	7.68*	0.10*	17.10*	22.92*	0.26*
σ^2 g.c.a.$_f$	19.32*	-0.08	-0.02	0.22*	0.95*	1.20*
σ^2 g.c.a.	126.82*	0.40	-0.02	1.28*	2.32*	1.14*
σ^2 s.c.a.	72.30*	0.18*	0.07*	0.54*	0.13	1.24*
σ^2 g.c.a./ σ^2 s.c.a.	0.88	1.11	-	1.17	9.36	0.46
σ^2 g.c.a.$_{mxL}$	0.16*	0.03	0.04	0.39*	-0.07	0.01
σ^2 g.c.a.$_{fxL}$	0.30	-0.06	0.01	0.10	-0.55	0.40*
σ^2 g.c.a. x L.	0.29	-0.05	0.01	0.12*	-0.51	0.37
σ^2 s.c.a. x L	-1.22	0.06	0.02	0.52*	1.83*	0.48*
σ^2 g.c.a.xL x s.c.a. xL	-	-	0.17	0.12	-	0.39

*** Significant at 0.05 probability level.**

Table 6: Estimates of general combining ability effects of ten C.M.S. lines and two testers for the studied traits.

Cross	Plant height (cm)	Days to 50% blooming	Panicle width (cm)	Panicle length (cm)	1000-grain weight (g)	Grain yield ard/fed
AL-1	0.78	3.01**	0.05	1.50**	0.30*	2.30**
AL-2	0.50	6.18**	0.30*	0.19	-3.39**	1.52**
AL-3	-2.12	3.25**	-0.10	0.60	0.15	0.40
AL-4	0.54	-7.20**	0.07	-1.95**	0.21	-3.10**
AL-5	0.12	3.76**	-0.26	0.23	0.68	0.39
AL-6	-1.90	-4.50**	-0.09	1.02**	1.03**	-1.44**
AL-7	0.05	2.30**	0.47**	0.19	0.21	1.80**
AL-8	-0.71	4.83**	0.18	0.18	-0.33	-2.20**
AL-9	-1.50	-0.50	0.23	-0.65*	0.68	1.40**
AL-10	0.20	5.20**	-0.34*	0.52	1.10	1.77**
Testers:						
NES 2412	2.80**	-20.71**	-2.15**	-2.70**	-0.31*	-0.63*
Local 162	-2.77	21.60**	2.17**	2.40**	0.31*	0.60*

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Specific combining ability effects in Table 6 showed that the restorer line NES 2412 was good combiner with the lines 1, 3, 5 and 9 for grain yield. These lines with Local 162 were negative and poor specific combining ability effects. While Local 162 had good specific combining ability effects with line 7 for grain yield.

REFERENCES

Agriculture Economic Year Book, (1995). Ministry of Agric. A.R.E.

Ali, A.H., M.S. Abd El-Fttah, F.I. El-Attar and M.F.S. Fayed, 1981. Estimation of general and specific combining ability in F_1 hybrids for grain yield and its components in grain sorghum (*Sorghum bicolor* (L.) Moench). Annals of Agric. Sci. Moshtohor, 16: 177-191.

Beil, G.M. and R.E. Atkins, (1967). Estimation of general and specific combining ability in F_1 hybrids for grain yield and its components in grain (*Sorghum vulgare* Pers). Crop Sci., 7: 225-228.

Berenji, J. (1988). Evaluation of combining ability and heterosis and analysis of yield components in grain sorghum. Bilten-Za Hmelj, Sirak-i-lecovito-Bilje 20: 56-57.

Bhatt, G.M. (1971). Heterotis performance and combining ability in diallel crosses among spring wheat's (*T. aestivum* L.). Australian J. Agric. Res. 22: 359-369.

Chaudhary, H.R., L.G. Esquivel and G. Moran, (1983). Study of combining ability and the nature of gene action in grain sorghum. Agron. Abst. American Society of Agronomy, Madison, WI. p. 59.

Cockerham, C.C. 1956. Analysis of quantitative gene action. Brookhaven Symposia in Biology N. 9. Genetics in Plant Breeding 53-66.

Dabholkar, A.R. and U. Sarode, (1988). Evaluation of new male-sterile lines and restorers of sorghum for combining ability. Madras Agric. J. 11: 434-441.

Fayed, M.F.S. (1975). Evaluation of newly developed cytoplasmic male sterile lines for their combining ability in sorghum. Agric. Res. Review, 53: 5-26.

Franca, J.G.E.de., D.S. Murty, D. Nicodemus and L.R. Hous, 1986. Genetic analysis of some agronomic traits in grain sorghum (*Sorghum bicolor* (L.) Moench). I- Heterosis. Revista-Brasileirade- genetica. Vol. 9: 659-678.

Gao, S.J. 1984. A study of combining ability in sorghum. Scientia Agric. Sinica No. 4: 26-32.

Hugar, C.B., R. Parameswarappa, and J.V. Goud, 1986. Genetic evaluation on new male sterile lines sorghum (*Sorghum bicolor* (L.) Moench). Mysore J. of Agric. Sci., 20: 262-275.

Manickam, S. and L.D.V. Das, 1994. Line x tester analysis in forage sorghum. Internatiional Sorghum and Millet, Newsletter, 35: 79-80.

Mahmoud, K.M. 1997. Combining ability and heterosis studies in grain sorghum (*Sorghum bicolor* (L.) Moench). M.Sc. Thesis, Fac. of Agric., Assiut Univ., Egypt.

Mostafa, M.S.A. 1979. Heterosis and combining ability in grain sorghum. M.Sc. Thesis, Fac. of Agric., Assiut Univ., Egypt.
Niu, T.T., H.T. Hou and W.C. Tan, 1985. Analysis of heterosis of some yield characters in sorghum hybrids. Shanxi Agri. Sci. 3: 2-5.
Patel, R.H., K.S. Desai, D.T. Desai, R.T. Desai and R.K. Parikhi, 1983. Line x tester analysis for combining ability of new restorers in grain sorghum. Sorghum Newsletter 26: 12-13.
Patel, P.I., R.H. Patel and M.S. Desai, 1990. Heterosis and combining ability in grain sorghum (*Sorghum bicolor*) at different locations in Gujarat. Indian J. of Agric. Sci. 60: 382-386.
Sahib, K.H., S.M. Ali and B.B. Reddy, 1986. Heterosis and combining ability of yield and its components in rabi sorghum (*Sorghum bicolor* (L.) Moench). Journal of Res. APAU 14: 134-140.
Sakare, R.S., J.J. Maheshwari and P.B. Ghorpade, 1992. Combining ability studies in grain sorghum. Journal of Soils and Crops, 2: 17-20.
Singh, R.K. and B.D. Chauahary, 1977. Biometrical methods in quantitative genetic analysis. p. 178-185 Kalyani Pub. New Delhi.
Spivakov, N.S., 1980. Combining ability of male sterile grain sorghum lines in top crosses. Turdy-Po-Prikladnoi-botanike, Genetike-i-Selektsii 69: 45-47 and 7 M. Sorghum and Millets - Abstracts 1984.
Stephens, J.C. and R.F. Holland, 1954. Cytoplasmic male sterility for hybrid sorghum seed production. Agronomy J., 46: 20-32.

القدرة العامة والخاصة على الائتلاف للمحصول ومكوناته فى الذرة الرفيعة للحبوب

فرغلى جلال يونس ، خلف عبد المجيد العارف
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استخدم فـى هـذه الدراسـة عشـر سـلالات مسـتوردة بهـا عقـم ذكـرى سيتوبلازمى وكـذلك سـلالتين معيدتين للخصوبة هما محلى ١٦٢ طويل الساق ، NES 2412 قصير الساق ثنـائى الغرض - وزرعت هذه الآباء والأمهات فى مزرعة كلية الزراعة جامعة الأزهر بأسيوط وتم تهجين العشر سلالات قميا مع السلالتين المعيدتين للخصوبة ونتج عن ذلك عدد عشرون هجيناً قمياً [عشرة مع المحلى ١٦٢ وعشرة مع NES 2412] وتم تقييم هذه الهجن القمية والسلالتين المعيدتين للخصوبة وصنفين قياسيين هما (جيزه ١٥ ودورادو) فى تجربة مصممة بنظام قطاعات كاملة العشوائية فى ٤ مكررات فى محافظتى أسيوط وسوهاج فى موسم ١٩٩٩ وقد درست صفات طول النبات - وعدد الأيام من الزراعة حتى ٥٠% تزهير - وطول وعرض القنديل - ووزن الألف حبة ومحصول الحبوب .

وقد أوضـح التحليـل المشـترك أن هنـاك اختلافـات معنويـة بـين التراكيـب الوراثيـة المختلفـة لجميـع الصفات المدروسة - كمـا أظهرت الهجـن القميـة العشـرين مـدى واسـع مـن قـوة الهجـين بعضـها موجب والآخـر سالب للصـفات المدروسـة . وقد أوضـحت النتـائج أيضـاً أن كـل مـن القـدرة العامـة والخاصـة علـى التـآلف كانـت معنوية لمعظم الصفات المدروسة وأن كل من التـأثير المضـيف والغير مضـيف تعتبر هامـة فـى تـوارث معظـم الصفات - بينما كان التباين الوراثى الغير مضيف أكثر أهمية فـى تـوارث صـفة عرض الكوز وعدد الأيام من الزراعـة حتـى ٥٠% تزهيـر . كمـا نوقشـت القدرة علـى التـآلف بـين الآبـاء والأمهـات وأفضـل الهجـن الفرديـة الناتجة منها .

Table 7: Estimates of specific combining ability effects of the crosses with NES 2412 and Local 162 for the studied traits.

Lines	Plant height (cm)		Days to 50% blooming		Panicle width (cm)		Panicle length (cm)		1000-grain weight (g)		Grain yield ard/fed	
	NES 2412	Local 162	NES 2412	Local 162	NES 2412	Local 162	NES 2412	Local 162	NES 2412	Local 162	NES 2412	Local 162
A-1	-0.68	0.65	2.02**	-2.03**	-0.09	0.08	0.17	-0.15	-0.30	0.28	1.10*	-1.12*
A-2	1.32	-0.80	-2.40**	2.80**	0.80**	-0.80**	0.25	-0.21	-1.20*	1.30*	0.45	0.46
A-3	-0.39	0.17	-2.50**	2.40**	0.33	-0.30	-1.40**	1.43**	0.40	-0.35	1.40**	-1.43**
A-4	0.49	-0.43	3.60**	-3.50**	0.40*	-0.43*	0.25	-0.20	1.50**	-1.45**	0.80	-0.79
A-5	-0.76	0.35	7.15**	-7.20**	-0.25	0.20	-1.00	1.10	0.35	-0.40	1.50**	-1.30
A-6	0.16	-0.15	3.50**	-3.40**	-0.17	0.17	0.16	-0.15	-0.20	0.19	0.75	-0.70
A-7	-0.22	0.20	5.30**	-5.20**	0.12	-0.12	1.40**	-1.40**	1.60**	-1.55**	-1.11*	1.10*
A-8	0.20	-0.19	1.45	-1.40	0.16	-0.16	0.33	-0.33	2.10**	2.05**	0.20	-0.21
A-9	0.43	-0.40	3.35**	-3.35**	-0.13	0.12	-0.40	0.35	-0.78	0.75	1.70*	-0.75*
A-10	-0.35	0.32	9.40**	-9.20**	-0.09	-0.08	0.13	-0.10	2.20**	2.10**	0.44	-0.40

***, ** significant at 0.05 and 0.01 probability levels, respectively.**