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EVALUATION OF NEWLY IMPROVED INBRED LINES OF MAIZE AND ITS TESTERS FOR COMBINING ABILITY

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ABSTRACT

The inbred line Gz 603, the male parent of single cross 122 (SC 122) and single cross 124 (SC 124) was crossed to three non-recurrent parents, **i.e.** Gz 601, Gz 602 and Gz 604. These non-recurrent parents along with the recurrent parent (Gz 603) were derived from the cross between inbred line Sids 7 (Sd 7) and an elite corn belt inbred B73. The three F_1 crosses, **i.e.** Gz 601 x Gz 603, Gz 602 x Gz 603 and Gz 604 x Gz 603 were backcrossed to Gz 603 for three successive generations before selfing once followed by selection in each generation for heat tolerance and increased production of pollen grains as well as grain yield and other attributes of agronomic value. Twenty-five modified lines were testcrossed to two testers, **i.e.**, Gz 628 and Gz 629, the female parents of the released single crosses 122 and 124, respectively.

In 1998 summer season, the fifty topcrosses along with two checks (SC 122 and SC 124) were evaluated in replicated field trails at three locations, **i.e.,** Sakha, Gemmeiza and Sids.

The obtained results revealed that both lines and testers were significantly differed for all studied traits, except late wilt resistance in the combined data over locations. The interactions of lines x locations, testers x locations, lines x testers and topcrosses x locations were highly significant for days to 50% silking and grain yield in ardab/fad.

Progress was achieved in developing good lines with best GCA effects for the three studied traits as well as remarkable improvement in heat tolerance and increased pollen grains production. Considering GCA effects, L-4 and L-25 were selected for the studied traits, while L-1, L-18 and L-24 were selected for late wilt resistance and high grain yield. The five modified lines should possess good favorable dominant alleles existed as a result of the complementation of Gz 628 which was better in its GCA effects for grain yield. The other inbred line tester (Gz 629) was better in it's GCA effect for days to 50% silking and late wilt resistance.

Crosses between these selected lines with either inbred line testers Gz 628 or Gz 629 must be made further for possibility of commer- cializing good improved single crosses.

Key words: ***Maize, Testcross, Combining ability, Inbred lines.***

INTRODUCTION

The two maize single crosses, ***i.e.*** SC 122 and SC 124 are common in their male parent (G 603) which lack heat tolerance in extreme high temperature and unadequate pollen grain production which cause poor seed set in hybrid seed production, and emphasize the importance of line improvement *per se* to improve the single cross and to produce its seed efficiency in a large scale.

Procedures for the improvement of inbred lines have been implemented as early as 1922 when Harlan and Pope (1922) proposed the backcross method to improve a simply inherited deficient character. Pinke (1960) proposed a breeding procedure based on the backcross method which increases yield component expression while maintaining desirable levels of expression of other traits. Duvick (1974) used four generations of continuous backcrossing to modify inbred C103 to greater numbers of ears per plant.

Many lines were currently in extensive use have been derived by simple backcrossing. Bauman (1981) indicated that the most logical sequel is to cross pairs of lines that complement one another to produce the F_2 generation (F_2 population) of specific single crosses which are used most frequently as a source of new inbred lines development. If one parent of such single cross is decidedly better than the other one, the chance of obtaining a derivative line superior to the better parent is remote (Bailey and Comstock, 1976).

Topcross procedure as suggested by Davis (1927) and Jenkins and Brunson (1932) has become a standard approach for the use of a common tester to evaluate lines for general combining ability (GCA). Matzinger (1953), however, showed that when the objective is the replacement of a line in a specific combination, specific combining ability (SCA) is of prime importance and the most appropriate tester is the opposite inbred line parent of a single cross, while, Keller (1949) reported that line x tester component of variance for low and high yielding groups were not different. On the other hand, Rawlings and Thompson (1962) and Hallauer and Miranda (1981) revealed that low performing testers give a better idea of GCA of the lines than the high performing once.

El-Itriby *et al* (1991) and El-Sherbieny *et al* (1991) followed different breeding procedures to improve single cross 9 by improving its component lines and to obtain converted yellow version. The breeding procedures gave different results with respect to grain yield, plant and ear height. They concluded that this is quit important as regards to which procedure to use for the improvement of elite inbreds within a breeding program.

The objectives of this study were to (i) improve pollen grain production of an elite inbred lines (Gz 603) and to increase its tolerance to heat, (ii) estimate the GCA and SCA effects for the newly modified inbred lines and the two inbred testers with the final goal of identifying the most superior lines to replace the original inbred line Gz 603 in both SC 122 and SC 124. The performance of the modified inbreds in testcrosses with the original male parental line Gz 603 as tester relative to the performance of the original single crosses 122 and 124 is considered.

MATERIALS AND METHODS

The elite white inbred line of maize, Gz 603 (the male parent of single crosses 122 and 124) was crossed to Gz 601, Gz 602 and Gz 604. All four inbreds are derived from the population of SD-7 x B-73. Inbred SD-7 was developed from the cross variety of the American Early Dent x A4, and inbred B-73 was derived in USA from Iowa Stiff Stalk Synthetic. The three F_1 crosses, *i.e.* Gz 601 x Gz 603, Gz 602 x Gz 603 and Gz 604 x Gz 603 were backcrossed to Gz 603 for three successive generations before selfing for one generation. Selection was followed in each generation for heat tolerance and increased production of pollen grains as well as grain yield and other desired agronomic attributes. Selection resulted in twenty-five modified inbred lines (10 from Gz 601 x Gz 603, BC_3S_1; 13 from Gz 602 x Gz 603 – BC_3S_1, and 2 from Gz 604 x Gz603 – BC_3S_1). These lines were topcrossed to the two original female parental lines Gz 628 and Gz 629 of the single crosses 122 and 124, respectively. Both Gz 628 and Gz 629 are related and developed from the population of (Sd 62 x B 73).

The fifty testcrosses along with S.C. 122 and S.C. 124 as checks were evaluated during 1998 season at Sakha, Gemmeiza and Sids Agric. Res. Stat. A randomized complete blocks design with four replications was used at each location. Plots were one ridge, 6 m long and 80 cm wide. Plants were spaced 25 cm resulting in normal population density of 24000 plants/faddan (faddan = 4200 m^2). All agricultural practices were applied as recommended. Data on a per plot basis were recorded for days to 50% silking, percentage of susceptibility to late wilt disease (calculated as the percentage of diseased plants to the total number of plants of each plot) and grain yield in ardab/faddan adjusted to 15.5% grain moisture (one ardab=140 kg).

Analysis of variance was performed for single and combined locations according to Steel and Torrie (1980). Procedure of Kempthorne (1957) was followed to provide information about the combining ability of lines as well as testers.

RESULTS AND DISCUSSION

Bartlett test of homogeneity of error mean squares for separate locations revealed no significant differences between the error variances of different locations, therefore the data combined over locations are presented. Analysis of variance for days to 50% silking, susceptibility to late wilt and grain yield in ardab/fad based on combined data (Table 1) indicated that the differences among locations, lines and testers were significant for days to 50% silking and grain yield, while insignificant in case of susceptibility to late wilt disease. The interactions lines x testers, lines x locations, testers x locations and lines x testers x locations were significant for 50% silking and grain yield and insignificant for susceptibility to late wilt.

Table 1. Mean squares and degrees of freedom for days to 50% silking, susceptibility to late wilt disease (%), and grain yield (ard/fad), data are combined over three locations, 1998 season.

S.O.V.	DF	Days to 50% silking	Susceptibility to late wilt	Grain yield
Locations (Loc)	2	4254.61**	10.21	6704.73**
Lines (L)	24	7.45**	3.98	44.54**
Testers (T)	1	27.31**	1.84	9.10**
L x T	24	3.06**	4.23	45.51**
L x Loc	48	2.29**	5.11	18.69**
T x Loc	2	4.35**	1.68	16.42**
L x T x Loc	48	3.52**	4.62	18.79**
Pooled error	441	0.87	4.65	0.58

* and ** indicate significant differences at 0.05 and 0.01 levels of probability, respectively.

These results indicate that it is important to evaluate testcrosses at many environments, especially for grain yield, which is regarded as complex polygenic traits (Darrah and Hallauer 1972). Visual selection practiced during backcrossing and selfing in the late wilt-screening nursery has been instrumental in realizing considerable improvement in level of wilt resistance which support Shehata (1976), El-Ytriby *et al* (1990) and El-Sherbieny *et al* (1996).

Grain yield of the 25 lines over testers (Table 2) ranged from 30.29 to 35.30 ard/fad for testcrosses with lines L-15 and L-14, respectively. Grain yield of seven lines, *i.e.* L-1, L-2, L-4, L-17, L-18, L-24 and L-25 across the two testers, and eight testcrosses of Gz 628 with linesL-1, L-4, L-13, L-17, L-19, L-20, L-24 and L-25 as well as seven testcrosses of Gz 629 with lines L-2, L-3, L-4, L-10, L-18, L-22 and L-25 significantly outyielded the SC 122. However, the grain yield of the crosses of the lines and testers or Gz 629 did not significantly exceed the yield of SC 124. On the other hand, two testcrosses Gz 628 with lines (L-1 and L-24) outyielded SC 124.

The above results are reflected in the estimates of general combining ability effects (Table 3), where L-4 was the best line in GCA effect for grain yield and high yield in crosses with the testers, followed by lines (L-24, L-25, L-17, L-18, L-2 and L-1. The inbred L-15 possessed high negative value in its GCA effect for grain yield.

Table 2. Means of 25 maize inbred lines crossed with 2 inbred testers for number of days to 50% silking, susceptibility to late wilt (%) and grain yield (ard/fad), data are combined over three locations, 1998 season.

Lines	Days to 50% silking			Late wilt infection (%)			Grain yield (ard/fad)		
	Testers								
	Gz 628	Gz 629	Mean	Gz 628	Gz 629	Mean	Gz 628	Gz 629	Mean
L- 1	61.3	62.3	61.8	0.57	0.57	0.57	36.47	31.46	33.97
L- 2	61.8	60.8	61.3	2.02	0.57	1.30	33.00	35.36	34.18
L- 3	61.5	61.7	61.6	0.57	0.57	0.57	31.91	35.23	33.57
L- 4	61.7	61.8	61.8	1.35	0.57	0.96	35.78	34.81	35.30
L- 5	62.7	61.9	62.3	0.57	0.57	0.57	32.58	31.01	31.80
L- 6	62.3	62.5	62.4	0.57	1.52	1.05	32.81	33.83	33.32
L- 7	63.3	63.2	63.2	0.57	1.51	1.04	29.96	31.87	30.92
L- 8	61.7	61.7	61.7	0.57	2.49	1.53	31.43	33.16	32.30
L- 9	62.7	61.1	61.9	2.89	0.57	1.73	30.68	33.95	32.32
L-10	62.6	62.2	62.4	1.51	0.57	1.04	31.13	34.37	32.75
L-11	61.5	62.3	61.9	0.57	0.57	0.57	33.50	27.59	30.55
L-12	63.0	61.0	62.0	1.51	0.57	1.04	31.26	32.33	31.80
L-13	60.8	60.9	60.8	1.60	1.48	1.54	34.15	33.12	33.64
L-14	62.7	61.5	62.1	1.58	0.57	1.08	30.86	32.22	31.54
L-15	61.7	61.9	61.8	0.57	0.57	0.57	30.043	30.15	30.29
L-16	62.3	62.1	62.2	1.51	1.51	1.51	32.57	30.26	31.42
L-17	61.5	61.2	61.3	0.57	1.51	1.04	34.83	33.63	34.23
L-18	62.7	61.5	62.1	0.57	0.57	0.57	32.88	35.58	34.23
L-19	62.4	61.5	62.0	0.57	0.57	0.57	34.67	31.83	33.25
L-20	61.8	61.1	61.4	1.51	1.52	1.52	33.99	28.62	31.31
L-21	62.3	61.1	61.7	0.57	0.57	0.57	32.46	32.76	32.61
L-22	61.6	60.7	61.1	0.57	0.57	0.57	32.08	34.56	33.32
L-23	60.8	60.3	60.5	1.48	1.51	1.50	32.68	31.96	32.32
L-24	62.3	62.0	62.1	0.57	0.57	0.57	36.36	32.77	34.57
L-25	61.3	61.0	61.1	0.57	0.57	0.57	34.38	34.28	34.33
Mean	62.0	61.6	61.8	1.02	0.91	0.97	32.91	32.67	32.79
SC 122			62.2			0.57			33.53
SC 124			61.2			1.48			35.15
				LSD 0.05 for					
Crosses		0.75			1.73			0.61	
Lines across testers		0.53			1.22			0.43	
Testers		0.15			0.35			0.12	

For SCA effects, the best testcross was L-11 x Gz 628 followed by L-20 x Gz 628 and L-1 x Gz 628 (which give the highest grain yield, 36.47 ard/fad). The average grain yield of crosses of all lines with inbred tester Gz 628 was higher than that of Gz 629.

Though grain yield of lines across testers or Gz 629 did not significantly exceeded the yield of SC 124, a desirable level of heat tolerance and adequate pollen grains production have been achieved in the modified Gz 603 version, which is desirable for improving seed setting, reducing male to female rows ratio and maximizing hybrid seed production.

Days to 50% silking of 25 lines across the two testers are presented in Table 2. The testcross with line 23 was earlier than both checks (SC 122 and SC 124). Other six testcrosses with lines L-2, L-3, L-17, L-20, L-22 and L-25 were earlier than SC 122 which was later than SC 124 in its silking date. Line L-23 crossed to Gz 629 was earlier than both checks, while 4 other lines crossed to Gz 628 and 9 Lines crossed to Gz 629 were earlier than SC 122. It is worthy to note that the inbred tester Gz 629 transmitted earliness to its crosses.

The best GCA effects (Table 3) were obtained for L-23, L-13, L-22, L-25, L-2, L-17, L-3 and L-4 as they were earlier than the other lines in silking emergence. The best SCA effects (Table 3) were for the crosses of Gz 628 with lines L-1, L-11, L-6, L-15, L-3, L-4 and L-13 as well as the crosses of Gz 629 with lines L-12, L-9, L-14, L-8, L-21, L-2, L-19 and L-22.

Breeding schemes to improve established inbreds could result in yield improvements in the resultant hybrids. Improvement of Sids 62, the male parent of single cross 9 (El-Sherbieny *et al* 1991) and improvement of its female parent, *i.e.* Sids 7 (El-Itriby *et al* 1991) resulted in more improvement in grain yield, maturity and plant stature in resultant hybrids. This was demonstrated by Ricke (1960) who developed outstanding inbreds, *i.e.* A 619 and A 632, which are still widely used in the USA.

Table 3. Estimates of general (GCA) and specific (SCA) combining ability effects of 25 lines crossed with 2 testers for number of days to 50% silking, susceptibility to late wilt and grain yield, data are combined over three locations, 1998 season.

Lines	Days to 50% silking			Late wilt infection (%)			Grain yield (ard/fad)		
	GCA effect	SCA effect		GCA effect	SCA effect		GCA effect	SCA effect	
		Gz 628	Gz 629		Gz 628	Gz 629		Gz 628	Gz 629
L- 1	0.01	-0.67	0.67	- 0.39	-0.06	0.06	1.17	2.39	-2.39
L- 2	-0.45	0.29	-0.29	0.32	0.67	-0.67	1.39	-1.30	1.30
L- 3	-0.20	-0.29	0.29	-0.39	-0.06	0.06	0.78	-1.78	1.78
L- 4	-0.03	-0.29	0.29	-0.003	0.34	-0.34	2.51	0.36	-0.36
L- 5	0.51	0.17	-0.17	-0.39	-0.06	0.06	-0.99	0.67	-0.67
L- 6	0.60	-0.35	0.35	0.08	-0.53	0.53	0.53	-0.63	0.63
L- 7	1.43	-0.18	0.18	0.07	-0.52	0.52	-1.88	-1.07	1.07
L- 8	0.11	-0.21	0.21	0.57	-1.02	1.02	0.49	-0.99	0.99
L- 9	0.10	0.57	-0.57	0.77	1.11	-1.11	-0.47	-1.76	1.76
L-10	0.60	-0.01	0.01	0.07	0.41	-0.41	0.04	-1.74	1.74
L-11	0.14	-0.64	0.64	-0.39	-0.06	0.06	-2.24	2.82	-2.82
L-12	0.22	0.78	-0.78	0.07	0.41	-0.41	-0.99	-0.65	0.65
L-13	-0.95	-0.29	0.29	0.58	0.002	-0.002	0.84	0.39	-0.39
L-14	0.30	0.37	-0.37	0.11	0.45	-0.45	-1.25	-0.80	0.80
L-15	0.01	-0.33	0.33	-0.39	-0.06	-0.06	-2.50	0.01	-0.01
L-16	0.39	-0.13	0.13	0.54	-0.06	0.06	-1.38	1.03	-1.03
L-17	-0.45	-0.04	0.04	0.07	-0.52	0.52	1.44	0.47	-0.47
L-18	0.30	0.37	-0.37	-0.39	-0.06	0.06	1.44	-1.47	1.47
L-19	0.18	0.25	-0.25	-0.39	-0.06	0.06	0.46	1.29	-1.29
L-20	-0.36	0.12	-0.12	0.55	-0.06	0.06	-1.49	2.56	-2.56
L-21	-0.11	0.37	-0.37	-0.39	-0.06	0.06	-0.18	-0.27	0.27
L-22	-0.65	0.24	-0.24	-0.39	-0.06	0.06	0.53	-1.36	1.36
L-23	-1.24	0.08	-0.08	0.53	-0.07	0.07	-0.47	0.23	-0.23
L-24	0.35	-0.09	0.09	-0.39	-0.06	0.06	1.77	1.67	-1.67
L-25	-0.60	-0.09	0.09	-0.39	-0.06	0.06	1.54	-0.07	0.07
GCA for testers		0.21	-0.21		0.06	-0.06		0.12	-0.12
GCA effects for lines		0.38			0.88			0.31	
GCA effects for testers		1.35			3.11			1.10	
SCA effects		0.27			0.62			0.22	

REFERENCES

Bailey, T. B. and R. E. Comstock (1976). Linkage and the synthesis of better genotypes in self-fertilization species. Crop Sci., 16:363-370.

Bauman, L.E. (1981). Review of methods used by breeder to develop superior corn inbreds. Proc. Ann. Corn Sorghum Ind. Conf., 36:199-208.

Darrah, L.L. and A.R. Hallauer (1972). Genetic effects estimated from generation means in four diallel sets of maize inbreds. Crop Sci., 12:615-621.

Davis, R.L. (1927). Report of the plant breeder. Rep. Puerto Rico Agric. Exp. Stn. P: 14-05.

Duvick, D.N. (1974). Continuous backcrossing to transfer prolificacy to an sing-eared inbred line of maize. Crop Sci., 14: 69-71.

El-Itriby, H.A., H. Y. S. El-Sherbieny, M. A. N. Mostafa and B. N. Ayad (1990). Evaluation of maize test-crosses for grain yield and resistance to late wilt disease. Proc. 4th Conf. Agron., Cairo, 1:375-388.

El-Itriby, H.A., H. Y. S. El-Sherbieny, G. M. A. Mahgoub and A. A. Ismail (1991). Improvement of a commercial maize single cross by improving its component inbreds. I. Improving inbred line Sids 7, the female parent of single cross 9. Bull. Fac. Agric., Cairo Univ, 42: 237-246.

El-Morshidy, M.A. (1974). Development of resistant inbred lines of corn for stalk rot disease caused by *Cephalosporium maydis* L and study of their resistance. Ph. D. Thesis, Fac. Agric., Assiut Univ., Egypt.

El-Sherbieny, H.Y., H. A. El-Itriby, G. M. A. Mahgoub and A. A. Ismail (1991). Improvement of a commercial maize single cross by improving its component inbreds. II. Improving inbred line Sd 62, the male parent of single cross 9. Bull. Fac. Agric., Cairo Univ, 42: 971-980.

El-Sherbieny, H.Y.S., G. M. A. Mahgoub and M. A. N. Mostafa (1996). Combining ability between newly developed white inbred lines of maize. Bull. Fac. Agric., Cairo Univ., 47:369-378.

Hallauer, A.R. and J. B. Mirinda (1981). Quantitative genetics in maize breeding. Iowa State Univ. Press, Ames, USA.

Harlan, H.V. and M. N. Pope (1922). The use and value of backcrosses in small grain breeding. Jour. Hered. 13: 319-322.

Jenkins, M.T. and A. M. Brunson (1932). Methods of testing inbred lines of maize in crosses combinations. J. Am. Soc. Agron., 24:523-530.

Keller, K.R. (1949). A comparison involving the number of and relationship between testers in evaluating inbred lines of maize. Agron. J. 4:323-331.

Kempthorne, O. (1957). An introduction to genetic statistics. John Wiley and Son Inc., New York, Chapman and Hall ltd., London.

Matzinger, D.F. (1953). Comparison of three types of testers for the evaluation of inbred lines of corn. Agron. J., 45:493-495.

Mostafa, M.A.N., K.I. Khalifa, H.Y. El-Sherbieny and S. E. Sadek (1991). Evaluation of S_1 lines derived from a yellow maize population using two testers. Egypt. J. Appl. Sci., 6:28-36.

Mostafa, M.A.N, F.A. Salama and A.A. Abdel-Aziz (1995). Combining ability of white maize populations with inbred testers. J. Agric. Sci., Mansoura Univ., 20:143-149.

Rinke, E. H. (1960). Reaching for yield. Ann. Hybrid Corn Ind. Res. Conf. Proc., 15: 61-67.

Rowling, J.O. and D.L. Thompson (1962). Performance level as criteria for the choice of maize testers. Crop Sci., 2:217-220.

Shehata, A.H. (1976). Gene action involved in the manifestation of late wilt (*Cephalosporium maydis* L.) of maize. Egypt. J. Genet. Cytol., 5:42-47.

Steel, R.G. and J.H. Torrie (1980). Principles and Procedures of statistics. McGraw-Hill Book Company, New York, USA.

تقييم سلالات محسنة حديثا من الذرة الشامية ومختبراتها للقدرة على التآلف

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برنامج بحوث الذرة الشامية – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية

هجنت السلالة جيزة ٦٠٣ (الأب المشترك للهجينين الفرديين ١٢٢ ، ١٢٤ والمستنبطة من الهجين سدس ٧ × ب–٧٣) مع كل من جيزة ٦٠١ ، جيزة ٦٠٢ ، جيزة ٦٠٤ والناتجة من نفس الهجين لثلاثة أجيال رجعية أعقبت بجيل من التلقيح الذاتى مع الإنتخاب فى الأجيال المختلفة لتحمل الحرارة ، وزيادة كمية حبوب اللقاح ، والمقاومة لمرض الذبول المتأخر ومحصول الحبوب. أنتخبت خمسة وعشرون سلالة (١٠ سلالات من المجتمع " جيزة ٦٠١ × جيزة ٦٠٣ " ، ١٣ سلالة من المجتمع " جيزة ٦٠٢ × جيزة ٦٠٣ " ، سلالتين من المجتمع " جيزة ٦٠٤ × جيزة ٦٠٣ " الجيل الرجعى الثالث والذاتى الأول) وهجنت مع السلالتين جيزة ٦٢٨ وجيزة٦٢٩ والتى تمثل الآباء الأخرى للهجينين الفرديين ١٢٢ ، ١٢٤ ، وفى موسم ١٩٩٨ تم تقييم الهجن القمية الناتجة (٥٠ هجينا قميا) فى تجارب حقلية بثلاث جهات (سخا والجميزة وسدس) مع قياس صفات عدد الأيام من الزراعة حتى ظهور ٥٠% حريرة ونسبة الإصابة بمرض الذبول المتأخر ومحصول الحبوب بالأردب للفدان.

أظهرت النتائج إختلاف السلالات المختبرة والسلالتين الكشافتين معنويا لجميع الصفات موضع الدراسة عدا صفة نسبة الإصابة بمرض الذبول المتأخر وذلك فى التحليل التجميعى للجهات ، وكذلك كانت التفاعلات بين السلالات المختبرة × الجهات ، السلالتين الكشافتين × الجهات ، السلالات المختبرة × السلالتين الكشافتين ، وكذلك الهجن المختبرة والجهات معنويا لصفتى عدد الأيام من الزراعة حتى ظهور ٥٠% حريرة ومحصول الحبوب بالأردب للفدان.

أوضحت النتائج تميز بعض السلالات المستنبطة فى القدرة على التآلف بالنسبة لجميع الصفات موضع الدراسة مثل السلالات رقم ٢ ، ١٧ ، ٢٥ ، والسلالات أرقام ١ ، ٤ ، ١٨ ، ٢٤ بالنسبة لمحصول الحبوب ،

والسلالات أرقام ٣ ، ٢٠ ، ٢٢ ، ٢٣ بالنسبة لصفة التبكير ، وهذه السلالات المنتخبة تحتوى اليلات جيدة سائدة تتكامل فى تأثيرها مع جينات الأب الآخر (جيزة-٦٢٨) الذى يعتبر الفضل فى القدرة العامة على التآلف لصفة المحصول ، والأب الكشاف جيزة-٦٢٩ فقد كان الفضل فى القدرة العامة على التآلف لصفة عدد الأيام من الزراعة حتى ظهور ٥٠% حريرة . هذا ويجب إعادة اختبار الهجن الناتجة بين أفضل السلالات المنتخبة مع أى من الكشافان (جيزة-٦٢٨ ، جيزة-٦٢٩) وذلك بغرض إنتاج هجن فردية تجارية جيدة ومحسنة.

المجلة المصرية لتربية النبات ٥: ١٩-٢٨ (٢٠٠١).