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CONTRIBUTION OF MATERNAL EFFECTS TO GRAIN YIELD AND OTHER TRAITS FOR SOME WHITE PROMISING MAIZE (*Zea mays* L.) HYBRIDS

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ABSTRACT

The differential expression of maternal effects could be an important source of fitness variation under some environmental conditions. Nine white promising maize lines were developed at maize breeding nursery of Nubaria. Non-systematic crosses and their reciprocals were done to produce eighteen promising single-cross hybrids. The resultant crosses and the check hybrid, SC.10, were evaluated in replicated yield trials at three environments in 2007 season. The objectives of this study were to (I) investigate the relative importance of maternal effects on grain yield and other traits of some promising maize hybrids and (II) identify new maize hybrids with superior grain yield across different environments.

The results showed significant differences among hybrids for all studied traits at each environment and combined data. Five hybrids had grain yield more than the check hybrid, SC.10. Two hybrids of them (Nb.49 x Nb.42 and Nb.49 x Nb.14) were significantly different than SC.10 for each environment and combined analysis. Their mean grain yields were 13.43 and 13.05 Mg ha^{-1} for combined data. Maternal effect was consistently clear and occurred in the cross, Nb.42 x Nb.49, and its reciprocal cross in each environment and in the combined analysis. Significant differences of reciprocal effect for this cross were found to be 1.86, 1.99, 2.16 and 2.0 Mg ha-1 at each environment and combined data, respectively. These differences amounted to 14.4, 19.8, 19.1 and 17.5% of the grain yield of SC.10, respectively. Nb.49 x Nb.42 and Nb.49 x Nb.14 crosses, which were significantly higher in grain yield than SC.10, were, also, significantly earlier than SC.10 by 4.4 and 5.5 days, respectively. All crosses gave significantly shorter plants than SC.10. Nb.49 line might be considered a superior new line and could be used in new white maize hybrids development. The present results showed that the maternal effect had a significant contribution to the superiority of a hybrid and should not be neglected, however, it was highly affected by environments.

Key words: *Maize. maternal effect, reciprocal crosses.*

INTRODUCTION

Maternal effects have recently been advocated as a possible pathway for adaptation in a wide number of taxa (Mousseau and Fox, 1998), Attempts to understand their potential role in adaptation to environmental stress could be rewarding. A number of studies have revealed interactions between maternal effects and environmental conditions (Groeters and Dingle, 1987; Parichy and Kaplan, 1992; Einum and Fleming, 1999), suggesting that differential expression of maternal effects could be an important source of fitness variation under some, but not all, environmental conditions.

Maternal effects are important components of genetic architecture and must be included in genetic analyses, if one wishes to achieve a complete understanding of phenotypic variation, where all sources of genetic variation are identified (Reifsynder *et al.*, 2000).

While maternal effect has, generally, not been included in genetic analyses, there is no reason to believe that they are less important to the genetic architecture of complex phenotypes than are direct effect loci (Caldji *et al.*, 2000). They might contribute to the variation among individuals.

Some differences, due to the reciprocal crosses, were greatly modified by varying environments at the testing environments, indicating cytoplasmic or cytoplasmic-genetic environment interactions (Khalifa *et al.*, 2005). Some reciprocal crosses differences were large enough to be considered in breeding programs.

The cytoplasm is a major contribution of maternal effects. Since the cytoplasm is mostly contributed by the female parent, it may be expected that differences among reciprocal crosses are mainly the result of cytoplasmic inheritance.

The reciprocal cross differences may be due to cytoplasmic and maternal effects or the interaction between the cytoplasm and the nuclear genes (Hansen and Baggett, 1977). The maternal effects sound a better explanation on the basis that these reciprocal cross differences mostly disappear in the backcross generations (Abdalla, 1974).

Derera *et al* (2001) reported greater importance of female parent GCA than male parent GCA in both F_1 and F_2 grain yields, indicating that maternal effects were important for weevil resistance in no-choice experiments. Tipping *et al* (1989) found significant maternal effect in the F_1, but was not significant in F_2 grain yield. Kang *et al* (1995) found significant GCA, SCA and maternal effects for grain weight loss caused by weevils.

The objectives of this study were to (*I*) investigate the relative importance of maternal effects on grain yield and other traits of some promising maize hybrids and (*II*) identify new maize hybrids with superior grain yield across different environments.

MATERIALS AND METHODS

Nine new white promising lines of maize were developed by the breeding program at Nubaria Agriculture Research Station. These promising lines included five lines isolated from Giza-2 composite population (Nb.1, 12, 14, 38 and Nb.42 lines), and three lines derived from American Early Dent

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Population (Nb.46, 48 and 49 lines), while, Nb.52 line was developed from crossing Giza-102 inbred line with Sids-63 inbred line.

Non-systematic crosses and their reciprocal crosses were done among the selected lines involved in this study to produce nine white promising single-cross hybrids and their reciprocal crosses. Crosses and their reciprocal crosses (eighteen) were evaluated in yield trials at three locations; i.e., Gemmiza (Mid Delta), Nubaria (north costal zone) and Mallawy (Upper Egypt) Agriculture Research Station in 2007 season, representing the different maize production zones in Egypt.

At each location, the eighteen hybrids, in addition to the check hybrid, single-cross 10 (SC.10), were planted on the optimum date, using a randomized complete block design, with four replications. Each plot consisted of one row, spaced at 80 cm with row length of 6 m. Hand sowing was done in hills, spaced at 25 cm along the row. All recommended cultural practices were followed through the growing season.

Data were recorded for grain yield, adjusted to 15.5% grain moisture and converted to ton/hectare (Mg ha^{-1}), number of days to mid-silking (silking date, d), plant height (cm), ear position (%), late wilt resistance and resistance of ear rot (%).

Data for individual location were analyzed, using Proc GLM (SAS software, 1997), according to Steel and Torrie (1980). Data were subjected to combined statistical analysis across locations. Test for homogeneity of error variances were carried out, according to Steel and Torrie (1980). Hybrid effects were considered fixed and locations random in the analysis of variance. Both late wilt and ear rot percentage were transformed to arcsine transformation before statistical analysis, as advised by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Combined analysis of variance showed that the differences among the three environments were highly significant for the three environments under study (Table 1). This was expected as the three environments represented three different climatological zones for growing maize, in addition to differences in soil types.

The differences between the check hybrid and the new eighteen hybrids were not significant, except for number of days to mid-silking. The none significance of this component was due to the low sensitivity of the F-test, as its d.f. was 1 and 2. The interaction between check vs hybrids and environment was highly significant for grain yield, plant height and ear position.

Differences among the eighteen hybrids across the three environments were significant for grain yield, number of days to mid-silking and plant height. However, the interaction between hybrids 'and environments was significant, suggesting that the differences due to hybrids should be examined for each environment.

None of the differences, due to maternal effect within hybrids, was significant, while, their interaction with environment was significant for all characters under study, except for ear position. Because of the interactions between environment and hybrid or maternal effect were significant, the effect of their factors on the different characters would be separately examined for each environment.

Single environment ANOVA showed that the differences between the check hybrid and the average of tested hybrids was significant for all characters at Gemmiza; number of days to mid-silking, plant height and resistance to ear rot at Nubaria; and grain yield, number of days to mid-silking and plant height at Mallawy (Table 2). All the differences between the nine hybrids were significant at the three environments.

Difference between the two versions of maternal effect, within the nine hybrids, was significant for all characters, except for the number of days to mid-silking at Gemmiza, ear position at Nubaria and number of days to mid-silking, plant height and ear position at Mallawy. This might indicate that the maternal effect would have a significant contribution to the mean of a hybrid. However, this contribution was different from one hybrid to another and should be separately examined for each hybrid.

Grain yield:

Mean performance of grain yield for the hybrids, in addition to SC.10, for each environment and combined data are presented in Table 3. Five hybrids had grain yield higher than the check hybrid, SC.10, in separate and combined data. Two hybrids, among them (Nb.49 x Nb.42 and Nb.49 x Nb.14) were consistently and significantly different than SC.10 under each environment and combined data. Their mean grain yields were 13.43 and 13.05 Mg ha^{-1} over the combined data. The hybrid, Nb.49 x Nb.52, was not significantly different from SC.10 and yielded about 11.45 Mg ha^{-1}.

It may be noticed, for the five superior hybrids, that Nb.49 line was a common female parent in these hybrids, reflecting its superiority due to GCA. Therefore, Nb.49 line might be considered a superior new line and could be used in new white maize hybrids. Also, this line would be recommended as a female parent of promising hybrids because it had a good ear yield, erect leaves and moderate tassel size. These results were compatible with those reported by Derera *et al* (2001), which emphasized that more weight was given for female parent GCA than male parent GCA in both F_1 and F_2. Maternal effect varied from one location to another, but it was consistent for the cross, Nb.49 x Nb.42. Three hybrids showed significant maternal effect at Gemmiza and Mallawy, while, only one difference was detected at Nubaria. The maternal effect ranged between 0.04 to 2.65 Mg ha^{-1}.

Table 1. Mean square analysis for grain yield and other traits of eighteen hybrids and SC.10 for combined analysis under three environments in 2007.

Source of variance	df	Grain yield (Mg ha^{-1})	Days to mid-silking (d)	Plant height (cm)	Ear position (%)	Late wilt $ resistance (%)	Ear rot $ resistance (%)
Environments (E)	2	34.44**	1372.77**	46275.8**	16.46	33.94**	225.78**
Rep. / E.	9	4.36	2.42	602.7	7.81	4.95	7.15
Check vs cross (C)	1	44.25	278.97**	20529.7	81.60	16.89	128.59*
Hybrids (H)	8	33.30**	27.41**	4489.4**	34.37	24.15	98.15
Maternal / H	9	3.20	4.66	568.0	11.78	23.33	5.51
E x C	2	19.15**	1.59	2629.3**	37.36**	1.88	6.96
E x H	16	5.45**	4.47**	326.2**	14.62**	22.52**	58.16**
E x M	18	3.15**	2.73*	238.0**	9.06	33.03**	30.82**
Combined error	162	1.17	1.51	111.3	6.11	2.06	7.08
C.V.		9.2	2.1	4.1	4.4	1.5	2.9

*,** Indicates significance at 0.05 and 0.01 levels of probability, respectively.

$ Data were transformed by arcsine.

Table 2. Mean square analysis for grain yield and other traits for eighteen hybrids and SC.10 evaluated under three environments in 2007.

Source of Variance	df	Grain yield (Mg ha^{-1})	Days to mid-silking (d)	Plant height (cm)	Ear position (%)	Late wilt resistance (%)	Ear rot resistance (%)
			Gemmiza				
Replications	3	2.14	1.28	32.00	1.34	1.83	10.74
Check vs. crosses	1	77.74**	120.49**	19470.70**	148.42**	14.46**	80.18**
Hybrids	8	9.69**	5.95**	2724.07**	18.17**	48.27**	30.57*
Maternal / hybrids	9	4.16**	0.66	2386.00**	6.71*	73.47**	15.30*
Error	54	1.34	0.64	38.13	3.34	0.99	5.17
C.V.		9.4	1.5	2.2	3.3	1.0	2.6
			Nubaria				
Replications	3	10.12	1.16	517.11	7.25	1.44	7.26
Check vs. crosses	1	0.35	90.06**	1590.37**	0.57	1.13	48.45*
Hybrids)	8	26.03**	14.72**	1475.61**	27.03*	5.05**	136.09**
Maternal / hybrids	9	2.76*	4.00**	477.00**	20.06	6.83**	36.04**
Error	54	1.32	0.82	157.85	11.31	1.35	8.75
C.V.		9.7	1.4	5.2	5.9	1.16	3.4
			Mallawy				
Replications	3	0.86	4.82	1258.96	14.85	11.58	3.46
Check vs. crosses	1	4.46*	71.61**	4727.23**	7.34	5.07	13.88
Hybrids	8	8.48**	15.68**	942.07**	18.41**	15.26*	47.81**
Maternal / hybrids	9	2.64**	5.46	79.00	3.13	9.06*	15.86*
Error	54	0.86	3.06	137.89	3.66	3.85	7.32
C.V.		8.4	2.9	4.8	3.4	1.9	2.9

*,** Indicates significance at 0.05 and 0.01 levels of probability, respectively.

Maternal effects were observed in some hybrids in one location, but not in another; i.e., Nb.1 x Nb.12, Nb.12 x Nb.42, Nb.12 x Nb.38, Nb.46 x Nb.52 and Nb.46 x Nb.48. This reflected the possibility of maternal environmental interaction. Groeters and Dingle, 1987; Parichy and Kaplan, 1992; Einum and Fleming, 1999; and Khalifa *et al.*, 2005 suggested that differential expression of maternal effects could be an important source of fitness variation under some, but not all, environmental conditions. Also, Tipping *et al* (1989) found significant maternal effect for grain in F_1, while, Kang *et al* (1995) found significant GCA, SCA and maternal effects for grain weight.

Maternal effect occurred in the cross, Nb.42 x Nb.49, and its reciprocal cross in each location and in the combined analysis. Significant maternal effect for this cross was estimated to be 1.86, 1.99, 2.16 and 2.0 Mg ha-1 for each environment and combined data, respectively. This difference amounted to 14.4, 19.8, 19.1 and 17.5% of the grain yield of SC.10, respectively. These results emphasized the role of the maternal effect in maize grain yield and it is worth to be considered in new maize hybrids development.

Table 3. Mean performance of grain yield (Mg ha^{-1}) for eighteen hybrids and SC.10 evaluated at three environments and combined data in 2007.

Cross	Gemmiza	Nubaria	Mallawy	Combined data
Nb.1 x Nb.12	12.01	9.11	10.64	10.58
Nb.12 x Nb.1	10.32	7.94	9.42	9.22
Difference	1.69 *	1.17	1.22	1.36
Nb.42 x Nb.12	12.19	7.68	10.91	10.26
Nb.12 x Nb.42	11.25	9.26	10.78	10.43
Difference	0.94	- 1.58 *	0.13	- 0.17
Nb.42 x Nb.14	11.96	9.55	10.19	10.56
Nb.41 x Nb.42	11.02	9.60	10.68	10.43
Difference	0.94	- 0.05	- 0.49	0.13
Nb.42 x Nb.49	13.14	10.28	10.87	11.43
Nb.49 x Nb.42	15.00 +	12.27 +	13.03 +	13.43 +
Difference	- 1.86 *	- 1.99 *	- 2.16 *	- 2.00 *
Nb.14 x Nb.49	12.65	12.73 +	13.01 +	12.79
Nb.49 x Nb.14	13.72	12.97 +	12.48	13.05 +
Difference	- 1.07	- 0.24	0.53	- 0.26
Nb.12 x Nb.38	11.69	7.99	11.85	10.51
Nb.38 x Nb.12	12.44	8.53	10.28	10.41
Difference	- 0.75	- 0.54	1.57 *	0.10
Nb.46 x Nb.52	11.92	9.37	9.97	10.41
Nb.52 x Nb.46	9.27	8.66	9.42	9.11
Difference	2.65 *	0.71	0.55	1.30
Nb.46 x Nb.48	11.25	9.94	12.73 +	11.30
Nb.48 x Nb.46	12.59	9.78	11.18	11.18
Difference	- 1.34	0.16	1.55 *	0.12
Nb.49 x Nb.52	13.04	11.08	10.24	11.45
Nb.52 x Nb.49	13.15	9.89	10.20	11.07
Difference	- 0.11	1.19	0.04	0.38
SC.10	12.88	10.04	11.28	11.40
LSD $_{0.05}$	1.65	1.64	1.32	1.91

* Maternal effects were significant at 0.05 level of probability.

\+ Significantly different than the check hybrid, SC.10, at 0.05 level of probability.

These results were compatible with earlier results reported by Abdalla (1974) who recommended a formula to include reciprocals in evaluation of hybrid programs. Reciprocal cross differences for grain yield, also, were reported by several investigators (Fleming *et al.*, 1960; Singh, 1965; Bhat and Dhawan, 1969; Kalsy and Sharma, 1972; Melchinger *et al.*, 1985; Seka and Cross, 1995b; Edwards *et al.*, 1996a and Khalifa *et al.*, 2005). Also, Cardelas *et al.* (1992) and Kang *et al.* (1995) showed that cytoplasm was a major contribution of maternal effects. Since the cytoplasm is mostly contributed by the female parent, it may be expected that differences among reciprocal crosses are mainly the result of cytoplasmic inheritance.

Number of days to mid-silking:

Differences of maternal effects were not significant (Table 3), but their interaction with environment was significant (Table 1).

All evaluated crosses and their reciprocals were significantly earlier than the check hybrid, SC.10, by, at least 3.3, with a maximum of 6.8 days (Table 4). Nb.49 x Nb.42 and Nb.49 x Nb.14 crosses, which were significantly higher in grain yield than SC.10, were, also, significantly earlier than SC.10 by 4.4 and 5.5 days, respectively.

The differences due to maternal effect for hybrids and their reciprocals ranged from 0.2 to 1.5 days. Similar results were obtained by Melchinger *et al.* (1985), Seka and Cross (1995) and Edwards *et al.* (1996).

Plant height:

The interaction between maternal effects by environments was significant (Table 1). This suggests that the maternal effect was not consistent across environments. At the same time, the differences between crosses and their reciprocals ranged from 3.0 to 12.6 cm. These differences were significant at some environments, but none was significant across the three environments. These results were, also, reported by Khalifa *et al.* (2005).

Superior crosses; i.e., Nb.49 x Nb.42 and Nb.49 x Nb.14, were shorter in plant height than SC.10 by 20.4 and 34.2 cm, respectively. Plant height of new hybrids ranged from 236 to 281, as compared to 301.4 cm for the check hybrid, SC.10 (Table 4). Therefore, all crosses were significantly shorter than SC.10.

Ear position:

None significant differences of maternal effects were observed in combined data, as well as their interaction with environments (Table 1). Differences of ear position between crosses and their reciprocals ranged from zero to 2.0%, indicating absence of maternal effects for ear position.

Ear placement of the crosses and their reciprocals ranged from 53.4 to 58.3% (Table 4). All crosses showed lower ear position than the check hybrid SC.10. Twelve crosses of them were significantly lower in ear position than SC.10. Nb.49 x Nb.42 and Nb.49 x Nb.14 superior crosses had lower ear position than SC.10 by 4.7 and 3.4%, respectively.

Late wilt resistance:

Insignificant differences of maternal effects were observed in the combined analysis, while, their interaction with environments was significant (Table 1). The maternal difference ranged between zero to 3.7%.

Means of tested hybrids, for late wilt resistance, ranged from 95.7 to 100.0%. Differences between hybrids across environments were not significant, but their interaction with environment was significant (Table 1). None of differences were observed between hybrids and the check hybrid, SC.10.

Ear rot disease resistance:

Insignificant differences of maternal effects were obtained, however, its interaction was significant for the combined data (Table 1).

Means of tested hybrids ranged from 88.2 to 91.6%, with 92.3% for the check hybrid, SC.10. Means of ear rot disease resistance, among these hybrids, were not significantly different, in addition, they were not significantly different from SC.10. However, their interaction with environments was significant.

It may be concluded that the present results detected maternal effects on grain yield, for some crosses, in one location, but not for another, reflecting the possibility of maternal environmental interaction. At the same time, maternal effects were detected, for only one cross, at all tested environments and combined analysis. These results showed that either some cytoplasms were active in determining cytoplasmic effects (cytoplasmic inheritance) or that some cytoplasms might interact more actively with the nuclear genes (cytoplasmic-genetic inheritance) to produce such reciprocal cross differences.

Nb.49 x Nb.42, Nb.49 x Nb.14 and Nb.49 x Nb.52 crosses were promising white single-cross maize hybrids and they might be recommended as promising hybrids and need further test in breeding programs. In addition, Nb.49 line was a superior promising line and could be used in maize hybrids developing programs. Also, this line would be recommended as a female parent of promising hybrids

The present results showed that the maternal effect had a significant contribution to the superiority of a hybrid and should not be neglected, however, it needs extensive testing to discover this phenomenon.

Table 4. Combined mean performance of number of days to mid-silking, plant height, ear position and late wilt and ear rot diseases resistance for eighteen hybrids and SC.10 evaluated at three environments in 2007.

Cross	Number of days to mid-Silking (d)	Plant height (cm)	Ear position (%)	Late wilt resistance (%)	Ear rot resistance (%)
Nb.1 x Nb.12	56.9	239.4	56.2 +	99.6	89.2
Nb.12 x Nb.1	57.1	236.0	53.4 +	95.9	90.5
Difference	- 0.2 *	3.4	1.8	3.7	- 1.3
Nb.42 x Nb.12	58.7	243.3	55.8 +	100.0	87.3
Nb.12 x Nb.42	58.9	251.6	53.8 +	98.2	87.9
Difference	- 0.2 *	- 8.3	2.0	1.8	- 0.6
Nb.42 x Nb.14	60.3	242.8	55.4 +	100.0	83.9
Nb.41 x Nb.42	59.5	247.4	54.1 +	99.6	85.4
Difference	0.8 *	- 4.6	1.3	0.4	- 1.5
Nb.42 x Nb.49	58.8	268.4	56.2 +	98.5	88.9
Nb.49 x Nb.42	59.5	281.0	55.1 +	99.7	90.4
Difference	- 0.7 *	- 12.6	1.1	- 1.2	- 1.5
Nb.14 x Nb.49	59.1	259.8	57.4	100.0	91.4
Nb.49 x Nb.14	58.4	267.2	56.4 +	96.7	91.6
Difference	0.7 *	- 7.4	1.0	3.3	- 0.2
Nb.12 x Nb.38	57.7	241.3	55.8 +	100.0	91.4
Nb.38 x Nb.12	57.1	237.2	55.8 +	100.0	90.4
Difference	0.6 *	4.1	0.0	0.0	1.0
Nb.46 x Nb.52	59.2	248.7	56.7 +	98.3	88.6
Nb.52 x Nb.46	60.4	261.0	57.2	99.3	88.3
Difference	- 1.2 *	- 12.3	- 0.5	- 1.0	0.3
Nb.46 x Nb.48	58.4	243.8	57.1	95.7	88.7
Nb.48 x Nb.46	59.9	252.8	58.3	97.9	88.2
Difference	- 1.5 *	- 9.0	- 1.2	- 2.2	0.5
Nb.49 x Nb.52	60.6	274.8	57.5	99.6	89.4
Nb.52 x Nb.49	59.5	271.8	57.3	98.8	89.9
Difference	1.1 *	3.0	0.2	0.8	- 0.5
SC.10	63.9	301.4	59.8	100.0	92.3
$LSD_{0.05}$	0.18	19.6	2.9	4.2	5.3

* Maternal effects were significant at 0.05 level of probability.
+ Significantly lower than SC.10, at 0.05 level of probability.

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الملخص العربى

مساهمة التأثيرات الأموية فى محصول الحبوب والصفات الأخرى لبعض هجن الذره الشاميه بيضاء الحبوب

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يمكن أن تكون التأثيرات الأموية مصدرا مهما لاختلاف المواءمة تحت بعض الظروف البيئية. وقد عزلت تسع سلالات مبشرة بيضاء الحبوب من الذره الشامية خلال برنامج التربية بالنوبارية. تم تكوين تسعة هجن فردية وأخرى عكسية بين هذه السلالات فى موسم ٢٠٠٦. وتم تقييم الهجن الناتجة (ثمانية عشرة) بالاضافة الى هجين فردى ١٠ (هـ. ف. ١٠) كهجين مقارنة فى تجربة تقييم محصولى فى قطاعات عشوائية كاملة ذات أربع مكررات في ثلاث محطات بحثية وهى: الجميزة و النوبارية وملوى فى موسم ٢٠٠٧. تم قياس صفات محصول الحبوب (طن / هكتار) وعدد الأيام حتى خروج ٥٠% حريرة وارتفاع النبات وموقع الكوز ودرجة المقاومة لمرضى الذبول المتأخر وعفن الكوز.

وقد أوضحت النتائج ما يلى:

- ظهور فروق معنوية بين الهجن المختبرة للصفات تحت الدراسة فى كل المناطق تحت الدراسة. وقد تفوقت خمسة هجن محصوليا عن هجين المقارنـــــة كمتوســط لكـــل المناطق ، بينمـــا أعطـــى الهجـــينين (Nb.49 x Nb.42 & Nb.49 x Nb.14) تفوقا معنويا عن هـــف. ١٠ لكل موقع على حدة وكذلك للمواقع مجتمعة حيث حققت هذه الهجن متوسط محصول حبوب يقـــدر بحوالى ١٣,٤٣ و١٣,٠٥ طن/هكتار.
- ظهرت التأثيرات الأموية من خلال الهجين (Nb.42 x Nb.49) والهجين التبادلى له فى كل من المناطق الثلاثة وكـــذلك عبـــر المناطق تحت الدراسة ، حيث أعطى الهجين التبادلى فروقا معنوية لمحصول الحبـــوب تقـــدر بحـــوالى ١,٨٦ و ١,٩٩ و ٢,١٦ و ٢,٠ طن/هكتار فى المناطق المختبره وكمتوسط لهذه المناطق وقد قدرت هـــذه الاختلافـــات بحـــوالى ١٤,٤ و ١٩,٨ و ١٩,١ و١٧,٥% عن هـــ ف. ١٠ على الترتيب.
- حقق الهجينان (Nb.49 x Nb.42 & Nb.49 x Nb.14) فروقا معنوية لمحصول الحبوب وأيضا حققا فروقا معنوية للتبكيـــر فى موعد خروج الحريرة عن هـــف. ١٠ قدرت بحوالى ٤,٤ و٥,٥ يوما على الترتيب.
- أعطت كل الهجن تحت الدراسة تقديرات أقل فى ارتفاع النبات عن الهجين القياسى.
- تعتبر السلالة " نوبارية ٤٩ " من السلالات المبشرة والتى يمكن استخدامها فى برنامج انتاج هجن الذره الشاميه الجديده.
- كما أوضحت هذه الدراسة أن التأثيرات الأموية لها دورا هاما ومعنويا فى المساهمة فى تفوق الهجن المبشرة من الـــذرة الـــشامية ويجب على المربين عدم اهمال دور التأثيرات الأموية فى تربية الذرة الشامية ولكنها تحتاج الى المزيد من الاختبارات حيث أنها تتفاعل مع مناطق الزراعة.