

COMBINING ABILITY OF NEW YELLOW MAIZE INBRED LINES USING LINE x TESTER MATING DESIGN

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ABSTRACT

General (GCA) and specific (SCA) combining ability were estimated in a lines x testers crossing program comprising 36 crosses of maize produced by crossing eighteen yellow inbred lines with two testers in 2014 season. The resulting 36 test crosses along with the two check hybrids SC.162 and TWC353 were evaluated for six traits, *i.e.* days to 50% silking, plant height, ear height, ear length, ear diameter and grain yield/ha at Sakha and Ismailia Agric. Res. Stations in 2015 grown season. Significant differences were obtained among crosses and their partitioning into lines, testers and line x testers for all studied traits, except testers for ear diameter and line x tester for number of days to 50% silking, plant height, ear length, ear diameter and grain yield. The additive gene action was more important than non-additive gene action for days to 50% silking and grain yield, while the non-additive gene action was more important for other traits. The best inbred lines for GCA effects were Sk-5001/32 and Sk-5001/33 for days to 50% silking, Sk-5001/36 and Sk-5001/38 for plant and ear height, Sk-5001/21, Sk-5001/29 and Sk-5001/36 for ear length, Sk-5001/24, Sk-5001/29 and Sk-5001/36 for ear diameter and Sk-5001/29, Sk-5001/30 and Sk-5001/36 for grain yield. Whereas, the line GZ-666 was the best tester for GCA effects for number of days to 50% silking and plant and ear height, while the single cross 162 was the best tester for ear length, ear diameter and grain yield. Two crosses (Sk-5001/25 x GZ-666 and sk-5001/33 x SC 162) were found to be the best for SCA effects for grain yield. Most single crosses and all three way crosses were significantly outyielding both checks SC162 and TWC353, respectively.

Key words: *Zea mays*, GCA, SCA and Gene action.

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops in Egypt and the world. Maize in the world ranks the third surpassed only by wheat and rice. In Egypt, it is necessary to increase maize yield to face the wide gap between the production and consumption. High maize production can be achieved by improving cultural practices and planting the promising hybrids. In recent years, a major objective of the maize breeding program in Egypt is to develop high yielding yellow maize hybrids. The concept of combining ability, as a measure of gene action was proposed by Sprague and Tatum (1942). Combining ability

and genetic variance components are important in the breeding programs for hybridization (Fehr, 1993). In any breeding program, the choice of the correct parents is the secret of the success. One of the most important criteria in breeding programs for identifying hybrids with high yield is knowledge regarding parent's genetic structure and information regarding their combining ability (Ceyhan 2003). Genetic information was obtained by different quantitative genetic methods. Line x tester analysis is a suitable and efficient method with eligible speed (Singh and Chaudhary, 1985). The line x tester analysis method has been widely used by plant breeders. This method was suggested by Kempthorne (1957) and is used to breed both self and cross pollinated plants, as well as identifying favorable parents, crosses and estimating their general and specific combining ability effects, respectively. The additive gene action was more important in the inheritance of number of days to 50% silking (Soliman and Sadik 1999 and El-Shenawy and Mosa 2005) and grain yield (Aly and Khalil 2013, Mostafa *et al.* 2014 and El-Gazzar 2015). While, the non-additive gene action seemed to have played an important role in the expression of plant height (Aly and Khalil 2013), ear height (El-Gazzar and Khalil 2012 and El-Gazzar 2015), ear length (El-Shenawy 2005) and ear diameter (Amer 2004).

The objective of this study was to estimate the general and specific combining ability effects for new yellow inbred lines and to identify the superior crosses to be used in maize breeding programs.

MATERIALS AND METHODS

The experimental material consisted of eighteen yellow inbred lines, which have been designated as Sk-5001/21, Sk-5001/22, Sk-5001/23, Sk-5001/24, Sk-5001/25, Sk-5001/26, Sk-5001/27, Sk-5001/28, Sk-5001/29, Sk-5001/30, Sk-5001/31, Sk-5001/32, Sk-5001/33, Sk-5001/34, Sk-5001/35, Sk-5001/36, Sk-5001/37 and Sk-5001/38 developed at Sakha Agriculture Research Station. These lines and the two testers (inbred line GZ - 666 and single cross 162) were crossed in line x tester design, in 2014 summer season. In 2015 summer season, resulting 36 crosses along with the two commercial check hybrids i.e. SC162 and TWC 353 were evaluated in a randomized complete blocks design (RCBD) with four replications at two locations, i.e. Sakha and Ismailia Agricultural Research Stations. The plot consisted of one row, 6m long, 0.8m width and space between hills at 0.25m along the row. Two kernels / hill were planted, then later thinned to one plant per hill. All cultural practices for maize production were applied as recommended at the proper time. Data were taken for number of days to 50% silking, plant height (cm), ear height (cm), ear length (cm), ear diameter (cm) and grain yield (adjusted to 15.5% moisture content) per plot and

converted to ton per hectare. After recording the observation for each character, the analysis of variance was carried out according to Steel and Torrie (1980) for combined data across locations. The mean squares from line x tester design and the general combining ability (GCA) and specific combining ability (SCA) variances and effects were calculated according to the procedures developed by Kempthorne (1957) and adopted by Singh and Choudhry(1979).

RESULTS AND DISCUSSION

Combined analysis of variance of 38 hybrids for six traits of maize across the two locations is given in Table 1. The results showed that the differences between locations (loc) were highly significant for all the studied traits, except for plant height and grain yield.

Differences between hybrids (H) were highly significant for the all studied traits. Also, hybrids x locations mean squares were significant or highly significant for all studied traits, indicating that the hybrids presented differential performance in the testing locations.

Mean performance of 36 hybrids and two check hybrids (SC162 and TWC 353) for the six traits across the two locations is presented in Table 2. For days to 50% silking, the new crosses ranged from 61.00 days for (Sk-5001/32 x GZ-666) to 67.25 days for (Sk-5001/31 x SC 162), most crosses were significantly earlier than the check hybrids (SC162 and TWC 353), the best hybrids from them were Sk-5001/32 x GZ-666 and Sk-5001/33 x SC 162. Regarding to plant and ear height, the means performance for the new crosses ranged from 242.25 cm to 298.50 cm for plant height and from 110.75 cm to 149.50 cm for ear height for the crosses Sk-5001/38 x GZ-666 and Sk-5001/36 x SC 162, respectively. Most of crosses were shorter in plant height and lower in ear placement compared with the two checks. As for ear length , the mean performance for the new crosses ranged from 18.62 cm for Sk-5001/25 x GZ-666 to 21.91 for Sk-5001/29 x GZ-666, most new three-way crosses had higher ear length than the check TWC 353. For ear diameter, the new crosses varied from 4.43 cm for Sk-5001/21 x GZ-666 to 4.88 cm for Sk-5001/30 x GZ-666.

As for grain yield , mean performance ranged from 10.15 ton / ha for Sk-5001/26 x GZ-666 to 12.29 ton/ha for Sk-5001/31 x GZ-666. Also, the results showed that nine new single crosses and all new three-way crosses significantly outyielded the checks SC 162 and TWC 353, respectively. The best hybrids from them were the single crosses Sk5001/30 x GZ-666, Sk5001/31 x GZ-666, Sk5001/36 x GZ-666 and the three-way crosses Sk- 5001/29 x SC-162, Sk- 5001/31 x SC 162; Sk-5001/33 x SC 162; these hybrids will be tested in yield trails for further evaluation.

Table 1: Combined analysis of variance for six quantitative traits across two locations

S.O.V	D.F.	Days to 50% silking	Plant height	Ear height	Ear length	Ear diameter	Grain yield
Location	1	8410**	175.52	23573.45**	325.77**	9.95**	0.576
Reps/Loc	6	11.74	346.98	218.24	2.80	0.295	3.15
Hybrids (H)	37	27.46**	1021.13**	914.31**	8.31**	0.090**	4.615**
H x Loc	37	5.71**	220.43*	145.24*	1.31**	0.044*	4.130**
Error	222	2.27	140.99	98.97	0.752	0.0276	0.925
CV%		2.34	4.31	7.39	4.29	3.59	8.64

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

Mean squares of line x tester analysis for 36 crosses for eight traits across two locations are presented in Table 3. The mean squares due to lines (L) and testers (T) were highly significant for all studied traits, except (T) for ear diameter, indicating that the inbred lines behaved differently in their respective top crosses, and that greater diversity existed between testers. While, the L x T interaction was significant for plant height only, indicating that the inbred lines performed differently in their respective top crosses depending on the type of testers used for this trait. These results are in agreement with those obtained by Dodiya and Joshi (2002), Habliza and Khalifa (2005), Mosa(2010), El-Gazzar and Khalil (2012), Mostafa *et al.* (2014) and Motawi *et al.* (2016).

The mean squares due to interaction of locations with lines(L), testers (T) and their interactions (L x T) were not significant for all traits, except L x loc for ear length and grain yield, T x Loc for days to 50% silking and L x T x Loc for grain yield. These results are in accordance with those reported by Amer (2004), Mosa (2005), El-Gazzar *et al.* (2013), El-Gazzar (2015) and Motawei *et al.* (2016).

Table (2): Mean performance of 36 crosses and two checks for six traits across two locations

Cross	Days to 50% silking (day)	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	Grain yield (ton/ha)
Sk-5001/21 x GZ-666	63.62	254.37	118.75	20.22	4.43	11.45
Sk-5001/22 x GZ-666	61.87	267.62	121.00	19.62	4.61	10.78
Sk-5001/23 x GZ-666	64.00	278.12	130.37	18.76	4.51	10.69
Sk-5001/24 x GZ-666	62.75	290.25	134.87	19.13	4.81	10.91
Sk-5001/25 x GZ-666	63.62	273.50	127.50	18.62	4.61	11.28
Sk-5001/26 x GZ-666	62.25	264.87	119.37	19.76	4.57	10.15
Sk-5001/27 x GZ-666	62.50	274.75	124.50	20.20	4.57	10.74
Sk-5001/28 x GZ-666	63.12	269.87	141.00	20.20	4.51	11.01
Sk-5001/29 x GZ-666	63.25	284.37	129.25	21.91	4.77	11.08
Sk-5001/30 x GZ-666	63.87	265.00	126.62	18.85	4.88	12.00
Sk-5001/31 x GZ-666	63.87	278.62	128.25	19.68	4.70	12.29
Sk-5001/32 x GZ-666	61.00	271.25	125.25	19.46	4.62	10.20
Sk-5001/33 x GZ-666	61.62	267.00	112.75	19.73	4.66	10.51
Sk-5001/34 x GZ-666	62.50	280.62	132.37	19.75	4.55	10.43
Sk-5001/35 x GZ-666	62.25	278.87	139.50	19.78	4.40	11.04
Sk-5001/36 x GZ-666	62.25	260.75	113.37	20.76	4.47	12.04
Sk-5001/37 x GZ-666	63.25	265.12	116.75	19.33	4.50	11.40
Sk-5001/38 x GZ-666	62.25	242.25	110.75	19.30	4.66	10.43
Sk-5001/21 x SC 162	66.00	276.50	139.50	21.65	4.62	11.86
Sk-5001/22 x SC 162	64.25	284.25	138.62	20.50	4.58	11.58
Sk-5001/23 x SC 162	65.62	275.25	136.12	20.03	4.53	10.94
Sk-5001/24 x SC 162	66.00	291.37	142.50	19.58	4.73	11.73
Sk-5001/25 x SC 162	66.87	280.37	133.50	19.28	4.52	10.34
Sk-5001/26 x SC 162	65.75	277.00	132.50	20.31	4.65	10.16
Sk-5001/27 x SC 162	64.87	279.12	138.12	20.85	4.57	11.27
Sk-5001/28 x SC 162	66.62	271.87	140.50	21.03	4.62	11.73
Sk-5001/29 x SC 162	66.12	286.50	142.12	21.07	4.68	12.20
Sk-5001/30 x SC 162	67.12	275.62	140.12	19.87	4.67	11.77
Sk-5001/31 x SC 162	67.25	283.50	145.00	20.58	4.68	12.04
Sk-5001/32 x SC 162	64.75	270.50	139.25	20.01	4.60	11.17
Sk-5001/33 x SC 162	64.00	281.37	143.50	20.81	4.65	11.94
Sk-5001/34 x SC 162	65.75	289.75	148.50	20.48	4.75	10.94
Sk-5001/35 x SC 162	66.62	298.50	149.50	20.90	4.55	10.23
Sk-5001/36 x SC 162	64.25	266.50	132.25	21.36	4.72	11.79
Sk-5001/37 x SC 162	65.37	279.25	136.00	20.36	4.56	11.35
Sk-5001/38 x SC 162	64.62	255.75	120.37	21.48	4.68	11.77
SC 162	68.00	291.12	144.37	23.78	4.70	9.97
TWC353	67.12	280.00	150.00	18.87	4.80	8.91
LSD at 0.05	1.47	11.63	9.75	0.84	0.16	0.94

Table 3: Line x tester analysis of 36 top crosses for six traits combined across two locations

S.O.V	D.F	Days to 50% silking	Plant height	Ear height	Ear length	Ear diameter	Grain yield (ton/hectar)
Lines (L)	17	12.19**	1576.17**	756.52**	6.81**	0.12**	4.37**
Testers(T)	1	600.88**	5390.68**	13708.92**	50.66**	0.06	10.34**
L x T	17	2.05	206.30	244.30*	1.36	0.05	1.98
L x Loc	17	3.258	137.728	125.928	1.185*	0.043	3.604**
T x Loc	1	55.125**	43.556	21.67	2.801	0.056	0.212
L x T x Loc	17	2.324	118.857	147.509	1.024	0.043	3.321**
Error	222	2.27	140.99	98.97	0.752	0.0276	0.925

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

Additive and non-additive genetic variances and their interaction with locations are presented in Table (4).The additive genetic effects (σ^2GCA) seemed to have played more important role than non-additive genetic effects (σ^2SCA) in the inheritance of number days to 50% silking and grain yield, while, non-additive gene action ($\sigma^2 SCA$) was

effective and played an important role in the inheritance of plant height, ear height, ear length and ear diameter. These results support the findings of Amer (2004), Motawei and Mosa (2009) and Mostafa et al. (2014) for number days to 50% silking, Mosa (2004), Motawei (2006) and Aly and Khalil (2013) for plant height, Amer (2004) El-Gazzar and Khalil (2012) and El-Gazzar (2015) for ear height, Mosa (2004) and El-Shenaway (2005) for ear length, Amer (2004) for ear diameter and Aly and Khalil (2013), Mostafa et al. (2013) and El-Gazzar (2015) for grain yield.

Table 4: Genetic components for six quantitative traits across two locations

Variance components	Days to 50% silking	Plant height	Ear height	Ear length	Ear diameter	Grain yield (ton/ha)
σ^2 GCA	0.217	6.351	6.723	0.034	0.0002	0.006
σ^2 SCA	0.0001	10.93	12.090	0.042	0.001	0.0001

Estimates of general combining ability effects of eighteen inbred lines and two testers for the six traits across the two locations are presented in Table 5. The excellent inbred lines for general combining ability effects were Sk-5001/22, Sk- 5001/32, Sk- 5001/33, Sk-5001/36 and Sk-5001/38 for earliness; Sk- 5001/36 and Sk- 5001/38 for short plant and ear height; Sk-5001/21, Sk-5001/29 and Sk-5001/36 for ear length, Sk-5001/24, Sk-5001/29 and Sk- 5001/30 for ear diameter and Sk- 5001/29, Sk- 5001/30, Sk-5001/31 and Sk-5001/36 for grain yield. In general, the best line for general combining ability was Sk-5001/36 for most studied traits.

Table 5: Estimates of general combining ability (g_i) effects of 18 inbred lines and 2 testers for six traits across two locations

Inbred line/ Testers	Days to 50% silking	Plant height	Ear height	Ear length	Ear diameter	Grain yield
Sk-5001/21	0.597	-9.291**	-2.899	0.788**	-0.088*	0.441
Sk-5001/22	-1.152**	1.208	-2.211	-0.086	-0.020	-0.032
Sk-5001/23	0.597	1.958	1.225	-0.748**	-0.095*	-0.397
Sk-5001/24	0.159	16.083**	6.663**	-0.786**	0.154**	0.104
Sk-5001/25	1.034**	2.208	-1.524	-1.192**	-0.051	-0.406
Sk-5001/26	-0.215	-3.791	-6.086*	-0.111	-0.007	-1.062**
Sk-5001/27	-0.527	2.208	-0.711	0.376	-0.045	0.017
Sk-5001/28	0.659	-3.854	8.725**	0.470*	-0.051	0.155
Sk-5001/29	0.472	10.708**	3.663	1.345**	0.111**	0.426*
Sk-5001/30	1.284**	-4.416	1.350	-0.786**	0.161**	0.674**
Sk-5001/31	1.347**	6.333*	4.600	-0.011	0.073	0.951**
Sk-5001/32	-1.340**	-3.854	0.225	-0.411	-0.007	-0.526*
Sk-5001/33	-1.402**	-0.541	-3.586	0.126	0.036	0.010
Sk-5001/34	-0.090	10.458**	8.413**	-0.029	0.029	-0.528*
Sk-5001/35	0.222	13.958**	12.475**	0.195	-0.145**	-0.577*
Sk-5001/36	-0.965*	-11.104**	-9.416**	0.913**	-0.020	0.700**
Sk-5001/37	0.097	-2.541	-5.649*	-0.29	-0.088*	0.164
Sk-5001/38	-0.777**	-25.729**	-15.211**	0.245	0.054	0.115
Tester GZ-666	-1.444**	-4.326**	-6.899**	-0.419**	-0.015	-0.189*
Tester SC-162	1.444**	4.326**	6.899**	0.419**	0.015	0.189*
LSD lines g_i	0.05	0.738	5.81	4.87	0.42	0.081
	0.01	0.971	7.65	6.41	0.55	0.107
LSD testers g_i	0.05	0.24	1.93	1.62	0.14	0.027
	0.01	0.32	2.55	2.13	0.18	0.035

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

Estimates of general combining ability effects of two testers for the six traits across the two locations are presented in Table 5. The best tester for general combining ability effects was the inbred line GZ-666 for earliness and short plants and low ear placement and SC162 for ear length, ear diameter and grain yield. Estimates of specific combining ability effects of the 36 top crosses for the six traits across the two locations are presented in Table 6. The desirable SCA effects were obtained from the crosses Sk-5001/35 x GZ-666 for earliness ; Sk-5001/21 x GZ-666 for plant height; Sk-5001/33 x GZ-666 for ear height; Sk-5001/29 x GZ-666 for ear length ; Sk-5001/30 x GZ-666 ear diameter and Sk-5001/25 x GZ-666 and sk-5001/33 x SC 162 for grain yield.

Table 6: Estimates of specific combining ability effects of 36 crosses for eight traits across two locations

Crosses	Days to 50% silking	Plant height	Ear height	Ear length	Ear diameter	Grain yield
Sk-5001/21 x GZ-666	0.256	-6.736	-3.475	-0.293	-0.078	-0.019
Sk-5001/21 x SC162	-0.256	6.736	3.475	0.293	0.078	0.019
Sk-5001/22 x GZ-666	0.256	-3.986	-1.913	-0.018	0.027	-0.207
Sk-5001/22 x SC162	-0.256	3.986	1.913	0.018	-0.027	0.207
Sk-5001/23 x GZ-666	0.631	5.763	4.024	-0.218	0.002	0.065
Sk-5001/23 x SC162	-0.631	-5.763	-4.024	0.218	-0.002	-0.065
Sk-5001/24 x GZ-666	-0.180	3.763	3.086	0.194	0.052	-0.220
Sk-5001/24 x SC162	0.180	-3.763	-3.086	-0.194	-0.052	0.220
Sk-5001/25 x GZ-666	-0.180	0.888	3.899	0.088	0.059	0.660*
Sk-5001/25 x SC162	0.180	-0.888	-3.899	-0.088	-0.059	-0.660*
Sk-5001/26 x GZ-666	-0.305	-1.736	0.336	0.144	-0.022	0.183
Sk-5001/26 x SC162	0.305	1.736	-0.336	-0.144	0.022	-0.183
Sk-5001/27 x GZ-666	0.256	2.138	0.086	0.094	0.015	-0.302
Sk-5001/27 x SC162	-0.256	-2.138	-0.086	-0.094	-0.015	0.302
Sk-5001/28 x GZ-666	-0.305	3.326	7.149*	0.001	-0.040	-0.166
Sk-5001/28 x SC162	0.305	-3.326	-7.149*	-0.001	0.040	0.166
Sk-5001/29 x GZ-666	0.006	3.263	0.461	0.838**	0.059	-0.367
Sk-5001/29 x SC162	-0.006	-3.263	-0.461	-0.838**	-0.059	0.367
Sk-5001/30 x GZ-666	-0.180	-0.986	0.149	-0.093	0.121*	0.303
Sk-5001/30 x SC162	0.180	0.986	-0.149	0.093	-0.121*	-0.303
Sk-5001/31 x GZ-666	-0.243	1.888	-1.457	-0.030	0.021	0.310
Sk-5001/31 x SC162	0.243	-1.888	1.457	0.030	-0.021	-0.310
Sk-5001/32 x GZ-666	-0.430	4.701	-0.100	0.144	0.027	-0.297
Sk-5001/32 x SC162	0.430	-4.701	0.100	-0.144	-0.027	0.297
Sk-5001/33 x GZ-666	0.256	-2.861	-10.788**	-0.118	0.021	-0.526
Sk-5001/33 x SC162	-0.256	2.861	10.788**	0.118	-0.021	0.526
Sk-5001/34 x GZ-666	-0.180	-0.236	-1.163	0.050	-0.084	-0.061
Sk-5001/34 x SC162	0.180	0.236	1.163	-0.050	0.084	0.061
Sk-5001/35 x GZ-666	-0.743	-5.486	1.899	-0.136	-0.059	0.596
Sk-5001/35 x SC162	0.743	5.486	-1.899	0.136	0.059	-0.596
Sk-5001/36 x GZ-666	0.444	1.451	3.461	0.119	-0.109	0.317
Sk-5001/36 x SC162	-0.444	-1.451	-3.461	-0.119	0.109	-0.317
Sk-5001/37 x GZ-666	0.381	-2.736	-2.725	-0.093	-0.015	0.215
Sk-5001/37 x SC162	-0.381	2.736	2.725	0.093	0.015	-0.215
Sk-5001/38 x GZ-666	0.256	-2.423	-2.913	-0.674*	0.002	-0.481
Sk-5001/38 x SC162	-0.256	2.423	2.913	0.674*	-0.002	0.481
LSD S _{0.05}	1.04	8.22	6.89	0.60	0.11	0.66
LSD S _{0.01}	1.37	10.82	9.07	0.79	0.15	0.87

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

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الملخص العربي

القدرة على الانتلاف لسلاسل صفراء جديدة من الذرة الشامية باستخدام طريقة السلالة في الكشف

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تم حساب القدرة العامة و الخاصة على التآلف لستة صفات عن طريق تحليل السلالة في الكشف لعدد 36 هجين و التي كونت بواسطة التهجين بين عدد 18 سلالة صفراء من الذرة الشامية و اثنين من الكشافات بمحطة بحوث سخا موسم 2014. تم تقييم ال36 هجين قمى الناتجة مع اثنين من الهجن التجارية و هي هجين فردى 162, هجين ثلاثى 353 و تم أخذ النتائج على ستة صفات و هي : عدد الأيام للوصول إلى 50% من الحراير للنورات المؤنثة , ارتفاع النبات , ارتفاع الكوز, طول وقطر الكوز, محصول الحبوب بالطن للهكتار وذلك بمحطتي بحوث سخا و الاسماعيلية في موسم 2015 و قد أوضحت النتائج وجود اختلافات معنوية بين الهجن و بين السلالات و بين

الكشافات وللتفاعل بين السلالات x الكشافات لكل الصفات المدروسة ما عدا بين الكشافات لصفة قطر الكوز للسلالات x الكشافات لصفات عدد الأيام لظهور 50% من حرابر النورات المؤنثة وارتفاع النبات و طول الكوز و قطره و محصول الحبوب. أظهرت النتائج أن الفعل المضيف للجين هو الأكثر أهمية من الفعل الغير مضيف للجين في وراثه صفتي عدد الأيام لظهور 50% من حرابر النورات المؤنثة و محصول الحبوب بينما كان الفعل الوراثي الغير مضيف هو الاكثر في وراثه الصفات الأخرى.

كانت أفضل السلالات في القدرة العامة على التآلف هي سلالة سخا- 32/5001 و سلالة سخا- 33/5001 لصفة عدد الأيام حتى ظهور 50% من حرابر النورات المؤنثة، سخا- 36/5001 و سخا- 38/5001 لارتفاع النبات وارتفاع الكوز ، سلالة سخا- 21/5001 و سلالة سخا- 5001/29 و سلالة سخا- 5001/36 لطول الكوز ، سلالة سخا- 24/5001 و سلالة سخا- 5001/29 و سلالة سخا- 5001/36 لقطر الكوز، سلالة سخا- 29/5001 و سلالة سخا- 5001/30 سلالة سخا- 5001/36 لصفة المحصول. بينما كانت السلالة جيزة - 666 أفضل الكشافات في القدرة العامة على التآلف لصفات عدد الأيام حتى ظهور 50% من حرابر النورات المؤنثة و ارتفاع النبات و ارتفاع الكوز بينما كان الهجين الفردي 162 هو الكشاف الأفضل لصفات طول و قطر الكوز و محصول الحبوب. كما أوضحت النتائج أن أفضل الهجن في تأثيرات القدرة الخاصة على الانتلاف لمحصول الحبوب هما سلالة سخا- 25/5001 x سلالة جيزة -666 و سلالة سخا- 33/5001 هجين فردي 162. أظهرت متوسطات المحصول أن أغلب الهجن الفردية و كل الهجن الثلاثية قد تفوقت معنويا على كل من هجيني المقارنة هجين فردي 162 و هجين ثلاثي 353 ، على التوالي.