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COMBINING ABILITY AND HETEROSIS FOR SOME YIELD TRAITS IN SORGHUM (*Sorghum bicolor* L. Moench) USING (LINE×TESTER) DESIGN

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ABSTRACT

This study was carried out in co-operation between the Faculty of Agriculture, Damascus University and the General Commission for Scientific Agricultural Research (GCSAR) in Jelleen Research Station during the two growing seasons of 2009 and 2010. In first year, eight local cultivars (male parents) were crossed with two exotic sterile lines (female parents) using (line×tester) method. In second year, the hybrids were grown along with their parents in a randomized complete block design (RCBD) with three replications to estimate general combining ability (GCA), specific combining ability (SCA) and both mid and high parent heterosis for panicle length, net percentage, 1000-grain weight and grain yield traits. The results showed that some parents had significant positive general combining ability for grain yield such as; (Baladi-1, Baladi-4, Ezraa-7). Many hybrids showed significant positive specific combining ability, having both mid and high parent heterosis, derived from parents which have significant positive general combining such as; (Baladi-1×SPL-10A, Baladi-4×SPL-10A and Ezraa-7×SPL-10A). The results showed the possibility of continuing selection procedure in subsequent generations to obtain distinct high yielding sorghum lines.

Keywords: Sorghum, Heterosis, GCA, SCA.

INTRODUCTION

Sorghum (*Sorghum bicolor* L. Moench) is the fifth most important cereal grain crop originated from West Africa and staple food for millions of poor in semi-arid tropics of Africa and Asia (Haussmann *et al*., 2002). It has gained importance as a fodder (green/dry) and feed crop in the last decade. Besides being an important food, feed and forage crop, it provides raw material for the production of starch, fiber, dextrose syrup, biofuels, alcohol and other products. Sorghum has been classified under family Graminae, subfamily Poaceae, tribe Andropogonae and genus Sorghum.

Breeding strategies based on selection of hybrids require expected level of heterosis as well as the specific combining ability (SCA). Sprague and Tatum (1942) were the first to develop the concept of combining ability. They defined “general combining ability” (GCA) as the average performance of the lines in hybrid combinations and “specific combining ability” (SCA) as the deviation of a cross from the average performance of the lines. Heterosis or hybrid vigor is the superiority or inferiority of the hybrids over its parents. The primary objective of any plant breeding program is to increase the yield and improve the quality of crop plants through gene recombination. In breeding high yielding varieties of crop plant, the breeders often face with the problem of selecting parents and crosses. Combining ability analysis is one of the powerful tools available to estimate the combining ability effects and aids in selecting the desirable parents and crosses for the exploitation of heterosis (Sarker *et al*., 2002 and Rashid *et al*., 2007). Presence of heterosis and SCA effects for yield and its related traits are reported by Nuruzzaman *et al*. (2002), Faiz *et al*. (2006) and Saleem *et al*. (2008). To exploit maximum heterosis using cytoplasmic male sterile (CMS) technique in the hybrid programme, we must know the combining ability of different male sterile and restorer lines. This study was carried out to achieve the following:

- Formation of high yielding sorghum hybrids (*Sorghum bicolor* L. Moench) using cytoplasmic-genetic male sterility.
- Estimation of general combining ability for parents and specific combining ability for hybrids.
- Estimation of heterosis for studied hybrids.

MATERIALS AND METHODS

The material involved in this study consisted of two exotic male sterile lines from India, used as female parents (lines) (ATX-629 and SPL10A) and eight local sorghum varieties, used as male parents (testers) (Baladi-1, Baladi-2, Baladi-3, Baladi-4, Izraa-3, Ezraa-5, Ezraa-7 and Rezzinnia). The maintainer (B-lines) lines were included instead of male sterile (A-lines) for recording observations. The field experiments were conducted on two years in Jelleen Research Station Located in South Syria which belong to (GCSAR). The soil type of tove sea level, despite being between the experimental site is slight clay. The city of Jelleen is located in South Syria, with an average elevation of 440 m above sea level, despite being between the latitude of 32° 45 N and longitude of 35° 39 E, mean annual rainfall of 350 mm.

During 2009 season, crossing was carried out between male strile lines and testers varieties to develop hybrids by (line × tester) design and entry lines reproduction was made in hybridization program.

The second season (2010), on 4th- july, 16 sorghum hybrids (F1) and their parents were planted in a Randomized Complete Block Design (RCBD) with 3 replications. The experimental plot was a three-ridges of 6 m long, spaced at 0.70 m apart and plant-to-plant distance of 0.25 m. The plants was given four- supplemental irrigations.

Data was subjected to ANOVA for different characters in order to assess the variability among the entries. GCA, SCA and Heterosis were estimated for panicle length, net percentage, 1000- grain weight and grain yield traits.

RESULTS AND DISCUSSION

Analysis of variance for different studied traits:

Analysis of variance revealed significant differences among the entries for all the traits (Table 1).

Grain yield recorded a general mean of 3.46 t/h and ranged from 1.4 t/h to 6.66 t/h.

Table 1: Analysis of variance and Mean of studied traits for sorghum hybrids and parents using line x tester

Hybrids and Parents	Panicle length (c.m)	Net percentage (%)	1000-grain weight (g)	Grain yield (t\ha)
Baladi-1×SPL10-A	21.10	82.33	30.00	6.26
Baladi-2×SPL10-A	28.33	77.66	27.00	3.76
Baladi-3×SPL10-A	26.20	73.33	29.66	3.43
Baladi-4×SPL10-A	28.23	78.66	31.33	6.66
Ezraa-3×SPL10-A	25.60	73.00	30.00	3.16
Ezraa-5×SPL10-A	23.83	79.33	21.33	3.3
Ezraa-7×SPL10-A	26.93	83.00	26.00	5.36
Rezzinnia×SPL10-A	26.90	79.33	29.66	3.96
Baladi-1×ATX-629	20.23	80.66	30.66	4.96
Baladi-2×ATX-629	27.10	78.66	28.66	4.6
Baladi-3×ATX-629	27.50	79.33	34.33	4.86
Baladi-4×ATX-629	29.50	77.66	30.33	3.7
Ezraa-3×ATX-629	25.43	81.66	33.33	4.1
Ezraa-5×ATX-629	23.83	71.66	21.33	1.9
Ezraa-7×ATX-629	28.66	77.33	29.00	4.6
Rezzinnia×ATX-629	26.90	76.66	33.33	3.83
Baladi-1	13.90	65.00	24.00	2.36
Baladi-2	22.20	76.00	27.00	2.26
Baladi-3	21.40	74.00	28.00	2.06
Baladi-4	22.40	68.00	34.00	2.3
Ezraa-3	18.60	72.00	37.00	2.46
Ezraa-5	20.00	73.00	26.00	1.63
Ezraa-7	20.90	83.00	34.00	2.66
Rezzinnia	24.50	79.00	30.00	2.13
SPL10-B	24.60	79.00	21.00	2.16
BTX-629	22.60	70.00	24.00	1.4
Mean	24.15	76.43	28.90	3.46
St.Error	2.88	5.94	5.68	0.28
C.V %	7.03	3.19	8.25	15.3٠
LSD at 5%	2.78	3.99	3.91	0.87
Mean Squares	40.35**	69.65**	54.9**	6.08**
F. value	13.98	11.72	9.66	21.7
Pr.	0.0001	0.0001	0.0001	0.0001

*** = Significant at (p=5%), ** = Significant at (p=1%)**

Heterosiss, general and specific combining ability for studied traits

Panicle length:

The Mid-parent Heterosis was positive in all 16 hybrids and ranged from 6.86% to 31.77% (Table 2), the two hybrids; Baladi-4×ATX-629 and Ezraa-7×ATX-629 recorded the highest heterosis vales 31.11% and 31.77% respectively, with respect to high parent, 6 hybrids had a significant and positive better parents heterosis varied from 14.76 to 30.53%. Three parents; Baladi-2, Baladi-4 and Ezraa-7showed significant and positive gca effect.

Eight hybrids recorded non-significant positive sca effects for panicle length, the top three hybrids were Baladi-2×SPL-10A (0.74), Ezraa-7×ATX-629 (0.74) and Baladi-1×SPL-10A (0.56).

Table 2: General, specific combining ability and heterosis for panicle length trait in sorghum.

No	Hybrids Male(j) Famel(i)	GCA(j)	GCA(i)	SCA (ji)	Heterosis% H(MP)	Heterosis% H(HP)
1	Baladi-1×SPL10-A	-5.35 **	-0.13	0.56	9.61	-14.23*
2	Baladi-2×SPL10-A	1.70 *	-0.13	0.74	21.07**	15.16*
3	Baladi-3×SPL10-A	0.83	-0.13	-0.52	13.91*	6.50
4	Baladi-4×SPL10-A	2.85 **	-0.13	-0.51	20.13**	14.76*
5	Ezraa-3×SPL10-A	-0.50	-0.13	0.21	18.52**	4.07
6	Ezraa-5×SPL10-A	-2.19 **	-0.13	0.13	6.86	-3.13
7	Ezraa-7×SPL10-A	1.78 *	-0.13	-0.74	18.37**	9.47
8	Rezzinnia×SPL10-A	0.88	-0.13	0.13	9.57	9.35
9	Baladi-1×ATX-629	-5.35 **	0.13	-0.56	10.85	-10.49
10	Baladi-2×ATX-629	1.70 *	0.13	-0.74	20.98**	19.91**
11	Baladi-3×ATX-629	0.83	0.13	0.52	25.00**	21.68**
12	Baladi-4×ATX-629	2.85 **	0.13	0.51	31.11**	30.53**
13	Ezraa-3×ATX-629	-0.50	0.13	-0.21	23.45**	12.52
14	Ezraa-5×ATX-629	-2.19 **	0.13	-0.13	11.88*	5.44
15	Ezraa-7×ATX-629	1.78 *	0.13	0.74	31.77**	26.81**
16	Rezzinnia×ATX-629	0.88	0.13	-0.13	14.23*	9.8
	St.Error	0.70	0.35	0.99	1.22	1.40

*** = Significant at (p=5%), ** = Significant at (p=1%)**

Net percentage:

Table 3 show that the Mid-parent Heterosis was positive in all 16 hybrids except baladi-3×SPL-10A and Ezraa-3×SPL-10A and ranged from 0.21% to 19.50%, the two hybrids; Baladi-1×ATX-629 and Ezraa-3×ATX-629 recorded the highest heterosis values 19.50% and 15.01% respectively, with respect to high parent, 4 hybrids had a significant and positive better parents heterosis, as the same results; Salunke and Deore (1998) and Kenga *et al*. (2006).

Two parents; Baladi-1 and Ezraa-7 showed significant and positive gca effect.

Four hybrids; Ezraa-5×SPL-10A, Ezraa-7×SPL-10A, Baladi-3×ATX-629 and Ezraa-3×ATX-629 recorded significant positive sca effects for net percentage, their values were 3.65, 2.65, 3.19 and 4.52, respectively, these results are in agree with Kenga *et al*. (2004).

1000-grain weight:

The Mid-parent Heterosis was positive in 14 hybrids and ranged from 0.00% to 33.33% (Table 4), 7 hybrids of them were significant, the two hybrids; Baladi-1×SPL-10A and Baladi-3×ATX-629 recorded the highest heterosis vales 33.33% and 32.04% respectively, with respect to high parent, 3 hybrids (Baladi-1×SPL10-A, Baladi-1×ATX-629 and Baladi-3×ATX-629) had a significant and positive better parents heterosis, as the same results achieved by Salunke and Deore (1998)

Three parents; Baladi-3, Ezraa-3, and Rezzinnia revealed significant and positive gca effect.

Eight hybrids recorded non-significant positive sca effects for 1000-grain weight, the top three hybrids were Baladi-4×SPL-10A (1.50), Baladi-3×ATX-629 (1.33) and Rezzinnia×SPL10-A (0.83),

Table 3: General, specific combining ability and heterosis for net percentage trait in sorghum.

No	Hybrids Male(j) Famel(i)	GCA(j)	GCA(i)	SCA (ji)	Heterosis% H(MP)	Heterosis% H(HP)
1	Baladi-1×SPL10-A	3.35 **	0.19	0.65	14.35**	4.22
2	Baladi-2×SPL10-A	0.02	0.19	-0.69	0.21	-1.70
3	Baladi-3×SPL10-A	-1.81 *	0.19	-3.19 *	-4.14*	-7.18**
4	Baladi-4×SPL10-A	0.02	0.19	0.31	7.02**	-0.43
5	Ezraa-3×SPL10-A	-0.81	0.19	-4.52 **	-3.31	-7.59**
6	Ezraa-5×SPL10-A	-2.65 **	0.19	3.65 **	4.38*	0.42
7	Ezraa-7×SPL10-A	2.02 *	0.19	2.65 *	2.47	0.00
8	Rezzinnia×SPL10-A	-0.15	0.19	1.15	0.42	0.42
9	Baladi-1×ATX-629	3.35 **	-0.19	-0.65	19.50**	15.23**
10	Baladi-2×ATX-629	0.02	-0.19	0.69	7.75**	3.50
11	Baladi-3×ATX-629	-1.81 *	-0.19	3.19 *	10.18**	7.20**
12	Baladi-4×ATX-629	0.02	-0.19	-0.31	12.55**	10.94**
13	Ezraa-3×ATX-629	-0.81	-0.19	4.52 **	15.01**	13.42**
14	Ezraa-5×ATX-629	-2.65 **	-0.19	-3.65 **	0.22	-1.84
15	Ezraa-7×ATX-629	2.02 *	-0.19	-2.65 *	1.08	-6.83**
16	Rezzinnia×ATX-629	-0.15	-0.19	-1.15	2.90	-2.96
	St.Error	0.86	0.43	1.22	1.50	1.73

*** = Significant at (p=5%), ** = Significant at (p=1%)**

Table 4: General and specific combining ability and heterosis for 1000-grain weight trait in sorghum

No	Hybrids Male(j) Famel(i)	GCA(j)	GCA(i)	SCA (ji)	Heterosis% H(MP)	Heterosis% H(HP)
1	Baladi-1×SPL10-A	1.21	-1.00	0.67	33.33**	25**
2	Baladi-2×SPL10-A	-1.29	-1.00	0.17	12.50	0.00
3	Baladi-3×SPL10-A	2.88 **	-1.00	-1.33	21.06**	5.93
4	Baladi-4×SPL10-A	1.71	-1.00	1.50	13.93*	-7.85
5	Ezraa-3×SPL10-A	2.54 *	-1.00	-0.67	3.45	-18.92**
6	Ezraa-5×SPL10-A	-7.79 **	-1.00	1.00	-9.23	-17.96*
7	Ezraa-7×SPL10-A	-1.63	-1.00	-0.50	-5.45	-23.53**
8	Rezzinnia×SPL10-A	2.38 *	-1.00	-0.83	16.31*	-1.13
9	Baladi-1×ATX-629	1.21	1.00	-0.67	27.75**	27.75**
10	Baladi-2×ATX-629	-1.29	1.00	-0.17	12.39	6.15
11	Baladi-3×ATX-629	2.88 **	1.00	1.33	32.04**	22.61**
12	Baladi-4×ATX-629	1.71	1.00	-1.50	4.59	-10.79
13	Ezraa-3×ATX-629	2.54 *	1.00	0.67	9.28	-9.92
14	Ezraa-5×ATX-629	-7.79 **	1.00	-1.00	-14.68*	-17.96*
15	Ezraa-7×ATX-629	-1.63	1.00	0.50	0.00	-14.71*
16	Rezzinnia×ATX-629	2.38 *	1.00	0.83	23.44**	11.10
	St.Error	1.01	0.50	1.42	1.74	2.02

*** = Significant at (p=5%), ** = Significant at (p=1%)**

Grain yield:

The results indicated that Mid-parent Heterosis was positive in all 16 hybrids and ranged from 25.41% to 198.65% (Table 5), the 14 hybrids recorded significant positive heterosis values, with respect to high parent, 14 hybrids had a significant and positive better parents heterosis varied from 52.78 to 189.57%, as the same results were noticed by; Berenji (1988), Senthil and Palanisamy (1995), Biradar *et al*. (1996), Salunke and Deore 1998), Sharma and Sharma (2006), Umakanth *et al.* (2006) and disagree with Kenga *et al*, (2006).

Three parents; Baladi-1 (1.34), Baladi-4 (0.90) and Ezraa-7 (0.70) showed significant and positive gca effect.

Eight hybrids recorded positive sca effects for grain yield, 2 among of them {Baladi-4×SPL-10A (1.27), Baladi-3×ATX-629 (0.93)} recorded significant positive sca, these results according with can *et al* (1997), Kenga *et al*. (2004), Umakanth *et al.* (2005)and Degu *et al.* (2009).

Table 5: General, specific combining ability and heterosis for grain yield trait in sorghum.

No	Hybrids	GCA(j)	GCA(i)	SCA (ji)	Heterosis%	
	Male(j) Famel(i)				H(MP)	H(HP)
1	Baladi-1×SPL10-A	1.34 **	0.21	0.44	176.99**	165.25**
2	Baladi-2×SPL10-A	-0.10	0.21	-0.63	70.14**	66.37**
3	Baladi-3×SPL10-A	-0.13	0.21	-0.93 *	62.56**	58.8*
4	Baladi-4×SPL10-A	0.90 **	0.21	1.27 **	198.65**	189.57**
5	Ezraa-3×SPL10-A	-0.65 *	0.21	-0.68	36.80	28.46
6	Ezraa-5×SPL10-A	-1.68 **	0.21	0.49	74.14**	52.78*
7	Ezraa-7×SPL10-A	0.70 **	0.21	0.17	122.41**	101.5**
8	Rezzinnia×SPL10-A	-0.38	0.21	-0.14	84.62**	83.33**
9	Baladi-1×ATX-629	1.34 **	-0.21	-0.44	163.83**	110.17**
10	Baladi-2×ATX-629	-0.10	-0.21	0.63	151.37**	103.54**
11	Baladi-3×ATX-629	-0.13	-0.21	0.93 *	180.92**	135.92**
12	Baladi-4×ATX-629	0.90 **	-0.21	-1.27 **	100.00**	60.87**
13	Ezraa-3×ATX-629	-0.65 *	-0.21	0.68	112.44**	66.67**
14	Ezraa-5×ATX-629	-1.68 **	-0.21	-0.49	25.41	16.56
15	Ezraa-7×ATX-629	0.70 **	-0.21	-0.17	126.60**	72.93**
16	Rezzinnia×ATX-629	-0.38	-0.21	0.14	117.00**	79.81**
	St.Error	0.24	0.12	0.34	0.42	0.48

*** = Significant at (p=5%), ** = Significant at (p=1%)**

Conclusion:

- The varieties, (Baladi-1, Baladi-2 and Ezraa-7) have high potential to improve productivity trait.
- The varieties, (Baladi-1 and Ezraa-7) have high net percentage in F1.
- The two hybrids (Baladi-4×SPL-10A) and (Baladi-3×ATX-629) recorded high significant positive values of heterosis.
- High levels of mid and better parent heterosis was recorded for grain yield in all hybrids except (Ezraa-3×SPL10-A) and (Ezraa-5×ATX-629).

REFERENCES

Berengi, J. (1988). Evaluation of combining ability and heterosis and analysis of yield components in grain sorghum. Bitten Zo Hmelj Sitak Lekovito Bilje zo (56-57):42-79.(C.F Computer Search).

Biradar, B. D.; R. Parameshwaappa; S. S. Patil; P. Goud; P. Parameshwar and P. Goud (1996). Heterosis studies involvoing diverse sources of cytoplasmic-genetic male sterility systems in sorghum . karnataka Jo of Agric Sci.9:4627-634.

Degu, E, Debello, A and Belete, K. (2009).Combining ability study for grain yield and yield-related traits of grain sorghum[*Sorghum bicolor (L.) Moench*] in Ethiopia. Acta Agronomica Hungarica J. 57(2): 175-184.

Faiz, F. A. Sabar, M.; Awan, T. H.; Tjaz, M. Manzoor, Z. (2006). Heterosis and combining ability analysis in basmati rice hybrids. *J. Anim. PI. Sci.,* 16 (1 - 2).

Faostat**,** 2009 ; http://apps.fao.org/default/htm

Haussmann B.I.G.; V Mahalakshmi.; Reddy B.V.S.; Seetharama N.; C.T. Hash and H.H. Geiger (2002). QTL mapping of stay-green in two sorghum recombinant inbred populations. *Theor*. *Appl*. *Genet*., 106: 133-142.

Kenga, R; A. Tenkouano; S. C. Gupta, and S. O. Alabi (2006). Genetic and Phenotypic Association between Yield Components in Hybrid Sorghum (*Sorghum bicolor* (L.) Moench) populations. Euphytica J., 150(3): 319-326.

Kenga, R; S. O. Alabi and S. C. Gupta (2004). Combining ability studies in tropical sorghum (*Sorghum bicolor (L.) Moench*). Field Crops Research, 88(2-3): 251-260.

Nuruzzamman, M.; Alam, M. F.; Ahmed, M. G.; Shohad, A. M.; Biswas, M.,K., Amin, M. R. and Hossain, M. M. (2002). Studies on parental variability and heterosis in rice. *Pakisstan Jo of Biolol Sci*, 5 (10):1006-1009.

Radish, M., Cheema, A. A. and Ashraf, M. (2007). Line x tester analysis in basmati rice. *Pak. J. Bot.*, 39 (6): 2035-2042.

Saleem, M. Y.; Mirza, J. I.and Haq, M. A. (2008). Heritability, genetic advance and Heterosis. 2002. In Line x Tester crosses of basmati rice. *J. Agric. Res*., 46 (1): 15-27.

Salunke, C. B and G. N. Deore (1998). Heterosis and_heterobeltiosis studies for grain yield and its components in rabi sorghum. Annals of Plant.

Sarker, U., Biswas, P. S., Prasad, B. and Khaleque Mian, M. A. (2002). Heterosis and genetic analysis in rice hybrid. Pakistan Journal of Biological Sciences, 5 (1): 1-5.

Senthil, N. and S. Palanisamy (1995). Fertility restoration studies on divers cyto steriles of sorghum . Jo of Maharashtra Agric Univ, 20(1): 159-160.

Sharma, H and V. Sharma (2006). Heterosis in sorghum (*Sorghum bicolor* (L.) Moench). Agricultural Science Digest., 26(4).

Sprague, G. F. and L. A. TATUM Tatum (1942). General vs. specific combining ability in single crosses of corn. J. Amer. Soc. Agronomy, 34: 923-939.

Umakanth, A. V; S. S. Rao; S. V. Kuriakose (2006). Heterosis in landrace hybrids of post-rainy sorghum {*Sorghum bicolor* (L.) Moench}. Indian Jo of Agric Res. 40(2).
Umakanth, A. V and S. V. Kuriakose (2005). Assessment of sorghum landraces for combining ability. Agricultural Science Digest J. 25(4).

دراسة المقدرة على الخلط وقوة الهجين لبعض الصفات الإنتاجية في محصول الذرة البيضــــاء (*Sorghum bicolor* L. Moench) بتصـــميم (سلالة ×مُختبِر)

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نفذت هذه الدراسة بالتعاون بين كلية الزراعة بجامعة دمشق والهيئة العامة للبحوث العلمية الزراعية في محطة بحوث جلين الزراعية خلال موسمي الزراعة ٢٠٠٩ و٢٠١٠، حيث تم التهجين بين سلالتين عقيمتين مدخلتين (أمهات) وثمانية أصناف محلية من الذرة البيضاء (آباء) وبتصميم (سلالة × مُختبِر)، زرعت الهجن مع آبائها وفق تصميم القطاعات العشوائية الكاملة بثلاثة مكررات لتقدير كل من المقدرة العامة على الخلط، المقدرة الخاصة على الخلط وقوة الهجين قياساً لمتوسط الأبوين وللأب الأفضل لصفات طول العثكول، نسبة التصافي المئوية، وزن الألف حبة والإنتاجية في النبات. أظهرت النتائج أنَّ بعض الآباء كانت تمتلك مقدرة عامة على الخلط لصفة الغلة الحبية وهي (بلدي-١، بلدي-٢ وازرع-٧)، كما أظهرت العديد من الهجن مقدرة خاصة على الخلط إيجابية وحاملة لقوة هجين معنوية قياساً لمتوسط الأبوين والأب الأفضل وهذه الهجن ناتجة عن آباء ذات مقدرة عامة على الخلط موجبة ومعنوية كالهجن (بلدي-١×SPL-10A)، (بلدي-٤×SPL-10A) و(ازرع-٧×SPL-10A) ، مما يمكننا من مواصلة عملية الانتخاب للنسل الناتج عن هذه الهجن خلال الأجيال اللاحقة للحصول على سلالات مبشرة من الذرة البيضاء ذات إنتاجية عالية.

الكلمات المفتاحية: الذرة البيضاء، قوة الهجين، المقدرة العامة على الخلط، المقدرة الخاصة غلى الخلط

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