Minufiya J. Agric. Res. Vol.36 No. 5:1227-1262 (2011) **"http://www.mujar.net"**

تقدير التباين الوراثي في بعض الصفات الكمية فى قمح الخبز

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الملخص العربي

أجرى هذا البحث في مزرعة محطة البحوث الزراعية بالجميزة خلال العامين ٢٠٠٨/٢٠٠٩ و ٢٠٠٩/٢٠١٠ وقد استخدم لتحقيق هذه الدراسة عشرة أصناف وسلالات من قمح الخبز وهى : جميزة ٧ ، سخا ٩٣ ، جيزة ١٦٨ ، سلالة ٤ ، سلالة ٥ ، سلالة ٦ ، سلالة ٧ ، سلالة ٨ ، سلالة ٩ و سدس ٤ . حيث أجرى التهجين بينهم فى الموسم الزراعي ٢٠٠٨/٢٠٠٩ وفى موسم ٢٠٠٩/٢٠١٠ تم تقييم هذه الآباء العشرة وجميع الهُجن الناتجة منها وذلك تحت مستويين من مستويات التسميد الآزوتي ٣٠ كجم آزوت للفدان و ٧٠ كجم آزوت للفدان وذلك في تصميم قطاعات كاملة العشوائية في ثلاثة مكررات وقد تم تحليل البيانات باستخدام طريقة تحليل الهُجن التبادلية (جريفنج ١٩٥٦)، الطريقة الثانية الموديل الأول.

ويُمكن تلخيص النتائج المتحصل عليها في ما يلي:

كان التباين الراجع إلى التسميد الآزوتى معنوياً لجميع الصفات المدروسة عدا ارتفاع النبات، عدد السُنيبلات بالسنبلة، طول السنبلة، وزن ١٠٠٠ حبة وكانت القيم الناتجة من مستوى التسميد الأول ٧٠ كجم آزوت للفدان أعلى من مثيلتها في مستوى التسميد الثاني ٣٠ كجم آزوت للفدان وذلك في معظم الصفات . كانت قيم التباين الوراثي الراجع إلى التراكيب الوراثية والآباء والهجن عالية المعنوية وذلك في كل الصفات المدروسة تحت مستويي التسميد الآزوتي في التحليل المشترك. كانت قيم التباين الراجع إلى متوسط قوة الهجين عالية المعنوية وذلك لصفات ميعاد التزهير، طول النبات ووزن ١٠٠٠ حبة وذلك تحت مستويي التسميد الآزوتى والتحليل المشترك. كانت قيم التفاعل بين التراكيب الوراثية مع التسميد الآزوتى معنوية وذلك لصفات ميعاد التزهير

وميعاد النضج .كانت قيم التفاعل بين التسميد الآزوتي مع الآباء معنوية وذلك لصفات ميعاد التزهير، ميعاد النضج ، عدد السنابل في النبات، وزن السنبلة وعدد الحبوب بالسنبلة. كانت قيم التفاعل بين متوسط قوة الهجين مع مستويي التسميد الآزوتى معنوية لصفات طول النبات، عدد السنابل في النبات، طول السنبلة ومحصول النبات من الحبوب. أظهر الهجينين جميزة ٧ × سخا ٩٣ و سخا ٩٣ × سلالة ٦ أهميتها العملية في برامج إنتاج الهُجن وذلك بسبب تفوقهما في محصول الحبوب بالنبات وأربعة صفات من مكونات المحصول كما أن قوة الهجين في صفة محصول الحبوب ترجع إلى قوة الهجين في عدد السنابل في النبات ووزن السنبلة.

كان التباين الراجع لكلٍ من القدرتين العامة والخاصة على التآلف عالي المعنوية لجميع الصفات تحت الدراسة في مستويي التسميد الآزوتي والتحليل المشترك فيما عدا صفة عدد السنيبلات في السنبلة تحت مستويي التسميد الآزوتى، وطول السنبلة تحت مستوى التسميد النيتروجيني المنخفض.

أظهرت النسبة بين تباين القدرتين العامة والخاصة على التآلف أن التباين الوراثي المُضيف وأيضاً التفاعل بين الفعل الجيني المضيف × المضيف هما الأكثر أهمية في وراثة جميع الصفات المدروسة.

أظهرت التفاعلات بين التسميد الآزوتي وكل من القدرتين العامة والخاصة على التآلف تأثيرات معنوية وذلك لصفات ميعاد التزهير وميعاد النضج . أظهرت السلالة خمسة قدرة تآلفية عالية لصفة المحصول وكذلك أثبتت أنها تملك قدرة تآلفية عالية لمعظم صفات مكونات المحصول. أظهر الهجين سخا ٩٣ × سلالة ٤ قدرة خاصة على التآلف عالية المعنوية وذلك لصفة محصول النبات من الحبوب تحت مستوى التسميد العادي.

ESTIMATION OF GENOTYPIC VARIABILITY OF SOME

QUANTITATIVE CHARACTERS IN BREAD WHEAT (*Triticum aestivum* L.)

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(Received: Jul. 5, 2011)

ABSTRACT: ***Nitrogen fertilizer levels mean squares were found to be significant for all traits studied except plant height, number of spikelets per spike length and 1000-grain weight, with the mean values of the first nitrogen fertilizer level i.e. 20 kg (faddan) being higher than those of the second nitrogen fertilizer level i.e. 30 kg nitrogen per faddan, in most cases. Genotypes, parent and the resultant forty five crosses mean square estimates were found to be highly significant for all traits studied under the two nitrogen fertilizer levels and their combined data. Parents vs crosses mean squares as an indication to average heterosis overall crosses, were found to be highly significant for heading data, plant height and 1000-grain weight under the two nitrogen fertilizer levels and their combined data. The interaction of genotypes with the two nitrogen fertilizer levels were found to be significant for only heading date and maturity date. The interactions of the two nitrogen levels with parents were found to be significant for heading date, maturity date, number of spikes per plant, spike weight and number of kernels per spike. The interaction of parents vs crosses with the two nitrogen levels were found to be significant for plant height, number of spikes per plant, spike length and grain yield per plant. The two crosses Gemmeiza 7 × Sakha 93 and Sakha 93 × Line 6 would of practical interest in hybrid breeding program because of their superiority in grain yield per plant and four traits contributing to yield, also heterosis for grain yield could be attributed to heterosis in number of spikes per plant and spike weight.***

General combining ability and specific combining ability were found to be highly significant for all characters under examination at the two nitrogen fertilizer levels and their combined data except number of spikelets per spike at both normal and stress nitrogen fertilizer levels and spike length under stress nitrogen level only. The GCA / SCA ratios were found to be greater than unity, indicating that additive and additive × additive types of gene action were of greater importance in the in heritance of all traits. The interactions of nitrogen fertilization with both types of combining ability were found to be significant for heading date and maturity date. The parental variety Line 5 which possessed high general combining ability effects for grain yield per plant was found to be also good combiner for most of the attributes contributing to grain yield. For grain yield per plant, the wheat cross Sakha 93 × Line 4 showed highly significant specific combining ability effects under the normal nitrogen fertilizer.

Key words: ***Genotypic Variability, Quantitative Characters, Bread Wheat, Triticum aestivum.***

INTRODUCTION

Wheat is the major cereal crop in Egypt as well as in several other countries. The increasing gap between production and consumption necessitate increasing wheat production in Egypt. Practically, this could not be achieved through extending the wheat cultivated area at the expense of other crops.

The initiation of any breeding programme especially with diverse germplasm, it is necessary to measure the nature and relative magnitude of different gene actions governing the various quantitative traits. This information would be helpful to plant breeders to identify the types of genetic variation in the traits for which selection is intended and carry out rapid evaluation of the yielding capacity of the materials under examination by identifying crosses which will produce superior genotypes. Combining ability analysis is the most widely used biometrical tool for classifying lines in terms of their ability to combine in hybrid combinations. With this method, the resulting total genetic variation is partitioned into general combining ability, as measure of additive gene action and specific combining ability, as measure of non-additive gene action.

The ability of some crop varieties to perform well over a wide range of environmental condition has been long appreciated by the agronomist and plant breeder. Therefore, the understanding of genotype-environment interaction in plant breeding is a matter of great interest, since genotype-environment interaction usually hamper selection of the genotypes which consistently show superior performance over a series of environments.

The objectives of the present study are to establish (i) The potentiality of heterosis expression for grain yield and its contributory characters, heading date, maturity date and plant height, (ii) The magnitude of both general and specific combining abilities and their interaction with the two nitrogen fertilizer levels, as two different environmental conditions and the different types of gene action.

MATERIALS AND METHODS

The experiments were carried out at Gemmeiza Agricultural Research Station, Agriculture Research Center, Egypt, during the two successive seasons 2008/2009 and 2009/2010. Ten common wheat varieties and lines of wide divergent origins were used to establish the experimental materials for this investigation and would be mentioned in the text as P_1, P_2, P_3, P_4, P_5, P_6, P_7, P_8, P_9 and P_{10}. The names and origins of these varieties and lines are presented in Table (1).

A. Experimental design and cultural practices:

A diallel cross set was carried out among the ten parents in 2008/2009 growing season. The parental varieties and their possible 45 crosses were sown in 2009/2010 under two fertilizer levels 30 kg. nitrogen per faddan and 70 kg. nitrogen per faddan, which would be mentioned in the text as stress condition (S) and normal condition (N), respectively. The two experiments were arranged in a randomized complete block design with three replicates per each fertilizer level.

Each plot comprised single row 3 meters long with 30 cm. between rows, plants within rows were 10 cm. apart allowing a total of 30 plants per plot. Normal agricultural wheat practices were applied as usual for the ordinary wheat fields in the area. With the exception of number of days to both heading and maturity which recorded in 50% from plant plot. Ten guarded plants were randomly selected from each plot for subsequent measurements as follows:

Table (1): The names and origin of the parental varieties evaluated.

Name	Origin	Symbol	Pedigree
Gemmeiza 7	Egypt	P_1	CMH 74A. 630/5 XllSeri 82/3/Agert
Sakha 93	Egypt	P_2	Sakha 92/TR 810328/S8871-1S-2S-1S-0S
Giza 168	Egypt	P_3	MFL/BUCllSeri CM93046-8M-0Y-0M-2Y-0B
Line 4	Egypt	P_4	Parent SK 47A-4-1/5/Sakha 61/3 MRS/MO73/Pol/t. aest.Bon/CN011 7C/4/Gem7
Line 5	Egypt	P_5	CMH 80.638/CMSSOIMOO 953T-2
Line 6	Egypt	P_6	B3/6/GV/ALD“S”/5/ALD“S”/4BB/GLL/ CNO67/7C/3/KVZ/TI
Line 7	Egypt	P_7	KAUZ/6ATL 66/H567.71//ATL66/5 PMNS11 S948AI 4*CNO67/3/PMNS/4/CMH75A.66
Line 8	Egypt	P_8	OPATAM85/GEMMEIZA//9
Line 9	Egypt	P_9	KVZ/4/CC/INIA/3/CNO//ELGAU/SON64/5/ SPARROW/“S”/BROCHFS“S”/6/BAYA“S”/IMU
Sids 4	Egypt	P_{10}	Maya“S”/MON“S”/CMHT4.A.592/3/CHZa157*

Heading date, Maturity date, Plant height (cm.), Number of spikes per plant, ,Number of spikelets per spike ,Spike length "cm",Spike weight “gm”,1000-grain weight, Number of kernels per spike and Grain yield per plant.

Two steps are involved in the analysis of the data. The first step consists of the ordinary analysis of variance for testing the null hypothesis that these are no genotypic differences among the F_1’s and the parents. Only when the significant differences among these are established, there is need to proceed for second step analysis, i.e. the combining ability analysis (i.e Griffing's approach, method 2 model 1 1956).

The average heterosis over all crosses were calculated by partitioning the genotypes sum of squares to its components, i.e. parents, crosses and parents Vs crosses. Useful heterosis for each trait of individual cross was expressed as percent increase of F_1 performance above the better parent values. To test the significance of useful heterosis effect, L.S.D values were calculated as follows:

$$\textbf{L.S.D. for better parent heterosis} = t\sqrt{\frac{2MSE}{r}}$$

(Wynne *et al.,* 1970)

The combined analysis was calculated over the nitrogen fertilizer levels to test the interaction of the different genetic components with the two different fertilizer levels, as two different environmental conditions, and that was done whenever the homogeneity of variance was detected.

RESULTS AND DISCUSSION

For better representation and discussion of the results obtained herein, it would be preferred to outline these results into four parts as follows:

1. Variation and interaction with nitrogen fertilizer-levels:
2. Heterosis.
3. Griffing's approach.

1. Variation and interaction with nitrogen fertilizer-levels:

The analysis of variance of each nitrogen fertilizer level together with the combined data for all traits studied is presented in Table (2).

Nitrogen fertilizer levels mean squares were found to be significant for all traits studied except plant height, number of spikelets per spike, spike length and 1000-grain weight, with the mean values of the first nitrogen fertilizer level, i.e. 70 kg. / faddan, being higher than those of the second nitrogen fertilizer level i.e. 30 kg. nitrogen per faddan in most cases (Table 3). Genotypes, parent and the resultant forty five crosses mean square estimates were found to be highly significant for all traits studied under the two nitrogen fertilizer levels and their combined data, indicating overall differences among these populations.

Parents Vs crosses mean squares as an indication to average heterosis overall crosses, were found to be highly significant for heading date, plant height and 1000-grain weight under the two nitrogen fertilizer levels and their combined data. However, parents Vs crosses were detected to be highly significant only under the first nitrogen fertilizer level 70 kg. nitrogen per faddan (normal) for number of spikes per plant, number of spikelets per spike, spike length, number of kernels per spike and grain yield per plant. This may indicate that average heterosis could be pronounced for heading date, plant height and 1000-grain weight and less pronounced for spikes per plant, spikelets per spike, spike length, kernels per spike and grain yield per plant.

Table (2):

Table (2): Cont.

Table (2): Cont.

Table (3):

Table (3): Cont.

Table (3): Cont.

Table (3): Cont.

Table (3): Cont.

Table (3): Cont.

The interaction of genotypes with the two nitrogen fertilizer levels were found to be significant for only heading date and maturity date, reflecting the fact that these genotypes behaved differently from nitrogen level to another for these two traits. The interactions of the two nitrogen levels with parents were found to be significant for heading date, maturity date, number of spikes per plant, spike weight and number of kernels per spike. The interactions of the resultant crosses with the two nitrogen levels were found to be significant for only heading date and maturity date.

The interactions of parents Vs crosses with the two nitrogen levels were found to be significant for plant height, number of spikes per plant, spike length and grain yield per plant. It could therefore be concluded that the test of potential parents for expression of heterosis would be necessarily conducting over a number of environmental conditions. Also, genetic diversity alone would not guarantee the expression of heterosis, but the suitability of the environments would be required in case of the above mentioned four characters.

2. Heterosis:

Useful heterosis expressed as the percentage deviation of F_1 mean performance from the better parent for all traits studied are presented in Table (4). High positive values of heterosis would be of interest in all characters studied except heading date, maturity date and plant height, high negative values would be useful from the wheat breeder point of view. Also, the heterosis values which found under the two nitrogen levels would only be mentioned here.

As for heading date, no useful heterosis was found under the two nitrogen fertilizer levels, however, the cross Gemmeiza 7 × Line 8 was found to exhibit significant negative useful heterosis under the normal fertilizer level only. Little or no heterosis for heading date was previously found by Hendawy (1990), Hendawy (1994 b), Hewezi (1996), Seleem (2001), Hendawy (2003), El-Nahas (2005) and El-Massry (2009).

As for maturity date, two hybrid combinations exhibited significant negative heterosis under the stress fertilizer level only, i.e. Giza 168 × Line 4 and Line 5 × Line 8. No heterosis for maturity date was previously detected by Zaied (1995).

Concerning plant height, no desirable heterotic effects were found under the two nitrogen fertilizer levels. The forty five hybrid combinations were found to be taller than their respective better parents.

Table (4):

Table (4): Cont.

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Table (4): Cont.

As for number of spikes per plant, two crosses exhibited significant useful heterosis under the normal fertilizer level, however, ten hybrid combinations showed highly significant useful heterosis under the stress nitrogen fertilizer level. Only Gemeiza 7 × Sakha 93 showed highly significant useful heterosis under the two nitrogen fertilizer levels. Heterosis for number of spike per plant were also found by Hendawy (1990), Seleem (1993), Hendawy (1994 b), Hewezi (1996) and Seleem (2001). No heterotic effects were previously found for number of spikes per plant by Esmail and Khattab (2002), Bayoumi (2004) and Dawwam *et al.* (2007).

Concerning number of spikelets per spike, fourteen hybrid combinations showed highly significant heterosis under the normal fertilizer level and eleven hybrid combinations exhibited highly significant useful heterosis under the stress nitrogen fertilizer level.

Only seven crosses showed highly significant heterosis under the two nitrogen fertilizer levels. Significant heterosis was also found by Hassan and Abd El-Monieum (1991), Hendawy (1994 b), El-Sayed (1997), Seleem (2001) and Ghanem (2008).

As for spike length, two hybrid combinations showed highly significant useful heterosis under the normal fertilizer level, however, ten hybrid combinations showed highly significant useful heterosis under the stress nitrogen fertilizer level.

The hybrid combination Sakha 93 × Line 6 was found to be the only cross showed highly significant useful heterosis under the two nitrogen fertilizer levels. Heterotic effects for spike length were previously reported by Hedawy (1990), Seleem (1993), Hewezi (1996), El-Sayed (1997) and Seleem (2001). However, highly significant negative heterosis for spike length was reported by Esmail and Kattab (2002) and Ghanem (2008).

Concerning spike weight, eight and thirteen hybrid combinations showed highly significant useful heterosis under the normal and stress nitrogen fertilizer levels respectively. Only three crosses from these superior crosses showed highly significant useful heterosis under the two nitrogen fertilizer levels. Heterosis for main calm ear yield was previously detected by Hendawy (1990), Seleem (1993), Hendawy (1994 a and b), Hewezi (1996), Hendawy (1998), Seleem (2001) and El-Nahas (2005).

As for 1000-grain weight, sixteen and twelve hybrid combinations showed highly significant useful heterosis under the normal and stress nitrogen fertilizer levels, respectively. Only nine of these superior crosses showed highly significant useful heterosis under the two nitrogen fertilizer levels. Similar results were previously reported by Hendawy (1990), Hewezi (1996), El-Sayed (1997), Hendawy (1998), Al-Gazar (1999), Comber (2001) and El-Nahas (2005).

As for number of kernels per spike, the cross Gemmeiza 7 × Giza 168 showed significant useful heterosis under the normal nitrogen fertilizer level. Also, six hybrid combinations showed significant useful heterosis under the stress nitrogen fertilizer level. No useful heterosis was detected under both nitrogen fertilizer levels. Significant heterosis was also found by Hendawy (1990), Hendawy (1994 a), Hewezi (1996), Hendawy (1998), Darwish and Ashoush (2003) and El-Nahas (2005).

Concerning grain yield per plant, four and fourteen crosses showed highly significant useful heterosis under the normal and stress nitrogen fertilizer levels, respectively. Only four crosses, i.e. Gemmeiza 7 × Sakha 93, Sakha 93 × Line 4, Sakha 93 × Line 6 and Sakha 93 × Sids 4 showed highly significant useful heterosis under the two nitrogen fertilizer levels. Heterosis for grain yield per plant was previously found by Hendawy (1990), Seleem (1993), Hendawy (1994 a and b), Hewezi (1996), El-Sayed (1997), Hendawy (1998), Al-Gazar (1999), Esmail and Kattab (2002), Darwish and Ashoush (2003), Bayoumi (2004) and Ghanem (2008).

It could be concluded that the two crosses Gemmeiza 7 × Sakha 93 and Sakha 93 × Line 6 would be of practical interest in hybrid breeding program because of their superiority in grain yield per plant and four traits contributing to yield, also heterosis for grain yield could be attributed to heterosis in number of spikes per plant and spike weight. Hendawy (1998) came to the same conclusion.

3. Griffing's approach:

3.1. Combining ability:

Estimates of both general combining ability (GCA) and specific combining ability (SCA) were computed according to Griffing (1956) method 2 model 1. The combined analysis was calculated over the two nitrogen fertilizer levels to test the interaction of the different genetic components with the two nitrogen fertilizer levels as two different environmental conditions, and that was done whenever the homogeneity of variances was detected. The analysis of variance of each nitrogen level together with the combined data for all traits studied are presented in Table (2).

General combining ability and specific combining ability were found to be highly significant for all characters under examination at the two nitrogen fertilizer levels and their combined data except number of spikelets per spike at both normal and stress nitrogen fertilizer levels and spike length under stress nitrogen level only. This would indicate the importance of both additive and non-additive genetic variance in determining the performance of all traits studied. The question remains would be about the relative importance of both general and specific combining abilities, therefore, GCA / SCA ratio was used to clarify the nature of the genetic variance involved. The

GCA / SCA ratios were found to be greater than unity, indicating that additive and additive × additive types of gene action were of greater importance in the inheritance of all traits. It is therefore could be concluded that the presence of large amount of additive effects, suggests the potentiality for obtaining further yield and yield components improvements. Also, selection procedures based on the accumulation of additive effect would be successful in improving all character studied. However, to maximize selection advance, procedures which are known to be effective in shifting gene frequency when both additive and non-additive variances are involved, would be preferred.

Both general and specific combining abilities were previously detected by El-Hennawy (1991), Hendawy (1994 a), El-Hennawy (1995), Hewezi (1996), Hendawy (1998) and Moussa (2005) for heading date; Seleem (1993), Hendawy (1994 b), El-Hennawy (1995), El-Hosary *et al.* (2000), Comber (2001) and Moussa (2005) for plant height; Seleem (1993), Hewezi (1996), El-Hosary *et al.* (2000), Moussa (2005) and Shahid *et al.* (2005) for number of spikes per plant; Seleem (1993), Hendawy (1994 b), Hewezi (1996) and Comber (2001) for spike length; El-Hennawy (1991) and Hewezi (1996) for number of spikelets per spike; Hewezi (1996) for number of grains per spike; Hamada (2003), El-Sayed and Moshref (2005) for spike weight; El-Hosary *et al.* (2000), Comber (2001) and Moussa (2005) for 1000-grain weight and El-Hennawy (1991), Darwish (1992), Hendawy (1994), Zaid (1995), El-Sayed (1996), Hewezi (1996), El-Sayed (1997) and Hendawy *et al.* (2007) for grain yield per plant.

The interactions of nitrogen fertilization with both types of combining ability were found to be significant for heading date and maturity date. The significant interactions of only general combining ability with nitrogen fertilization were detected for spike length and number of kernels per spike, indicating that the magnitude of all types of gene action was fluctuated from nitrogen level to another for heading date and maturity date. However, additive effects only were fluctuated from nitrogen level to another for spike length and number of kernels per spike. The significant interaction of additive gene effects with nitrogen fertilization for these traits indicated that selection for these characters would not be effective in a single environment and more environment would be required. Hendawy (1998) came to the same conclusion.

3.2. General combining ability effects:

Estimation of the general combining ability effects (g_i) of the individual parental lines for each trait under the two nitrogen fertilizer levels and their combined data are given in Table (5). General combining ability effects computed herein were found to be differed significantly from zero in most cases. High positive values of general combining ability effects would be of interest in most traits in question. On the contrary, for heading and maturity dates and plant height, high negative values would be useful from the breeder's point of view.

Table (5):

Table (5): Cont.

Table (5): Cont.

The two parents Line 9 and Sids 4 showed highly significant negative general combining ability effects for heading date and maturity date under the two nitrogen fertilizer levels and their combined data, revealing that these two parents could be considered as excellent combiners for developing early genotypes.

As for plant height, the wheat cultivar Sakha 93, Line 4 and Line 6 showed highly significant negative general combining ability effects under the two nitrogen fertilizer levels and their combined data proving to be good combiners for shortness. Lodging resistance in wheat has usually been observed to be negatively correlated with plant height.

Concerning number of spikes per plant, the three parental lines, Giza 168, Sakha 93 and Line 7 exhibited highly significant general combining ability effects under the two nitrogen fertilizer levels and their combined data proving to be excellent combiners in this concern.

As for number of spikelets per spike, the five wheat varieties and lines, Gemmeiza 7, Line 4, Line 5, Line 6 and Sids 4 showed significant general combining ability effects under the two nitrogen levels and their combined data proving to be good general combiners for this trait.

Concerning spike length, Line 4, Line 5 and Sids 4 proved to be excellent combiners by showing highly significant estimates of general combining ability effects under the two nitrogen fertilizer levels and their combined data.

As for spike weight, the three parental variety and lines Line 5, Line 6 and Sids 4 showed highly significant general combining ability effect under the two nitrogen fertilizer levels and their combined data proving to be good combiners in this respect.

Concerning 1000-grain weight, Line 5, Line 9 and the wheat cultivar Sids 4 showed highly significant estimates of general combining ability effects under the two nitrogen fertilizer levels and their combined data proving to be good general combiners for 1000-grain weight.

The two wheat Lines 5 and 6 and the wheat cultivar Sids 4 showed highly significant general combining ability effects under the two nitrogen levels and their combined data proving to be good combiners for number of kernels per spike.

As for grain yield per plant, the wheat Line 5 exhibited highly significant general combining ability effects under the two nitrogen fertilizer levels and their combined data proving to be good combiner for grain yield per plant, however, Line 7 showed highly significant general combining ability effect under the normal nitrogen fertilizer level and combined data.

It is of interest to note that the parental variety Line 5 which possessed high general combining ability effects for grain yield per plant was found to be also good combiner for most of the attributes contributing to grain yield i.e. number of spikelets per spike, spike length, spike weight, 1000-grain weight, and number of kernels per spike. Also, Line 6 proved to be good combiner for plant height, number of spikelets per spike, spike weight and number of kernels per spike. Also, the wheat cultivar Sids 4 proved to be good combiner for seven characters i.e. heading date, maturity date, number of spikelets per spike, spike length, spike weight, 1000-grain weight and number of kernels per spike.

3.3. Specific combining ability effects:

Estimates of the specific combining ability effects (S_i) for the forty five hybrid combinations under the two nitrogen fertilizer levels and their combined data are presented in Table (6).

As for heading date, five and two hybrid combinations under the normal and stress nitrogen fertilizer levels respectively showed significant negative specific combining ability effects.

However, the two crosses Gemmeiza 7 × Sakha 93 and Sakha 93 × Line 7 showed significant negative specific combining ability effects under the two nitrogen fertilizer levels and their combined data. Also, these three parental varieties were detected to be among the poorest combiners for heading date. concerning maturity date, two and seven crosses showed significant negative specific combining ability effects under the normal and stress nitrogen fertilizer levels, respectively. As for plant height, only three hybrid combinations showed significant negative specific combining ability effects under the stress nitrogen fertilizer level.

As for number of spikes per plant, the crosses Gemmeiza 7 × Sakha 93 and Sakha 93 × Line 4 showed significant specific combining ability effects under the normal nitrogen fertilizer level only. The three crosses Gemmeiza 7 × Line 4, Gemmeiza 7 × Line 6 and Line 6 × Line 7 showed significant specific combining ability effects under the stress nitrogen fertilizer level only.

Concerning number of spikelets per spike, the two hybrid combinations Gemmeiza 7 × Giza 168 and Line 4 × Line 9 showed significant specific combining ability effects under the normal nitrogen fertilizer level, however only the cross Sakha 93 × Giza 168 showed highly significant estimates of specific combining ability effects under the stress nitrogen fertilizer level. It is of interest to mention that the wheat variety Gemmeiza 7 and Line 4 proved to be good combiners for number of spikelets per spike, however the other two parental varieties Giza 168 and Line 9 were found to be among the poorest combiners for spikelets per spike.

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As for spike length, the cross Gemmeiza 7 × Giza 168 was found to be the only cross showed significant specific combining ability effects under the normal nitrogen fertilizer level. Also, three crosses Sakha 93 × Line 8, Line 4 × Line 6 and Line 6 × Sids 4 showed significant specific combining ability effects under the stress nitrogen fertilizer level. It is of interest to note that Sids 4 and Line 4 were found to be good combiners for spike length.

Concerning spike weight, three hybrid combinations showed significant specific combining ability effects under the normal fertilizer level, also under the stress nitrogen fertilizer level there were three different crosses showed significant specific combining ability effects. The hybrid combination Line 4 × Sids 4 showed highly significant specific combining ability effects under the two nitrogen fertilizer levels and their combined data. It is of interest to note that the wheat variety Sids 4 was found to be among the excellent combiner for spike weight, however, Line 4 proved to be poor combiner for spike weight.

As for 1000-grain weight, six crosses showed significant specific combining ability effects under the normal fertilizer level, also different six hybrid combinations showed significant specific combining ability effects under the stress nitrogen fertilizer level. However, two crosses Line 4 × Line 7 and Line 4 × Sids 4 exhibited highly significant specific combining ability effects under both normal and stress nitrogen fertilizer levels. The wheat variety Sids 4 proved to be good combiner for 1000-grain weight.

As for number of kernels per spike, the cross Sakha 93 × Line 4 was found to be the only cross showed significant specific combining ability effects under the normal fertilizer level. The two crosses Gemmeiza 7 × Line 7 and Line 4 × Sids 4 exhibited significant specific combining ability effects under stress nitrogen fertilizer level and Sids 4 was found to be among the good combiners for kernels per spike, however, the rest of the wheat varieties which involved in these three crosses were found to be among the poor general combinrs.

As for grain yield per plant, the wheat cross sakha 93xline 4 showed highly significant specific combing ability effects under the normal nitrogen fertilizer level .the three hybrid combination gemeiza 7 x line 4 ,gemmeiza 7x line6 and line 6 x line 7exhibited significant specific combining ability effects under the stress nitrogen fertilizer level. It is of interest to mention that the parental variety line 7 was found to be the only variety proved to be good combiner for grain yield per plant among the five wheat varities involved in these four crosses .

The results obtained here concerning general and specific combining ability effects could indicate that the excellent hybrid combinations were obtain from the three possible combinations between the parents of high and

low general combining ability effects, i.e. high × high, high × low and low × low. Consequently, it could be concluded that general combining ability effects of the parental lines were generally unrelated to the specific combining ability effects of their respective crosses. Similar conclusion was also drawn by Hendawy (1989), Hendawy (1990), Seleem (1993), Hendawy (1994 a), Hewezi (1996) and El-Sayed (1997).

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تقدير التباين الوراثي في بعض الصفات الكمية فى قمح الخبز

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الملخص العربي

أجرى هذا البحث في مزرعة محطة البحوث الزراعية بالجميزة خلال العامين ٢٠٠٩/٢٠٠٨ و ٢٠١٠/٢٠٠٩ وقد استخدم لتحقيق هذه الدراسة عشرة أصناف وسلالات من قمح الخبز وهى : جميزة ٧ ، سخا ٩٣ ، جيزة ١٦٨ ، سلالة ٤ ، سلالة ٥ ، سلالة ٦ ، سلالة ٧ ، سلالة ٨ ، سلالة ٩ و سدس ٤ . حيث أجرى التهجين بينهم فى الموسم الزراعي ٢٠٠٩/٢٠٠٨ وفى موسم ٢٠١٠/٢٠٠٩ تم تقييم هذه الآباء العشرة وجميع الهُجن الناتجة منها وذلك تحت مستويين من مستويات التسميد الآزوتي ٣٠ كجم آزوت للفدان و ٧٠ كجم آزوت للفدان وذلك في تصميم قطاعات كاملة العشوائية في ثلاثة مكررات وقد تم تحليل البيانات باستخدام طريقة تحليل الهُجن التبادلية (جريفنج ١٩٥٦)، الطريقة الثانية الموديل الأول.

ويُمكن تلخيص النتائج المتحصل عليها في ما يلي:

كان التباين الراجع إلى التسميد الآزوتى معنوياً لجميع الصفات المدروسة عدا ارتفاع النبات، عدد السُنيبلات بالسنبلة، طول السنبلة، وزن ١٠٠٠ حبة وكانت القيم الناتجة من مستوى التسميد الأول ٧٠ كجم آزوت للفدان أعلى من مثيلتها في مستوى التسميد الثاني ٣٠ كجم آزوت للفدان وذلك في معظم الصفات . كانت قيم التباين الوراثي الراجع إلى التراكيب الوراثية والآباء والهجن عالية المعنوية وذلك في كل الصفات المدروسة تحت مستويي التسميد الآزوتي في التحليل المشترك. كانت قيم التباين الراجع إلى متوسط قوة الهجين عالية المعنوية وذلك لصفات ميعاد التزهير، طول النبات ووزن ١٠٠٠ حبة وذلك تحت مستويي التسميد الآزوتى والتحليل المشترك. كانت قيم التفاعل بين التراكيب الوراثية مع التسميد الآزوتى معنوية وذلك لصفات ميعاد التزهير

وميعاد النضج .كانت قيم التفاعل بين التسميد الآزوتي مع الآباء معنوية وذلك لصفات ميعاد التزهير، ميعاد النضج ، عدد السنابل في النبات، وزن السنبلة وعدد الحبوب بالسنبلة. كانت قيم التفاعل بين متوسط قوة الهجين مع مستويي التسميد الآزوتى معنوية لصفات طول النبات، عدد السنابل في النبات، طول السنبلة ومحصول النبات من الحبوب. أظهر الهجينين جميزة ٧ × سخا ٩٣ و سخا ٩٣ × سلالة ٦ أهميتها العملية في برامج إنتاج الهُجن وذلك بسبب تفوقهما في محصول الحبوب بالنبات وأربعة صفات من مكونات المحصول كما أن قوة الهجين في صفة محصول الحبوب ترجع إلى قوة الهجين في عدد السنابل في النبات ووزن السنبلة.

كان التباين الراجع لكلٍ من القدرتين العامة والخاصة على التآلف عالي المعنوية لجميع الصفات تحت الدراسة في مستويي التسميد الآزوتي والتحليل المشترك فيما عدا صفة عدد السنيبلات في السنبلة تحت مستويي التسميد الآزوتى، وطول السنبلة تحت مستوى التسميد النيتروجيني المنخفض.

أظهرت النسبة بين تباين القدرتين العامة والخاصة على التآلف أن التباين الوراثي المُضيف وأيضاً التفاعل بين الفعل الجيني المضيف × المضيف هما الأكثر أهمية في وراثة جميع الصفات المدروسة.

أظهرت التفاعلات بين التسميد الآزوتي وكل من القدرتين العامة والخاصة على التآلف تأثيرات معنوية وذلك لصفات ميعاد التزهير وميعاد النضج . أظهرت السلالة خمسة قدرة تآلفية عالية لصفة المحصول وكذلك أثبتت أنها تملك قدرة تآلفية عالية لمعظم صفات مكونات المحصول. أظهر الهجين سخا ٩٣ × سلالة ٤ قدرة خاصة على التآلف عالية المعنوية وذلك لصفة محصول النبات من الحبوب تحت مستوى التسميد العادي.

Estimation of genotypic variability of some quantitative characters...........
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Table (2): Mean square estimates of ordinary analysis and combining ability analysis for all traits studied under the two different fertilization levels.

S.O.V.	d.f.		Heading date			Maturity date			Plant height "cm"		
	S	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Fertilization		1			97.64 *			1116.51 *			133.64
Rep/F	2	4	9.41 **	3.62	6.52 **	0.58	21.99 **	11.29 **	448.22 **	167.33 **	307.78 **
Genotypes	54	54	40.04 **	41.45 **	79.16 **	34.49 **	42.45 **	71.36 **	236.69 **	186.73 **	370.60 **
Parent	9	9	101.44 **	95.42 **	193.77 **	52.84 **	94.18 **	137.83 **	501.23 **	481.22 **	969.71 **
Cross	44	44	27.53 **	29.90 **	55.23 **	31.50 **	32.75 **	59.29 **	154.08 **	126.75 **	225.92 **
Par.vs.cr.	1	1	37.88 **	64.06 **	100.23 *	0.84	3.82	4.12	1490.79 **	175.37 **	1344.40 *
G/F		54			2.34 *			5.58 **			52.83
par./F		9			3.09 *			9.18 **			12.74
Cr./F		44			2.20 *			4.95 **			54.91
Par.vs.cr. F		1			1.71			0.54			321.77 *
Error	108	216	0.89	2.06	1.47	2.42	1.72	2.07	75.03	11.87	43.45
GCA	9	9	70.18 **	70.78 **	140.00 **	61.13 **	75.73 **	133.60 **	248.21 **	327.89 **	559.20 **
SCA	45	45	1.98 **	2.42 **	3.66 **	1.57 **	1.83 **	1.82 **	45.03 **	9.12 **	36.40 **
GCA × F		9			0.97 *			3.26 **			16.90
SCA × F		45			0.74 *			1.58 **			17.75
Error	108	216	0.30	0.69	0.49	0.81	0.57	0.69	25.01	3.96	14.48
GCA/SCA			35.41	29.21	38.22	38.93	41.30	73.21	5.51	35.97	15.36
GCA × F/GCA					0.01			0.02			0.03
SCA × F/SCA					0.20			0.87			0.49

Comb. = combined data.

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

Table (2): Cont.

S.O.V.	d.f.		No. of spikes per plant			No. of spikelets per spike			Spike length "cm"		
	S	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Fertilization		1			332.81*			2.41			5.97
Rep/F	2	4	30.26*	43.32**	36.79**	22.80**	4.60	13.70**	17.15**	9.85	13.50**
Genotypes	54	54	31.73**	15.86**	41.99**	8.75**	11.70**	17.68**	12.86**	20.48**	30.76**
Parent	9	9	96.54**	29.97**	111.59**	15.07**	12.02**	26.62**	32.75**	39.18**	71.23**
Cross	44	44	16.96**	13.32**	27.80**	7.44**	11.71**	15.84**	8.65**	17.10**	23.05**
Par.vs.cr.	1	1	98.73**	0.95	40.17*	9.57**	8.51	18.07*	18.83**	0.82	5.91
G/F		54			5.61			2.78			2.58
par./F		9			14.92**			0.47			0.71
Cr./F		44			2.48			3.31			2.70
Par.vs.cr. F		1			59.50*			0.02			13.74*
Error	108	216	6.56	2.99	4.77	1.26	3.57	2.42	1.06	2.80	1.93
GCA	9	9	44.91**	24.03**	66.63**	14.59	14.91	28.83**	22.29**	35.93**	56.44**
SCA	45	45	3.71*	1.54*	3.47**	0.58	1.70	1.31*	0.68**	1.01	1.02*
GCA × F		9			2.32			0.67			1.78**
SCA × F		45			1.78			0.98			0.67
Error	108	216	2.19	1.00	1.59	0.42	1.19	0.81	0.35	0.93	0.64
GCA/SCA			12.10	15.62	19.20	25.02	8.77	22.04	32.64	35.69	55.57
GCA × F/GCA					0.03			0.02			0.03
SCA × F/SCA					0.51			0.75			0.66

Comb. = combined data.

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

Table (2): Cont.

S.O.V.	d.f.		Spike weight "gm"			1000 grain weight "gm"			No. of kernels per spike			Grain yield-plant "gm"		
	S	Comb.	Normal	Stress	Comb	Normal	Stress	Comb	Normal	Stress	Comb.	Normal	Stress	Comb.
Fertilization		1			3.94*			25.80			739.20*			4424.74**
Rep/F	2	4	13.12**	1.20	7.16**	29.33	10.19	19.76	5182.36**	421.20	2801.78**	770.16**	105.66	437.91**
Genotypes	54	54	3.13**	2.29**	4.69**	114.87**	113.48**	207.70**	656.75**	520.71**	933.04**	211.67**	118.99**	260.56**
Parent	9	9	7.41**	4.73**	10.67**	178.23**	226.02**	394.30**	1760.31**	1393.04**	2554.56**	622.11**	228.97**	747.54**
Cross	44	44	2.30**	1.82**	3.58**	91.83**	86.19**	155.15**	409.62**	353.60	599.79**	115.83	96.23**	164.09**
Par.vs.cr.	1	1	1.15	1.31	0.00	558.45**	301.60**	840.42*	1598.37**	23.02	1002.54*	734.42**	130.83	122.65
G/F		54			0.73			20.65			244.42			70.10
par./F		9			1.47*			9.96			598.79**			103.55
Cr./F		44			0.54			22.86			163.43			47.97
Par.vs.cr.F		1			2.46			19.62			618.86			742.60*
Error	108	216	0.74	0.71	0.73	21.95	11.82	16.89	199.58	157.26	178.42	87.42	46.87	67.14
GCA	9	9	3.94**	3.27**	6.96**	134.70**	160.65**	289.78**	724.87**	632.43**	1223.71**	205.83**	82.61**	250.72**
SCA	45	45	0.46**	0.26	0.49**	19.01**	13.26**	25.12**	117.73**	81.80*	128.47**	43.50*	31.07**	54.08**
GCA × F		9			0.25			5.56			133.60*			37.72
SCA × F		45			0.24			7.15			71.05			20.49
Error	108	216	0.25	0.24	0.24	7.32	3.94	5.63	66.53	52.42	59.47	29.14	15.62	22.38
GCA/SCA			8.50	12.43	14.33	7.09	12.11	11.54	6.16	7.73	9.52	4.73	2.66	4.64
GCA × F/GCA					0.04			0.02			0.11			0.15
SCA × F/SCA					0.50			0.28			0.55			0.38

Comb. = combined data.

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

Table (3): Genotype mean performance under the two nitrogen fertilizer levels.

Genotypes	Heading date			Maturity date			Plant height (cm)			No. of spikes / plant		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Gemmeiza 7	91.767	92.100	91.933	150.400	149.733	150.067	120.167	119.233	119.700	12.067	9.233	10.650
Gemmeiza 7 × Sakha 93	87.933	87.000	87.467	150.300	147.767	149.033	108.333	111.300	109.817	16.767	10.433	13.600
Gemmeiza 7 × Giza 168	90.733	89.833	90.283	151.133	147.567	149.350	115.600	113.100	114.350	11.467	11.033	11.250
Gemmeiza 7 × Line 4	91.900	91.267	91.583	150.967	151.300	151.133	111.567	108.900	110.233	10.100	9.800	9.950
Gemmeiza 7 × Line 5	90.700	90.000	90.350	150.900	148.100	149.500	119.400	121.033	120.217	10.967	7.967	9.467
Gemmeiza 7 × Line 6	90.133	89.733	89.933	150.200	145.667	147.933	105.533	106.467	106.000	9.200	9.933	9.567
Gemmeiza 7 × Line 7	90.300	90.967	90.633	149.700	146.800	148.250	119.667	116.167	117.917	12.633	9.267	10.950
Gemmeiza 7 × Line 8	90.933	91.500	91.217	151.300	149.967	150.633	116.767	116.000	116.383	11.367	9.200	10.283
Gemmeiza 7 × Line 9	85.967	84.867	85.417	150.533	142.633	146.583	114.367	114.300	114.333	10.867	9.733	10.300
Gemmeiza 7 × Sids 4	86.633	87.100	86.867	145.367	142.500	143.933	121.433	116.067	118.750	8.133	7.967	8.050
Sakha 93	87.000	85.200	86.100	149.433	145.167	147.300	98.133	101.167	99.650	13.933	10.167	12.050
Sakha 93 × Giza 168	88.400	87.833	88.117	150.767	147.667	149.217	103.900	102.267	103.083	13.167	13.067	13.117
Sakha 93 × Line 4	92.133	89.033	90.583	151.133	150.500	150.817	103.867	101.367	102.617	13.833	9.800	11.817
Sakha 93 × Line 5	88.467	89.567	89.017	151.000	145.833	148.417	109.067	108.400	108.733	10.933	10.300	10.617
Sakha 93 × Line 6	87.867	87.467	87.667	151.133	144.633	147.883	98.233	95.967	97.100	12.100	9.300	10.700
Sakha 93 × Line 7	87.433	85.833	86.633	148.300	143.933	146.117	103.167	108.267	105.717	13.900	12.767	13.333
Sakha 93 × Line 8	91.933	89.567	90.750	151.333	147.333	149.333	107.233	103.367	105.300	10.567	9.367	9.967
Sakha 93 × Line 9	84.933	83.000	83.967	144.467	143.833	144.150	102.600	106.567	104.583	11.867	10.333	11.100
Sakha 93 × Sids 4	84.700	82.867	83.783	144.300	141.200	142.750	110.200	106.133	108.167	9.900	9.133	9.517
Giza 168	87.800	87.033	87.417	149.033	149.233	149.133	99.300	105.667	102.483	20.700	13.733	17.217
Giza 168 × Line 4	92.000	91.167	91.583	152.567	147.400	149.983	110.500	107.800	109.150	10.100	7.967	9.033
Giza 168 × Line 5	89.200	87.200	88.200	150.733	144.500	147.617	112.400	114.233	113.317	10.967	9.000	9.983
Giza 168 × Line 6	89.900	88.500	89.200	151.533	148.000	149.767	101.467	95.900	98.683	10.300	8.067	9.183
Giza 168 × Line 7	89.567	88.033	88.800	150.033	145.600	147.817	110.933	109.900	110.417	14.867	10.733	12.800
Giza 168 × Line 8	89.333	88.200	88.767	150.167	145.700	147.933	112.700	109.433	111.067	10.333	10.067	10.200
Giza 168 × Line 9	84.400	83.767	84.083	145.133	142.367	143.750	104.000	104.000	104.000	8.233	8.067	8.150
Giza 168 × Sids 4	83.733	82.433	83.083	142.233	140.967	141.600	111.133	106.300	108.717	9.433	8.733	9.083

Table (3): Cont.

Genotypes	Heading date			Maturity date			Plant height (cm)			No. of spikes / plant		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Line 4	91.967	90.167	91.067	151.767	151.200	151.483	85.400	87.967	86.683	5.633	5.300	5.467
Line 4 × Line 5	91.433	91.200	91.317	149.300	147.433	148.367	106.433	103.900	105.167	7.633	6.100	6.867
Line 4 × Line 6	90.667	91.167	90.917	151.800	148.767	150.283	98.700	87.167	92.933	7.100	4.433	5.767
Line 4 × Line 7	91.500	91.100	91.300	150.933	147.367	149.150	109.300	108.733	109.017	11.367	9.633	10.500
Line 4 × Line 8	93.633	92.600	93.117	151.967	149.133	150.550	108.967	111.200	110.083	10.033	8.567	9.300
Line 4 × Line 9	88.267	85.800	87.033	145.167	143.233	144.200	104.600	105.567	105.083	8.400	7.567	7.983
Line 4 × Sids 4	84.167	83.767	83.967	146.233	141.567	143.900	105.467	104.100	104.783	5.300	4.033	4.667
Line 5	89.000	88.667	88.833	149.467	144.533	147.000	114.333	117.367	115.850	11.667	8.933	10.300
Line 5 × Line 6	92.133	90.200	91.167	148.533	147.700	148.117	104.267	101.533	102.900	8.067	5.633	6.850
Line 5 × Line 7	90.567	89.500	90.033	149.000	144.300	146.650	117.067	115.567	116.317	12.233	11.233	11.733
Line 5 × Line 8	91.600	89.967	90.783	149.867	142.367	146.117	114.300	114.133	114.217	11.267	9.133	10.200
Line 5 × Line 9	88.333	83.833	86.083	143.500	140.333	141.917	112.367	110.833	111.600	9.867	7.033	8.450
Line 5 × Sids 4	83.800	81.967	82.883	141.833	139.733	140.783	109.300	110.633	109.967	7.133	4.867	6.000
Line 6	89.633	88.900	89.267	150.700	144.767	147.733	77.200	79.700	78.450	6.933	4.067	5.500
Line 6 × Line 7	89.667	88.933	89.300	149.967	142.600	146.283	137.600	100.200	118.900	12.033	11.133	11.583
Line 6 × Line 8	89.300	91.033	90.167	151.100	146.233	148.667	104.000	102.767	103.383	8.033	6.933	7.483
Line 6 × Line 9	86.067	85.100	85.583	144.667	140.600	142.633	102.300	99.367	100.833	9.233	7.167	8.200
Line 6 × Sids 4	83.833	82.600	83.217	144.467	140.433	142.450	97.733	98.733	98.233	4.833	4.300	4.567
Line 7	90.133	87.567	88.850	148.400	143.033	145.717	108.800	109.800	109.300	20.133	9.367	14.750
Line 7 × Line 8	94.433	91.400	92.917	152.300	148.000	150.150	111.400	107.733	109.567	11.533	11.267	11.400
Line 7 × Line 9	86.533	83.567	85.050	143.500	141.000	142.250	110.667	110.533	110.600	13.633	11.500	12.567
Line 7 × Sids 4	84.867	83.733	84.300	143.967	140.633	142.300	114.267	111.533	112.900	10.700	8.600	9.650
Line 8	91.833	87.200	89.517	151.833	146.100	148.967	108.267	115.733	112.000	14.067	10.567	12.317
Line 8 × Line 9	85.867	85.000	85.433	146.067	141.700	143.883	113.200	111.567	112.383	9.600	8.733	9.167
Line 8 × Sids 4	84.467	83.833	84.150	146.367	141.100	143.733	116.333	114.900	115.617	8.800	7.500	8.150
Line 9	78.600	78.400	78.500	141.767	136.067	138.917	106.800	105.433	106.117	14.867	10.400	12.633
Line 9 × Sids 4	83.133	84.567	83.850	142.767	138.700	140.733	108.367	107.600	107.983	8.200	7.233	7.717
Sids 4	75.067	73.633	74.350	139.467	133.933	136.700	101.600	107.100	104.350	3.833	3.967	3.900
LSD 5%	1.509	2.296	1.374	2.491	2.096	1.628	13.862	5.514	7.459	4.098	2.767	2.472

Table (3): Cont.

Genotypes	No. of spikelets / spike			Spike length (cm)			Spike weight (gm)			1000 grain weight (gm)		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Gemmeiza 7	25.300	25.133	25.217	14.300	13.233	13.767	3.230	3.208	3.219	52.822	54.636	53.729
Gemmeiza 7 × Sakha 93	23.633	25.067	24.350	13.100	13.833	13.467	3.490	3.864	3.677	42.266	56.230	49.248
Gemmeiza 7 × Giza 168	25.600	24.733	25.167	14.833	13.100	13.967	3.951	3.789	3.870	55.450	53.161	54.306
Gemmeiza 7 × Line 4	25.667	27.600	26.633	16.267	16.767	16.517	3.865	3.151	3.508	50.135	53.727	51.931
Gemmeiza 7 × Line 5	26.233	27.267	26.750	14.667	16.900	15.783	5.635	4.178	4.907	59.819	61.779	60.799
Gemmeiza 7 × Line 6	25.767	26.567	26.167	14.400	14.533	14.467	4.472	3.999	4.235	54.784	55.537	55.161
Gemmeiza 7 × Line 7	24.667	24.400	24.533	13.433	13.567	13.500	3.788	3.913	3.851	54.571	50.356	52.463
Gemmeiza 7 × Line 8	22.733	24.533	23.633	11.733	13.033	12.383	3.988	3.254	3.621	57.067	54.956	56.011
Gemmeiza 7 × Line 9	23.067	22.867	22.967	11.900	11.167	11.533	3.543	3.615	3.579	57.281	58.640	57.961
Gemmeiza 7 × Sids 4	25.800	26.733	26.267	14.867	15.300	15.083	4.829	4.357	4.593	62.529	57.930	60.230
Sakha 93	22.400	22.800	22.600	12.467	11.667	12.067	2.467	2.263	2.365	43.814	42.217	43.015
Sakha 93 × Giza 168	23.933	31.267	27.600	12.200	12.633	12.417	3.207	3.208	3.208	45.838	47.066	46.452
Sakha 93 × Line 4	26.033	25.000	25.517	16.167	15.100	15.633	4.771	3.056	3.913	52.479	48.941	50.710
Sakha 93 × Line 5	25.000	25.033	25.017	15.067	14.633	14.850	5.291	5.200	5.246	60.735	56.562	58.648
Sakha 93 × Line 6	25.000	24.733	24.867	13.133	13.100	13.117	3.683	4.016	3.850	56.149	56.106	56.127
Sakha 93 × Line 7	23.133	23.867	23.500	11.733	11.633	11.683	2.994	3.454	3.224	48.557	48.540	48.549
Sakha 93 × Line 8	22.700	22.200	22.450	11.633	14.733	13.183	3.814	3.222	3.518	56.858	56.382	56.620
Sakha 93 × Line 9	22.667	22.767	22.717	11.033	11.300	11.167	3.109	3.573	3.341	54.516	53.949	54.233
Sakha 93 × Sids 4	24.733	23.400	24.067	14.200	14.000	14.100	4.754	4.015	4.385	57.996	57.538	57.767
Giza 168	22.800	23.800	23.300	13.433	12.800	13.117	2.750	3.413	3.082	43.219	42.520	42.870
Giza 168 × Line 4	25.967	25.333	25.650	15.633	15.767	15.700	3.434	3.374	3.404	55.917	52.087	54.002
Giza 168 × Line 5	24.800	25.600	25.200	13.700	14.233	13.967	4.738	4.127	4.433	55.319	55.653	55.486
Giza 168 × Line 6	25.067	25.133	25.100	13.067	13.067	13.067	3.496	3.665	3.581	48.092	47.146	47.619
Giza 168 × Line 7	23.400	23.733	23.567	11.733	11.733	11.733	3.564	3.384	3.474	48.702	48.040	48.371
Giza 168 × Line 8	23.333	22.067	22.700	11.967	10.867	11.417	3.594	3.187	3.390	52.720	51.598	52.159
Giza 168 × Line 9	20.200	21.600	20.900	10.733	10.567	10.650	3.117	3.092	3.105	59.208	53.352	56.280
Giza 168 × Sids 4	24.467	23.800	24.133	12.967	12.600	12.783	4.090	3.994	4.042	57.749	58.983	58.366

Table (3): Cont.

Genotypes	No. of spikelets / spike			Spike length (cm)			Spike weight (gm)			1000 grain weight (gm)		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Line 4	26.767	26.200	26.483	20.267	21.167	20.717	5.462	2.739	4.101	48.056	46.497	47.277
Line 4 × Line 5	26.667	26.933	26.800	16.500	20.467	18.483	4.360	4.618	4.489	59.843	58.854	59.349
Line 4 × Line 6	26.067	27.100	26.583	15.633	19.433	17.533	3.550	4.355	3.952	52.068	45.927	48.998
Line 4 × Line 7	25.600	25.533	25.567	14.600	15.533	15.067	3.448	3.187	3.317	59.692	56.123	57.908
Line 4 × Line 8	24.400	25.733	25.067	12.933	17.800	15.367	3.084	3.747	3.416	54.050	51.751	52.900
Line 4 × Line 9	25.467	23.400	24.433	14.300	14.667	14.483	2.893	4.089	3.491	52.078	57.656	54.867
Line 4 × Sids 4	27.233	27.167	27.200	16.700	17.833	17.267	6.609	5.944	6.277	70.012	70.246	70.129
Line 5	27.367	26.867	27.117	18.500	18.100	18.300	6.172	4.824	5.498	62.985	60.884	61.934
Line 5 × Line 6	26.167	26.167	26.167	14.433	16.167	15.300	4.965	5.344	5.155	60.685	58.972	59.829
Line 5 × Line 7	24.133	25.200	24.667	13.667	13.533	13.600	4.297	4.527	4.412	55.240	56.182	55.711
Line 5 × Line 8	24.967	24.267	24.617	13.233	13.567	13.400	4.275	3.468	3.871	56.253	55.742	55.998
Line 5 × Line 9	24.600	25.000	24.800	14.033	14.267	14.150	4.564	4.146	4.355	63.491	58.732	61.112
Line 5 × Sids 4	25.600	25.200	25.400	15.333	15.700	15.517	5.480	5.652	5.566	64.400	65.786	65.093
Line 6	23.933	24.133	24.033	12.600	12.267	12.433	5.217	5.652	5.435	49.623	47.547	48.585
Line 6 × Line 7	25.467	23.667	24.567	12.500	12.967	12.733	4.484	4.011	4.248	55.799	52.378	54.089
Line 6 × Line 8	24.100	25.067	24.583	12.700	13.400	13.050	5.074	3.893	4.484	64.096	57.770	60.933
Line 6 × Line 9	23.933	22.200	23.067	11.567	10.833	11.200	4.971	4.591	4.781	66.040	60.982	63.511
Line 6 × Sids 4	26.533	25.867	26.200	15.600	16.667	16.133	5.830	6.498	6.164	61.756	67.411	64.584
Line 7	22.833	22.800	22.817	12.367	11.033	11.700	3.264	2.645	2.954	43.532	45.107	44.320
Line 7 × Line 8	21.667	23.000	22.333	11.133	11.300	11.217	3.645	3.198	3.422	55.298	52.250	53.774
Line 7 × Line 9	21.600	21.933	21.767	10.900	11.133	11.017	3.180	3.190	3.185	57.347	51.595	54.471
Line 7 × Sids 4	25.200	24.467	24.833	13.367	12.200	12.783	3.362	3.842	3.602	52.391	56.231	54.311
Line 8	21.667	21.733	21.700	10.800	10.800	10.800	3.620	3.307	3.464	52.572	56.544	54.558
Line 8 × Line 9	21.267	20.600	20.933	10.833	10.500	10.667	3.411	3.538	3.474	62.006	60.643	61.325
Line 8 × Sids 4	24.667	22.800	23.733	13.133	11.967	12.550	4.509	3.803	4.156	64.344	59.865	62.104
Line 9	20.400	20.933	20.667	10.867	9.967	10.417	3.761	3.334	3.548	59.909	65.024	62.467
Line 9 × Sids 4	22.267	22.000	22.133	11.267	11.200	11.233	2.697	3.410	3.054	59.359	66.115	62.737
Sids 4	25.000	26.067	25.533	17.500	16.100	16.800	7.091	5.799	6.445	62.655	62.965	62.810
LSD 5%	1.799	3.023	1.759	1.651	2.680	1.574	1.381	1.351	0.966	7.498	5.502	4.650

Table (3): Cont.

Genotypes	No. of kernels / spike			Grain yield-plant		
	Normal	Stress	Comb.	Normal	Stress	Comb.
Gemmeiza 7	61.133	59.733	60.433	31.220	22.698	26.959
Gemmeiza 7 × Sakha 93	69.167	68.700	68.933	43.399	31.925	37.662
Gemmeiza 7 × Giza 168	73.067	70.967	72.017	34.118	32.408	33.263
Gemmeiza 7 × Line 4	75.067	59.367	67.217	30.912	42.111	36.512
Gemmeiza 7 × Line 5	95.567	67.233	81.400	38.727	33.722	36.225
Gemmeiza 7 × Line 6	82.167	71.333	76.750	32.289	42.852	37.571
Gemmeiza 7 × Line 7	74.767	77.667	76.217	38.936	26.116	32.526
Gemmeiza 7 × Line 8	69.667	58.900	64.283	35.020	23.198	29.109
Gemmeiza 7 × Line 9	61.267	61.433	61.350	28.048	29.682	28.865
Gemmeiza 7 × Sids 4	77.100	75.200	76.150	31.930	28.401	30.166
Sakha 93	55.567	53.367	54.467	26.925	23.288	25.106
Sakha 93 × Giza 168	70.000	69.300	69.650	36.502	31.718	34.110
Sakha 93 × Line 4	92.233	65.800	79.017	45.234	32.178	38.706
Sakha 93 × Line 5	85.967	72.300	79.133	44.617	37.345	40.981
Sakha 93 × Line 6	64.833	73.500	69.167	39.425	33.357	36.391
Sakha 93 × Line 7	60.833	69.700	65.267	33.246	31.399	32.323
Sakha 93 × Line 8	67.567	58.167	62.867	32.929	24.596	28.763
Sakha 93 × Line 9	57.067	66.133	61.600	32.049	29.303	30.676
Sakha 93 × Sids 4	81.800	68.500	75.150	32.728	30.597	31.663
Giza 168	63.833	80.400	72.117	58.388	36.844	47.616
Giza 168 × Line 4	61.900	65.933	63.917	25.399	21.601	23.500
Giza 168 × Line 5	86.200	78.667	82.433	37.022	29.891	33.457
Giza 168 × Line 6	61.467	76.633	69.050	33.326	26.173	29.750
Giza 168 × Line 7	74.100	72.633	73.367	36.643	27.725	32.184
Giza 168 × Line 8	67.733	61.833	64.783	34.936	26.807	30.871
Giza 168 × Line 9	53.600	57.867	55.733	25.694	22.864	24.279
Giza 168 × Sids 4	71.000	67.600	69.300	31.910	30.393	31.152

Table (3): Cont.

Genotypes	No. of kernels / spike			Grain yield-plant		
	Normal	Stress	Comb.	Normal	Stress	Comb.
Line 4	112.367	59.100	85.733	26.307	18.848	22.578
Line 4 × Line 5	74.233	64.133	69.183	26.569	26.737	26.653
Line 4 × Line 6	72.000	89.600	80.800	23.620	16.135	19.877
Line 4 × Line 7	61.933	56.400	59.167	36.963	29.781	33.372
Line 4 × Line 8	58.733	70.533	64.633	28.043	23.037	25.540
Line 4 × Line 9	56.367	67.333	61.850	27.797	23.545	25.671
Line 4 × Sids 4	93.933	103.900	98.917	25.255	20.479	22.867
Line 5	94.900	80.000	87.450	60.832	44.241	52.536
Line 5 × Line 6	81.867	90.433	86.150	42.635	27.866	35.251
Line 5 × Line 7	77.300	86.233	81.767	46.792	37.297	42.044
Line 5 × Line 8	76.033	62.333	69.183	37.085	30.534	33.810
Line 5 × Line 9	70.967	70.500	70.733	40.555	26.965	33.760
Line 5 × Sids 4	84.400	85.833	85.117	33.651	23.465	28.558
Line 6	103.867	117.933	110.900	34.473	17.174	25.823
Line 6 × Line 7	80.233	71.533	75.883	39.400	36.282	37.841
Line 6 × Line 8	84.233	62.367	73.300	37.854	31.071	34.462
Line 6 × Line 9	75.133	77.733	76.433	42.771	27.688	35.230
Line 6 × Sids 4	92.233	95.700	93.967	28.291	25.045	26.668
Line 7	75.167	59.000	67.083	51.604	24.504	38.054
Line 7 × Line 8	65.900	62.833	64.367	44.861	25.975	35.418
Line 7 × Line 9	56.800	62.233	59.517	34.903	31.154	33.029
Line 7 × Sids 4	64.233	68.600	66.417	33.433	26.493	29.963
Line 8	68.300	56.667	62.483	47.744	26.980	37.362
Line 8 × Line 9	54.733	57.100	55.917	25.671	21.834	23.753
Line 8 × Sids 4	70.367	62.867	66.617	29.694	24.856	27.275
Line 9	49.700	51.333	50.517	41.351	29.287	35.319
Line 9 × Sids 4	45.400	51.000	48.200	24.223	16.593	20.408
Sids 4	113.900	93.167	103.533	19.214	17.315	18.264
LSD 5%	22.608	20.069	15.115	14.963	10.956	9.272

Table (4): Percentage of heterosis over better parent for all traits studied under the two nitrogen fertilizer levels.

Genotypes	Heading date		Maturity date		Plant height (cm)		Number of spikes / plant		Number of spikelets / spike	
	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
Gemeiza 7 × Sakha 93	1.072*	2.112**	0.580	1.791**	10.394*	10.016**	20.340**	2.616**	-6.588**	-0.262
Gemeiza 7 × Giza 168	3.340**	3.217**	1.409*	-1.116	16.414**	7.034**	-44.603**	-19.660**	1.185*	-1.591
Gemeiza 7 × Line 4	0.144	1.219	0.376	1.046	30.640**	23.796**	-16.300**	6.11**	-4.109**	5.343**
Gemeiza 7 × Line 5	1.910*	1.503*	0.958	2.467**	4.431	3.123	-9.115**	-13.711**	-4.193**	1.488
Gemeiza 7 × Line 6	0.557	0.937	-0.132	0.621	38.700**	33.584**	-23.759**	7.581**	1.845**	5.705**
Gemeiza 7 × Line 7	0.1852	3.882**	0.876	2.633**	9.988*	5.798**	-37.252**	-1.067	-2.501**	-2.916**
Gemeiza 7 × Line 8	-0.908*	4.931**	0.598	2.646**	7.850	0.230	-19.193**	-12.936**	-10.196**	-2.387**
Gemeiza 7 × Line 9	9.372	8.248**	6.183**	4.825**	7.085	8.410**	-26.905**	-6.413**	-8.826**	-9.016**
Gemeiza 7 × Sids 4	15.407**	18.289**	4.230**	6.396**	19.520**	8.372**	-32.601**	-13.711*	1.976**	2.55**
Sakha 93 × Giza 168	1.609**	3.090**	1.163	1.722*	5.876	1.083	-36.391**	-4.849**	4.969**	31.37**
Sakha 93 × Line 4	5.9**	4.498**	1.137	3.673**	21.624**	15.232**	-0.717	-3.609**	-2.742**	-4.580**
Sakha 93 × Line 5	1.686*	5.125**	1.048	0.899	11.142**	7.149**	-21.531**	1.308	-8.649**	-6.826**
Sakha 93 × Line 6	0.996	2.660**	1.137	-0.092	27.244**	20.410**	-13.155**	-8.527**	4.458**	2.486**
Sakha 93 × Line 7	0.497	0.742	-0.067	0.629	5.129	7.018**	-30.959**	25.572**	1.313*	4.679**
Sakha 93 × Line 8	5.670**	5.125**	1.271	1.492*	9.273*	2.174	-24.880**	-11.356**	1.339*	-2.631**
Sakha 93 × Line 9	8.057**	5.867**	1.904**	5.707**	4.551	5.337**	-20.178**	-0.644	1.191*	-0.144
Sakha 93 × Sids 4	12.832**	12.540**	3.465**	5.425**	12.296**	4.908**	-28.945**	-10.17**	-1.068*	-10.231**
Giza 168 × Line 4	4.783**	4.749**	3.713**	-1.228*	29.391**	22.545**	-51.207**	-41.986**	-2.988**	-3.309**
Giza 168 × Line 5	1.594**	0.191	1.140	-0.022	13.192**	8.106**	-47.019**	34.464**	-9.379**	-4.715**
Giza 168 × Line 6	2.391**	1.685	1.677*	2.233**	31.433**	20.326**	-50.241**	-41.258**	4.738**	4.143**
Giza 168 × Line 7	2.012**	1.148	1.100	1.794**	11.715**	4.005*	-28.178**	-21.845**	2.483**	-0.281

Table (4): Cont.

Genotypes		Heading date		Maturity date		Plant height		Number of spikes / plant		Number of spikelet/spike	
		Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
Giza 168 × Line 8		1.746**	1.340	0.760	-0.273	13.494**	3.564*	-50.082**	-26.694**	2.337**	-7.281**
Giza 168 × Line 9		7.379**	6.845**	2.374**	4.630**	4.733	-1.359	-60.227**	-41.258**	-11.403**	-9.243**
Giza 168 × Sids 4		11.544**	11.951**	1.983**	5.251**	11.916**	0.599	-54.429**	-36.408**	-2.132**	-8.696**
Line 4 × Line 5		2.733**	2.856**	-0.111	2.006**	24.628**	18.112**	-34.576**	-31.713**	-2.557**	0.245
Line 4 × Line 6		1.153*	2.550**	0.729	2.763**	27.849**	9.368**	2.408*	-16.358**	-2.615**	3.435**
Line 4 × Line 7		1.516**	4.034**	1.706*	3.030**	27.985**	23.606**	-43.540**	2.839**	-4.359**	-2.545**
Line 4 × Line 8		1.960**	6.192**	0.118	2.075**	27.596**	26.411**	-28.677**	-18.926**	-8.842**	-1.782*
Line 4 × Line 9		12.298**	9.438**	2.398**	5.266**	22.482**	20.007**	-43.499**	-27.240**	-4.856**	-10.687
Line 4 × Sids 4		12.122**	13.762**	4.851**	5.699**	23.497**	18.339**	-5.911**	-23.905**	1.740**	3.690**
Line 5 × Line 6		3.520**	1.728*	-0.624	2.191**	35.060**	27.393**	-30.858**	-36.941**	-4.384**	-2.605**
Line 5 × Line 7		1.760**	2.207**	0.404	0.885	7.598	5.252**	-39.239**	19.920**	-11.817**	-6.204**
Line 5 × Line 8		2.921**	3.173**	0.267	-1.498*	5.572	-1.382	-19.904**	-13.570**	-8.769**	-9.677**
Line 5 × Line 9		12.382**	6.929**	1.222	3.135**	5.212	5.121**	-33.631**	-32.375**	-10.110**	-6.949**
Line 5 × Sids 4		11.633**	11.318**	1.696*	4.330**	7.578	3.298*	-38.861**	-45.516**	-6.822**	-6.204**
Line 6 × Line 7		0.037	1.559*	1.055	-0.302	78.238**	25.721**	-40.232**	18.853**	6.409**	-1.930*
Line 6 × Line 8		-0.371	4.395**	0.265	1.012	34.715**	28.942**	-42.894**	-34.390**	0.697	3.870**
Line 6 × Line 9		9.5**	8.545**	2.045**	3.331**	32.512**	24.676**	-37.896**	-31.086**	0.00	-8.009**
Line 6 × Sids 4		11.677**	12.177**	3.585**	4.853**	26.597**	23.880**	-30.289**	5.729**	6.132**	-0.767
Line 7 × Line 8		4.770**	4.816**	2.628**	3.472**	2.893	-1.882	-42.715**	6.624**	-5.106**	0.877
Line 7 × Line 9		10.092**	6.590**	1.222	3.625**	3.620	4.837**	-32.285**	10.576**	-5.400**	-3.802**
Line 7 × Sids 4		13.055**	13.716**	3.226**	5.002**	12.467**	4.139*	-46.853**	-8.188**	0.80	-6.138**
Line 8 × Line 9		9.245**	8.418**	3.033**	4.139**	5.992	5.817**	-35.427**	-17.355**	-1.846**	-5.213**
Line 8 × Sids 4		12.522**	13.852**	4.947**	5.351**	14.500**	7.282**	-37.442**	-29.024**	-1.332*	-12.533**
Line 9 × Sids 4		10.745**	14.849**	2.300**	3.559**	6.660	2.055	-44.844**	-30.451**	-10.932**	15.602**
L.S.D. at	0.05	0.886	1.344	1.456	1.221	8.093	3.220	2.395	1.618	1.049	1.765
	0.01	1.174	1.780	1.929	1.780	10.719	4.265	3.172	2.143	1.389	2.338

Table (4): Cont.

Genotypes	Spike length (cm)		Spike weight (gm)		1000-grain weight (gm)		Number of kernels / spike		Grain yield / plant	
	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
Gemeiza 7 × Sakha 93	-8.391**	4.534**	8.049**	20.448**	-19.984**	2.917	13.141	15.011*	39.010**	37.087**
Gemeiza 7 × Giza 168	3.727**	-1.005	22.321**	11.016**	4.975*	-2.699	14.465*	-11.732*	-41.566**	-12.039**
Gemeiza 7 × Line 4	-19.738**	-20.787**	-29.238**	-1.776**	-5.086*	-1.663	-33.194**	-0.612	-0.988	85.527**
Gemeiza 7 × Line 5	-20.718**	-6.629**	-8.700**	-13.391**	-5.026*	1.470	0.702	-15.958**	-36.337**	-23.776**
Gemeiza 7 × Line 6	0.699	9.823**	-14.280**	-29.246**	3.713	1.649	-20.892**	-39.513**	-6.335	88.791**
Gemeiza 7 × Line 7	-6.062**	2.523**	16.053**	21.976**	3.311	-7.833**	-0.532	30.023**	-24.548**	6.578
Gemeiza 7 × Line 8	-17.951**	-1.511	10.165**	-1.602**	8.036**	-2.808	2.001	-1.394	-26.650**	-14.017**
Gemeiza 7 × Line 9	-16.783**	-15.612**	-5.796**	8.428**	-4.386*	-9.817**	0.219	2.845	-32.170**	1.348
Gemeiza 7 × Sids 4	-15.045**	-4.968**	-31.899**	-24.866**	-0.201	-7.996**	-32.309**	-19.284**	2.270	25.125**
Sakha 93 × Giza 168	-9.178**	-1.304	29.995**	-6.006**	4.619*	10.691**	9.661	-13.805*	-37.483**	-13.912**
Sakha 93 × Line 4	-20.229**	-28.662**	-12.651**	11.573**	9.203**	5.256**	-17.918**	11.336	68.00**	38.174**
Sakha 93 × Line 5	-18.558**	-19.154**	-14.274**	7.794**	-3.572	-7.098**	-9.413	-9.625	-26.655**	-15.587**
Sakha 93 × Line 6	4.23**	6.790**	-29.403**	-28.945**	13.151**	18.001**	-37.580**	-37.676**	14.364**	43.236**
Sakha 93 × Line 7	-5.887**	-0.291	-8.272**	30.586**	10.825**	7.610**	-19.069**	18.135**	-35.574**	28.138**
Sakha 93 × Line 8	-6.689**	26.279**	5.359**	-2.570**	8.152**	-0.286	-1.073	2.647	-31.030**	-8.836**
Sakha 93 × Line 9	-11.502**	-3.145**	-17.335**	7.168**	-9.001**	-17.032**	2.699	23.921**	-22.495**	0.054
Sakha 93 × Sids 4	-18.857**	-13.043**	-32.957**	-30.763**	-7.435**	-8.619**	-28.182**	-26.476**	21.552**	31.385**
Giza 168 × Line 4	-22.884**	-25.511**	-37.129**	-1.142**	16.357**	11.966**	-44.912**	-17.993**	-56.499**	-41.371**
Giza 168 × Line 5	-25.945**	-21.364**	-23.233**	-14.448**	-12.171**	-8.591**	-9.167	-2.155	-39.140**	-32.435**
Giza 168 × Line 6	-2.720**	2.085**	-32.988**	-35.155**	-3.085	-0.843	-40.821**	-35.019**	-42.923**	-28.962**
Giza 168 × Line 7	-12.655**	-8.335**	9.191**	-0.849*	11.876**	6.502**	-1.419	-9.660	-37.242**	-24.750*
Giza 168 × Line 8	-10.913**	-15.101**	-0.718	-6.621**	0.281	-8.747**	-0.830	-23.093**	-40.165**	-27.241**
Giza 168 × Line 9	-20.099**	-17.445**	-17.123**	-9.405**	-1.170	-17.950**	-16.030*	-28.026**	-55.994**	-37.943**
Giza 168 × Sids 4	-25.902**	-21.739**	-42.321**	-31.126**	-7.830**	-6.324**	-37.664**	-27.442**	-45.348**	-17.508**

Table (4): Cont.

Genotypes	Spike length (cm)		Spike weight (gm)		1000-grain weight (gm)		Number of kernels / spike		Grain yield / plant	
	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
Line 4 × Line 5	-18.586**	-3.307**	-29.358**	-4.270**	-4.988*	-3.334*	-33.937**	-19.833**	-56.323**	-39.565**
Line 4 × Line 6	-22.864**	-8.191**	-35.005**	-22.947**	4.927*	-3.407*	-35.924**	-24.024**	-31.482**	-14.394**
Line 4 × Line 7	-27.961**	-26.616**	-36.872**	16.356*	24.213**	20.702**	-44.883**	-4.568	-28.371**	21.535**
Line 4 × Line 8	-36.186**	-15.906**	-43.537**	13.305**	2.811	-8.476**	-47.730**	19.345**	-41.263**	-14.614**
Line 4 × Line 9	-29.441**	-30.708**	-47.034**	22.645**	-13.071**	-11.331**	-49.836**	13.930*	-32.777**	-19.605**
Line 4 × Sids 4	-17.600**	-15.750**	-6.797**	2.500**	11.742**	11.563**	-17.530**	11.520	-3.998	8.653**
Line 5 × Line 6	-21.983**	-10.679**	-19.556**	-5.449**	-3.651	-3.140	-21.180**	-23.318**	-29.913**	-37.013**
Line 5 × Line 7	-26.124**	-25.232**	-30.379**	6.156**	-12.296**	-7.722**	-18.545**	7.791	-23.079**	-15.695**
Line 5 × Line 8	-28.470**	-25.044**	-30.735**	-28.109**	-10.688**	-8.445**	-19.880**	-22.083**	-39.037**	-30.982**
Line 5 × Line 9	-24.145**	-21.176**	-26.053**	-14.054**	0.803	-9.676**	-25.219**	-11.875*	-33.332**	-39.049**
Line 5 × Sids 4	-17.118**	-13.259**	-22.718**	-2.534**	2.246	4.480**	-25.899**	-7.871	-44.830**	-46.960**
Line 6 × Line 7	-0.793	5.706**	-14.050**	-29.033**	12.445**	10.160**	-22.754**	-39.344**	-23.649**	48.065**
Line 6 × Line 8	0.793	9.236**	-2.741**	-31.121**	21.920**	2.168	-18.903**	-47.116**	-20.714**	15.163**
Line 6 × Line 9	-8.198**	-11.689**	-4.715**	-18.772**	10.233**	-6.216**	-27.664**	-34.087**	3.434	-5.459
Line 6 × Sids 4	-10.857**	3.521**	-17.783**	-99.887**	-1.434	7.061**	-19.022**	-18.852**	-17.932**	45.830**
Line 7 × Line 8	-9.978**	2.420**	11.672**	-3.296**	5.185*	-7.594**	-12.328	6.496	-13.066**	-3.724
Line 7 × Line 9	-11.862**	0.906	-15.448**	-4.319**	-4.276	-20.652**	-24.434**	5.479	-32.363**	6.374
Line 7 × Sids 4	-23.617**	-24.223**	-52.587**	-33.747**	-16.381**	-10.694**	-43.605**	-26.476**	-35.212**	8.117*
Line 8 × Line 9	-0.312	-2.777**	-9.306**	6.118**	3.500	-6.737**	-19.863**	0.764	-46.231**	-25.448**
Line 8 × Sids 4	-24.954**	-25.670**	-36.412**	-34.419**	2.695	-4.923**	-38.220**	-32.522**	-37.805**	-7.872*
Line 9 × Sids 4	-35.617**	-30.434**	-61.965**	-41.196**	-5.260*	5.002**	-60.140**	-45.259**	-41.421**	-43.343**
L.S.D. at 0.05	0.957	1.561	0.809	0.793	4.378	3.212	13.199	11.717	8.736	6.396
L.S.D. at 0.01	1.268	2.067	1.072	1.050	5.799	4.254	17.482	15.517	11.570	8.471

Table (5): Estimation of general combining effects for parents evaluated under two fertilizer levels.

Parents	Heading date			Maturity date			Plant height "cm"		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Gemmeiza 7	1.46 **	2.26 **	1.86 **	1.59 **	2.51 **	2.05 **	6.74 **	6.97 **	6.86 **
Sakha 93	-0.29	-0.56 *	-0.42 *	0.79 **	0.95 **	0.87 **	-4.11 **	-2.68 **	-3.39 **
Giza 168	0.13	0.14	0.14	0.85 **	1.38 **	1.11 **	-0.91	-0.32	-0.62
Line 4	2.36 **	2.35 **	2.35 **	1.79 **	3.12 **	2.45 **	-5.16 **	-5.29 **	-5.23 **
Line 5	1.08 **	0.96 **	1.02 **	0.12	-0.19	-0.04	3.43 *	4.74 **	4.08 **
Line 6	0.63 **	1.10 **	0.87 **	1.05 **	0.21	0.63 **	-7.33 **	-10.89 **	-9.11 **
Line 7	1.16 **	0.74 **	0.95 **	0.20	-0.45 *	-0.13	4.96 **	2.51 **	3.73 **
Line 8	1.99 **	1.52 **	1.75 **	1.83 **	1.00 **	1.42 **	2.44	3.70 **	3.07 **
Line 9	-3.38 **	-3.58 **	-3.48 **	-3.57 **	-3.76 **	-3.67 **	-0.51	0.25	-0.13
Sids 4	-5.15 **	-4.93 **	-5.04 **	-4.64 **	-4.75 **	-4.70 **	0.44	1.00	0.72
L.S.D gi 0.05	0.29	0.45	0.38	0.48	0.41	0.45	2.70	1.07	2.04
L.S.D gi 0.01	0.39	0.59	0.49	0.64	0.54	0.58	3.55	1.41	2.68
L.S.D gi-gj 0.05	0.44	0.67	0.56	0.72	0.61	0.66	4.02	1.60	3.05
L.S.D gi-gj 0.01	0.58	0.88	0.74	0.95	0.80	0.87	5.29	2.10	3.99

Comb. = combined data.
* and ** significant at 0.05 and 0.01 levels of probability, respectively.

Table (5): Cont.

Parents	No. of spikes per plant			No. of spikelets per spike			Spike length "cm"		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Gemmeiza 7	0.62	0.64 *	0.63	0.49 **	0.85 **	0.67 **	0.36 *	0.18	0.27
Sakha 93	1.89 **	1.56 **	1.73 **	-0.53 **	-0.07	-0.30	-0.53 **	-0.68 *	-0.60 **
Giza 168	1.84 **	1.51 **	1.68 **	-0.46 **	0.09	-0.19	-0.49 **	-1.03 **	-0.76 **
Line 4	-1.92 **	-1.46 **	-1.69 **	1.56 **	1.37 **	1.46 **	2.48 **	3.60 **	3.04 **
Line 5	-0.48	-0.58 *	-0.53	1.25 **	1.22 **	1.23 **	1.51 **	1.93 **	1.72 **
Line 6	-1.95 **	-1.75 **	-1.85 **	0.67 **	0.41 **	0.54 *	-0.11	0.18	0.04
Line 7	2.92 **	1.57 **	2.24 **	-0.62 **	-0.70 *	-0.66 **	-0.98 **	-1.40 **	-1.19 **
Line 8	0.12	0.49	0.31	-1.23 **	-1.34 **	-1.29 **	-1.55 **	-1.14 **	-1.35 **
Line 9	0.12	0.17	0.15	-1.84 **	-2.13 **	-1.99 **	-1.77 **	-2.24 **	-2.01 **
Sids 4	-3.17 **	-2.15 **	-2.66 **	0.71 **	0.31 **	0.51 *	1.08 **	0.60 *	0.84 **
L.S.D gi 0.05	0.80	0.54	0.68	0.35	0.59	0.48	0.32	0.52	0.43
L.S.D gi 0.01	1.05	0.71	0.89	0.46	0.77	0.63	0.42	0.69	0.57
L.S.D gi-gj 0.05	1.19	0.80	1.01	0.52	0.88	0.72	0.48	0.78	0.64
0.01	1.56	1.06	1.32	0.69	1.155	0.94	0.63	1.02	0.84

Comb. = combined data.
* and ** significant at 0.05 and 0.01 levels of probability, respectively.

Table (5): Cont.

Parents		Spike weight "gm"			1000 grain weight "gm"			No. of kernels / spike			Grain yield-plant "gm"		
		Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Gemmeiza 7		-0.11	-0.20	-0.16	-1.21	0.31	-0.45	-0.49	-3.57	-2.03	-1.07	2.31*	0.62
Sakha 93		-0.44**	-0.40**	-0.42**	-4.25**	-3.51**	-3.88**	-3.78	-4.52*	-4.15*	0.45	1.74	1.09
Giza 168		-0.56**	-0.36**	-0.46**	-4.05**	-4.65**	-4.35**	-4.94*	0.77	-2.09	1.97	1.27	1.62
Line 4		0.13	-0.17	-0.02	-0.97	-1.63**	-1.30*	5.43*	-0.99	2.22	-5.52**	-2.90**	-4.21**
Line 5		0.88**	0.66**	0.77**	3.98**	3.51**	3.74**	9.70**	5.38**	7.54**	6.72**	4.52**	5.62**
Line 6		0.46**	0.72**	0.59**	0.39	-0.88	-0.24	7.99**	14.30**	11.15**	-0.01	-0.60	-0.31
Line 7		-0.51**	-0.42**	-0.46**	-3.28**	-3.83**	-3.56**	-3.30	-2.27	-2.78	4.98**	1.10	3.04*
Line 8		-0.23	-0.42**	-0.33*	1.15	0.51	0.83	-4.53*	-8.57**	-6.55**	1.08	-1.85	-0.39
Line 9		-0.53**	-0.26	-0.39**	3.09**	3.65**	3.37**	-14.60**	-8.25**	-11.43**	-2.02	-1.66	-1.84
Sids 4		0.91**	0.84**	0.88**	5.15**	6.51**	5.83**	8.52**	7.71**	8.12**	-6.59**	-3.93**	-5.26**
L.S.D gi	0.05	0.27	0.26	0.26	1.46	1.07	1.27	4.40	3.91	4.14	2.91	2.13	2.54
	0.01	0.35	0.35	0.35	1.92	1.41	1.67	5.79	5.14	5.43	3.83	2.80	3.33
L.S.D	0.05	0.40	0.39	0.39	2.18	1.60	1.90	6.56	5.82	6.17	4.34	3.18	3.79
gi-gj	0.01	0.53	0.52	0.52	2.86	2.10	2.49	8.62	7.66	8.09	5.71	4.18	4.96

Comb. = combined data.

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

Table (6): Estimates of specific combining ability effects for all the nitrogen forty five crosses evaluated under two fertilizer levels.

Hybrid	Heading date			Maturity date			Plant height "cm"		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Gemmeiza 7 × Sakha 93	-1.53**	-1.91*	-1.72**	-0.45	-0.38	-0.42	-2.68	-0.09	-1.38
Gemmeiza 7 × Giza 168	0.84	0.22	0.53	0.32	-1.02	-0.35	1.39	-0.65	0.37
Gemmeiza 7 × Line 4	-0.22	-0.55	-0.39	-0.78	0.98	0.10	1.61	0.11	0.86
Gemmeiza 7 × Line 5	-0.14	-0.43	-0.28	0.82	1.09	0.95	0.86	2.22	1.54
Gemmeiza 7 × Line 6	-0.25	-0.84	-0.55	-0.82	-1.74*	-1.28	-2.26	3.28	0.51
Gemmeiza 7 × Line 7	-0.61	0.75	0.07	-0.46	0.04	-0.21	-0.41	-0.42	-0.41
Gemmeiza 7 × Line 8	-0.81	0.51	-0.15	-0.50	1.76*	0.63	-0.79	-1.78	-1.28
Gemmeiza 7 × Line 9	-0.41	-1.02	-0.72	4.14**	-0.81	1.66*	-0.24	-0.03	-0.14
Gemmeiza 7 × Sids 4	2.03**	2.56**	2.29**	0.04	0.04	0.04	5.88	0.99	3.43
Sakha 93 × Giza 168	0.26	1.04	0.65	0.75	0.64	0.70	0.54	-1.83	-0.65
Sakha 93 × Line 4	1.76**	0.04	0.90	0.18	1.74*	0.96	4.76	2.23	3.50
Sakha 93 × Line 5	-0.62	1.96*	0.67	1.72*	0.38	1.05	1.37	-0.76	0.30
Sakha 93 × Line 6	-0.77	-0.28	-0.53	0.92	-1.22	-0.15	1.29	2.43	1.86
Sakha 93 × Line 7	-1.73**	-1.56*	-1.64*	-1.06	-1.26	-1.16	-6.06	1.34	-2.36
Sakha 93 × Line 8	1.93**	1.40	1.67**	0.34	0.69	0.51	0.52	-4.76**	-2.12
Sakha 93 × Line 9	0.31	-0.07	0.12	-1.13	1.95**	0.41	-1.16	1.89	0.36
Sakha 93 × Sids 4	1.84**	1.15	1.50*	-0.22	0.31	0.04	5.49	0.71	3.10
Giza 168 × Line 4	1.21*	1.47	1.34*	1.55	-1.79*	-0.12	8.19	6.31**	7.25*
Giza 168 × Line 5	-0.31	-1.11	-0.71	1.38	-1.38*	0.00	1.51	2.71	2.11
Giza 168 × Line 6	0.84	0.04	0.44	1.25	1.72*	1.48	1.32	0.01	0.67
Giza 168 × Line 7	-0.02	-0.06	-0.04	0.61	-0.03	0.29	-1.49	0.61	-0.44
Giza 168 × Line 8	-1.09*	-0.67	-0.88	-0.89	-1.38*	-1.14	2.79	-1.05	0.87
Giza 168 × Line 9	-0.65	0.00	-0.33	-0.53	0.05	-0.24	-2.96	-3.04	-3.00
Giza 168 × Sids 4	0.45	0.01	0.23	-2.35**	-0.36	-1.36	3.22	-1.49	0.87

Table (6): Cont.

Hybrid		Heading date			Maturity date			Plant height "cm"		
		Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Line 4 × Line 5		-0.31	0.69	0.19	-0.98	-0.19	-0.59	-0.21	-2.65	-1.43
Line 4 × Line 6		-0.63	0.51	-0.06	0.58	0.74	0.66	2.81	-3.76*	-0.48
Line 4 × Line 7		-0.32	0.80	0.24	0.57	0.00	0.29	1.12	4.41*	2.77
Line 4 × Line 8		0.98	1.53*	1.25	-0.03	0.31	0.14	3.31	5.68**	4.50
Line 4 × Line 9		0.99	-0.17	0.41	-1.43	-0.82	-1.12	1.89	3.50	2.69
Line 4 × Sids 4		-1.34**	-0.86	-1.10	0.71	-1.50*	-0.40	1.81	1.28	1.55
Line 5 × Line 6		2.12**	0.93	1.53*	-1.02	2.99**	0.99	-0.21	0.58	0.18
Line 5 × Line 7		0.03	0.59	0.31	0.31	0.24	0.28	0.30	1.22	0.76
Line 5 × Line 8		0.23	0.28	0.26	-0.46	-3.14**	-1.80*	0.06	-1.41	-0.68
Line 5 × Line 9		2.34**	-0.75	0.79	-1.43	-0.41	-0.92	1.07	-1.26	-0.10
Line 5 × Sids 4		-0.43	-1.27	-0.85	-2.02*	-0.02	-1.02	-2.94	-2.21	-2.58
Line 6 × Line 7		-0.42	-0.12	-0.27	0.34	-1.86**	-0.76	31.59**	1.48	16.53**
Line 6 × Line 8		-1.62**	1.20	-0.21	-0.16	0.32	0.08	0.51	2.85	1.68
Line 6 × Line 9		0.52	0.37	0.45	-1.20	-0.54	-0.87	1.76	2.89	2.32
Line 6 × Sids 4		0.06	-0.78	-0.36	-0.32	0.28	-0.02	-3.76	1.51	-1.12
Line 7 × Line 8		2.99**	1.93*	2.46*	1.90*	2.75**	2.32**	-4.38	-5.58**	-4.98
Line 7 × Line 9		0.46	-0.80	-0.17	-1.50	0.51	-0.50	-2.16	0.67	-0.75
Line 7 × Sids 4		0.56	0.71	0.64	0.03	1.13	0.58	0.49	0.92	0.70
Line 8 × Line 9		-1.04*	-0.14	-0.59	-0.57	-0.24	-0.41	2.89	0.51	1.70
Line 8 × Sids 4		-0.67	0.04	-0.32	0.80	0.15	0.47	5.07	3.09	4.08
Line 9 × Sids 4		3.37**	5.87**	4.62**	2.60**	2.51**	2.56**	0.06	-0.76	-0.35
LSD (sij)	5%	0.99	1.50	1.26	1.63	1.37	1.49	9.08	3.61	6.84
	1%	1.30	1.98	1.66	2.14	1.80	1.97	11.93	4.75	9.01
LSD (sij-sik)	5%	1.45	2.21	1.85	2.40	2.02	2.19	13.34	5.31	10.05
	1%	1.91	2.90	2.44	3.15	2.65	2.89	17.54	6.98	13.24
LSD (sij-ski)	5%	1.38	2.11	1.76	2.29	1.92	2.09	12.72	5.06	9.58
	1%	1.82	2.77	2.33	3.01	2.53	2.76	16.72	6.65	12.63

Comb. = combined data. * and ** significant at 0.05 and 0.01 levels of probability, respectively.

Table (6): Cont.

Hybrid	No. of spikes / plant			No. of spikelets / spike			Spike length "cm"		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Gemmeiza 7 × Sakha 93	3.51*	-0.51	1.50	-0.69	-0.24	-0.46	-0.32	0.47	0.07
Gemmeiza 7 × Giza 168	-1.74	0.14	-0.80	1.22*	-0.73	0.24	1.37*	0.08	0.73
Gemmeiza 7 × Line 4	0.65	1.89*	1.27	-0.74	0.85	0.06	-0.16	-0.88	-0.52
Gemmeiza 7 × Line 5	0.08	-0.83	-0.38	0.14	0.67	0.41	-0.79	0.92	0.07
Gemmeiza 7 × Line 6	-0.21	2.31*	1.05	0.25	0.77	0.51	0.56	0.30	0.43
Gemmeiza 7 × Line 7	-1.65	-1.68	-1.66	0.44	-0.28	0.08	0.46	0.92	0.69
Gemmeiza 7 × Line 8	-0.12*	-0.66	-0.39	-0.88	0.49	-0.19	-0.66	0.13	-0.27
Gemmeiza 7 × Line 9	-0.62	0.18	-0.22	0.06	-0.38	-0.16	-0.28	-0.63	-0.46
Gemmeiza 7 × Sids 4	-0.06	0.74	0.34	0.24	1.04	0.64	-0.16	0.66	0.25
Sakha 93 × Giza 168	-1.31	1.26	-0.03	0.56	6.72**	3.64**	-0.38	0.48	0.05
Sakha 93 × Line 4	3.12*	0.97	2.04	0.64	-0.82	-0.09	0.62	-1.68	-0.53
Sakha 93 × Line 5	-1.22	0.58	-0.32	-0.08	-0.64	-0.36	0.49	-0.48	0.01
Sakha 93 × Line 6	1.41	0.76	1.08	0.50	-0.13	0.18	0.18	-0.26	-0.04
Sakha 93 × Line 7	-1.65	0.90	-0.38	-0.08	0.11	0.02	-0.36	-0.15	-0.25
Sakha 93 × Line 8	-2.20	-1.42	-1.81	0.10	-0.92	-0.41	0.12	2.70**	1.41
Sakha 93 × Line 9	-0.89	-0.14	-0.52	0.67	0.44	0.56	-0.26	0.36	0.05
Sakha 93 × Sids 4	0.44	0.98	0.71	0.19	-1.37	-0.59	0.06	0.22	0.14
Giza 168 × Line 4	-0.56	-0.81	-0.69	0.51	-0.65	-0.07	0.05	-0.67	-0.31
Giza 168 × Line 5	-1.14	-0.67	-0.90	-0.34	-0.23	-0.29	-0.92	-0.53	-0.73
Giza 168 × Line 6	-0.33	-0.42	-0.38	0.50	0.10	0.30	0.07	0.05	0.06
Giza 168 × Line 7	-0.63	-1.08	-0.86	0.12	-0.18	-0.03	-0.40	0.30	-0.05
Giza 168 × Line 8	-2.38	-0.66	-1.52	0.67	-1.21	-0.27	0.41	-0.83	-0.21
Giza 168 × Line 9	-4.47**	-2.35*	-3.41**	-1.85**	-0.88	-1.37	-0.61	-0.03	-0.32
Giza 168 × Sids 4	0.02	0.64	0.33	-0.14	-1.13	-0.63	-1.22*	-0.83	-1.03

Table (6): Cont.

Hybrid		No. of spikes / plant			No. of spikelets / spike			Spike length "cm"		
		Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Line 4 × Line 5		-0.71	-0.59	-0.65	-0.50	-0.18	-0.34	-1.08	1.07	0.00
Line 4 × Line 6		0.23	-1.08	-0.43	-0.52	0.79	0.14	-0.33	1.79*	0.73
Line 4 × Line 7		-0.37	0.80	0.21	0.30	0.34	0.32	-0.49	-0.53	-0.51
Line 4 × Line 8		1.09	0.81	0.95	-0.29	1.18	0.45	-1.59**	1.48	-0.05
Line 4 × Line 9		-0.55	0.12	-0.21	1.39*	-0.36	0.51	0.00	-0.55	-0.28
Line 4 × Sids 4		-0.35	-1.09	-0.72	0.60	0.96	0.78	-0.45	-0.23	-0.34
Line 5 × Line 6		-0.25	-0.77	-0.51	-0.11	0.01	-0.05	-0.56	0.19	-0.19
Line 5 × Line 7		-0.95	1.51	0.28	-0.85	0.16	-0.35	-0.46	-0.86	-0.66
Line 5 × Line 8		0.88	0.49	0.69	0.59	-0.14	0.23	-0.32	-1.08	-0.70
Line 5 × Line 9		-0.52	-1.30	-0.91	0.83	1.39	1.11	0.70	0.72	0.71
Line 5 × Sids 4		0.04	-1.14	-0.55	-0.72	-0.86	-0.79	-0.84	-0.69	-0.77
Line 6 × Line 7		0.32	2.59**	1.46	1.06	-0.57	0.24	-0.01	0.32	0.16
Line 6 × Line 8		-0.88	-0.53	-0.71	0.30	1.47	0.88	0.77	0.50	0.63
Line 6 × Line 9		0.32	0.01	0.17	0.75	-0.61	0.07	-0.15	-0.97	-0.56
Line 6 × Sids 4		-0.79	-0.53	-0.66	0.79	0.61	0.70	1.04	2.02*	1.53*
Line 7 × Line 8		-2.25	0.48	-0.88	-0.84	0.51	-0.17	0.07	-0.02	0.03
Line 7 × Line 9		-0.15	1.03	0.44	-0.30	0.24	-0.03	0.05	0.92	0.48
Line 7 × Sids 4		0.21	0.45	0.33	0.75	0.33	0.54	-0.32	-0.86	-0.59
Line 8 × Line 9		-1.39	-0.66	-1.03	-0.02	-0.46	-0.24	0.56	0.02	0.29
Line 8 × Sids 4		1.10	0.43	0.77	0.83	-0.70	0.06	0.02	-1.35	-0.67
Line 9 × Sids 4		0.51	0.47	0.49	-0.97	-0.71	-0.84	-1.63**	-1.02	-1.33
LSD (sij)	5%	2.68	1.81	2.27	1.18	1.98	1.61	1.08	1.75	0.00
	1%	3.53	2.38	2.99	1.55	2.60	2.12	1.42	2.31	0.73
LSD (sij-sik)	5%	3.94	2.66	3.33	1.73	2.91	2.37	1.59	2.58	-0.51
	1%	5.18	3.50	4.39	2.28	3.82	3.12	2.09	3.39	-0.05
LSD (sij-ski)	5%	3.76	2.54	3.18	1.65	2.77	2.26	1.52	2.46	-0.28
	1%	4.94	3.34	4.19	2.17	3.65	2.98	1.99	3.23	-0.34

Comb. = combined data. *** and ** significant at 0.05 and 0.01 levels of probability, respectively.**

Table (6): Cont.

Hybrid		Spike weight (gm)			1000 grain weight "gm"			No. of kernels per spike			Grain yield-plant "gm"		
		Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb	Normal	Stress	Comb
Gemmeiza 7 × Sakha 93		-0.08	0.56	0.24	-8.10**	4.17*	-1.96	0.17	6.51	3.34	8.69	-0.14	4.28
Gemmeiza 7 × Giza 168		0.50	0.45	0.47	4.89	2.24	3.56	5.22	3.49	4.36	-2.12	0.82	-0.65
Gemmeiza 7 × Line 4		-0.28	-0.39	-0.33	-3.51	-0.21	-1.86	-3.14	-6.36	-4.75	2.17	14.69**	8.43
Gemmeiza 7 × Line 5		0.74	-0.19	0.28	1.23	2.70	1.96	13.09	-4.86	4.11	-2.26	-1.12	-1.69
Gemmeiza 7 × Line 6		0.00	-0.43	-0.22	-0.22	0.85	0.31	1.39	-9.68	-4.15	-1.97	13.14**	5.59
Gemmeiza 7 × Line 7		0.28	0.63	0.45	3.24	-1.38	0.93	5.28	13.22 *	9.25	-0.31	-5.30	-2.80
Gemmeiza 7 × Line 8		0.21	-0.03	0.09	1.30	-1.13	0.09	1.42	0.75	1.09	-0.32	-5.27	-2.80
Gemmeiza 7 × Line 9		0.06	0.17	0.12	-0.43	-0.58	-0.50	3.09	2.98	3.03	-4.20	1.02	-1.59
Gemmeiza 7 × Sids 4		-0.10	-0.19	-0.14	2.76	-4.15*	-0.69	-4.20	0.78	-1.71	4.26	2.01	3.13
Sakha 93 × Giza 168		0.08	0.07	0.07	-1.68	-0.04	-0.86	5.45	2.78	4.11	-1.25	0.70	-0.27
Sakha 93 × Line 4		0.96	-0.28	0.34	1.88	-1.18	0.35	17.31 *	1.03	9.17	14.98**	5.33	10.15*
Sakha 93 × Line 5		0.73	1.04*	0.88	5.19*	1.30	3.24	6.78	1.16	3.97	2.12	3.08	2.60
Sakha 93 × Line 6		-0.46	-0.21	-0.34	4.19	5.24**	4.71*	-12.65	-6.56	-9.61	3.66	4.21	3.93
Sakha 93 × Line 7		-0.18	0.37	0.09	0.27	0.62	0.44	-5.36	6.21	0.42	-7.51	0.55	-3.48
Sakha 93 × Line 8		0.36	0.14	0.25	4.14	4.12*	4.13	2.61	0.97	1.79	-3.93	-3.30	-3.61
Sakha 93 × Line 9		-0.04	0.33	0.14	-0.15	-1.45	-0.80	2.18	8.63	5.40	-1.71	1.21	-0.25
Sakha 93 × Sids 4		0.16	-0.33	-0.09	1.27	-0.73	0.27	3.79	-4.97	-0.59	3.54	4.77	4.16
Giza 168 × Line 4		-0.26	-0.01	-0.13	5.12*	3.10	4.11	-11.86	-4.12	-7.99	-6.39	-4.77	-5.58
Giza 168 × Line 5		0.29	-0.08	0.11	-0.43	1.52	0.55	8.17	2.24	5.20	-7.01	-3.90	-5.45
Giza 168 × Line 6		-0.54	-0.61	-0.57	-4.07	-2.59	-3.33	-14.86 *	-8.71	-11.79	-3.97	-2.50	-3.23
Giza 168 × Line 7		0.50	0.25	0.38	0.21	1.26	0.73	9.06	3.86	6.46	-5.64	-2.64	-4.14
Giza 168 × Line 8		0.26	0.06	0.16	-0.20	0.47	0.13	3.93	-0.64	1.65	-3.45	-0.62	-2.03
Giza 168 × Line 9		0.08	-0.20	-0.06	4.34	-0.92	1.71	-0.13	-4.92	-2.53	-9.59	-4.75	-7.17
Giza 168 × Sids 4		-0.39	-0.40	-0.39	0.83	1.85	1.34	-5.86	-11.15	-8.50	1.20	5.05	3.12
Line 4 × Line 5		-0.78	0.22	-0.28	1.02	1.71	1.36	-14.16	-10.54	-12.35	-9.97*	-2.89	-6.43
Line 4 × Line 6		-1.17*	-0.11	-0.64	-3.17	-6.82**	-5.00*	-14.69	6.01	-4.34	-6.19	-8.37*	-7.28
Line 4 × Line 7		-0.30	-0.14	-0.22	8.12**	6.32**	7.22**	-13.47	-10.62	-12.05	2.17	3.58	2.87
Line 4 × Line 8		-0.94*	0.43	-0.26	-1.95	-2.39	-2.17	-15.43 *	9.81	-2.81	-2.85	-0.22	-1.53
Line 4 × Line 9		-0.83	0.60	-0.11	-5.87	0.37	-2.75	-7.73	6.30	-0.72	0.00	0.09	0.05
Line 4 × Sids 4		1.44**	1.36	1.40	10.01**	10.10**	10.06**	6.71	26.90 * *	16.81	2.03	-0.70	0.67
Line 5 × Line 6		-0.51	0.05	-0.23	0.50	1.08	0.79	-9.09	0.47	-4.31	0.59	-4.05	-1.73
Line 5 × Line 7		-0.20	0.37	0.09	-1.28	1.24	-0.02	-2.37	12.84	5.23	-0.24	3.67	1.72
Line 5 × Line 8		-0.50	-0.68	-0.59	-4.69	-3.55	-4.12	-2.40	-4.76	-3.58	-6.05	-0.14	-3.09
Line 5 × Line 9		0.09	-0.17	-0.04	0.60	-3.69*	-1.55	2.60	3.09	2.85	0.52	-3.90	-1.69
Line 5 × Sids 4		-0.44	0.24	-0.10	-0.55	0.50	-0.02	-7.09	2.46	-2.31	-1.81	-5.13	-3.47
Line 6 × Line 7		0.40	-0.20	0.10	2.87	1.83	2.35	2.26	-10.78	-4.26	-0.90	7.78**	3.44
Line 6 × Line 8		0.71	-0.32	0.20	6.73**	2.87	4.80*	7.50	-13.65 *	-3.07	1.45	5.52	3.49
Line × Line 9		0.91*	0.21	0.56	6.74**	2.95	4.84*	8.47	1.41	4.94	9.47	1.94	5.70
Line 6 × Sids 4		0.33	1.02*	0.67	0.39	6.52**	3.46	2.45	3.41	2.93	-0.44	1.57	0.56
Line 7 × Line 8		0.26	0.13	0.19	1.61	0.31	0.96	0.46	3.39	1.92	3.47	-1.28	1.10
Line 7 × Line 9		0.09	-0.05	0.02	1.71	-3.49	-0.89	1.43	2.48	1.95	-3.39	3.71	0.16
Line 7 × Sids 4		-1.17*	-0.49	-0.83	-5.30*	-1.71	-3.51	-14.27	-7.12	-10.69	-0.29	1.32	0.52
Line 8 × Line 9		0.05	0.31	0.18	1.94	1.21	1.58	0.60	3.64	2.12	-8.72	-2.67	-5.69
Line 8 × Sids 4		-0.30	-0.53	-0.41	2.22	-2.42	-0.10	-6.89	-6.55	-6.72	-0.12	2.63	1.25
Line 9 × Sids 4		-1.81**	-1.09*	-1.45**	-4.71	0.69	-2.01	-21.79 * *	-18.73 * *	-20.26	-2.50	-5.83	-4.16
LSD (sij)	5%	0.90	0.88	0.89	4.91	3.60	4.26	14.80	13.14	13.85	9.80	7.17	8.50
	1%	1.19	1.16	1.17	6.45	4.74	5.62	19.46	17.27	18.26	12.88	9.43	11.20
LSD (sij-sik)	5%	1.33	1.30	1.30	7.22	5.29	6.26	21.76	19.31	20.36	14.40	10.54	12.49
	1%	1.75	1.71	1.71	9.49	6.96	8.26	28.60	25.39	26.84	18.93	13.86	16.46
LSD (sij-ski)	5%	1.27	1.24	1.24	6.88	5.05	5.97	20.74	18.41	19.41	13.73	10.05	11.91
	1%	1.67	1.63	1.64	9.05	6.64	7.87	27.27	24.21	25.59	18.05	13.22	15.70

Comb. = combined data. * and ** significant at 0.05 and 0.01 levels of probability, respectively.