

COMBINING ABILITY AND GENETIC COMPONENTS FOR YIELD AND ITS COMPONENTS AND ITS IMPLICATIONS IN BREEDING FOR LOW INPUT OF NITROGEN FERTILIZER LEVELS IN BREAD WHEAT

A. A. Swelam and Manal, A. Hassan

Agriculture Research Center, Crop Research Institute, wheat research section

(Received: Jun. 14, 2007)

ABSTRACT: *Combining ability and genetic variance for spike length, plant height, number of spikes/plant, number. of grains/spike, 1000-grain weight and grain yield/plant were investigated under three nitrogen fertilizer levels; 30 kg N/fed (low), 60 Kg N/fed (recommended) and 90 Kg N/fed (high) using diallel cross among six diverse bread wheat genotypes, excluding reciprocals. The obtained data were statistically and genetically analysed according to Griffing (1956 a and b) and Hayman (1954 a and b).*

Results revealed the importance of GCA and SCA variances in the genetic control of all characters studied under all nitrogen levels. The GCA variances were greater in magnitude than SCA ones for all studied characters under various levels of nitrogen, except plant height (30 Kg N/fed), Number of spikes/plant (30 and 60 Kg N/fed) and grain yield/plant (60 and 90 Kg N/fed), where SCA variances made up the most part of the total variation. Association between GCA effects and the mean performance of the parental genotypes variations were insignificant in most characters studied under various nitrogen doses, indicating that good general combiner parents could not be identified on the basis of mean performance. The two local wheat cultivars Giza 168 and Sakha 93 as well as line 116 having positive, high and significant GCA effects under the three nitrogen levels for spike length, number of grains/spike and number of spikes/plant (Giza 168), 1000-grain weight (Sakha 93) and plant height and grain yield/plant (Line 116). These parents are considered as good general combiners when applying low, medium and high nitrogen fertilizer levels. Line 116 is the most promising parent, since it contained positive and significant GCA effects for spike length, number of spikes/plant and 1000-grain weight under low nitrogen level; 30 Kg N/fed, giving evidence that this parent would be of great interest in breeding programme for improving grain yield under low input of nitrogen fertilizer for wheat production.

Cross combinations; Giza 168×Gemmeiza 10, Sakha 93×Line 28 and Sids 1×Line 28 gave desirable SCA effects for plant height under 3 nitrogen levels. Meanwhile, Sakha 93×Line 116 and Sids 1×Line 28 gave positive and significant SCA effects for spike length under the 3 levels of nitrogen. Also, Sids 1×Line 28 gave desirable SCA effects for number of grains/spike under low input nitrogen. Cross combinations; Sakha 93× Sids 1 and Line 28×Sids 1 and Line 28×Gemmeiza 10 gave positive and significant SCA effects for no

grains/spike. Also, hybrids of bread wheat; Giza 168×Line 116 and Line 28×Gemmeiza 10 gave positive and significant SCA effects for 1000- grain weight under low level of nitrogen. Also, Sids 1×Gemmeiza 10, Giza 168×Line 116 and Line 28×Gemmeiza 10 cross combinations gave desirable SCA effects for plant height .

For genetic components, the dominance gene effects accounted for the most part of the total variation for all characters resulting $(H_1/D)^{1/2}$ more than one under various nitrogen levels. Both positive and negative alleles ($H_2/4H_1$) were unequally distributed among parents for all characters studied under low, medium and high nitrogen levels. Heritability in narrow sense $T_{(n)}$ were in most cases low, except for spike length under 30 Kg N/fed (0.54) and 90 Kg N/fed (0.558) as well as grain yield/plant under medium nitrogen levels 60 Kg N/fed (0.628).

These information are of great attention for wheat breeder aiming to breed wheat genotypes that are more productive under low nitrogen input to sustain clean environment, especially for soil, ground water and grain yield.

Key words: Combining ability – gene action – heritability – additive and non additive – wheat.

INTRODUCTION

In the initial stages of breeding programme, breeders need general knowledge about combining ability, gene action and genetic system controlling the inheritance of the studied characters. The dialled analysis procedure, is more refinement technique providing detailed of genetic informations about specific genotype before evaluated in breeding programme. Many research workers used diallel technique to obtain genetical information for yield and its components in wheat under various nitrogen levels (El Morshidy *et al.*, 2001, El-Nagar, 2003, Allam 2005 and Koumber and Esmail, 2005).

General combining ability in wheat were studied under Egyptian conditions and stated that additive and non-additive gene action played a great role in controlling yield and yield components under various environments (Abd El-Aty, 2000, El-Beially and El Sayed 2002, Abd El-Aty, 2004 and Abd El-Aty and Hamad, 2006).

Genetic components of yield and its components were studied by many investigators and indicated that dominance gene effect played a great role in the genetics of yield and yield components. Heritability values and various distribution of positive and negative alleles were investigated under various environmental conditions by many investigators i.e. Al kaddoussi *et al.*, (1994) and Salem *et al.*, (2003).

Grain yield is quantitatively inherited characters and much affected by environmental fluctuations. Thus, direct selection for yield is misleading. Assessment and quantifying the types of gene action for yield attributes may help breeder for choosing the appropriate method to improve grain yield

indirectly. Several studies were employed to ascertain the mode of gene action. In this respect, Edwards *et al.*, (1976) and Ketata *et al.*, (1976) on bread wheat reported that, both additive and non-additive gene effects governed the inheritance of grain yield and its components. The non-allelic interaction of duplicate types for grain yield/plant Gurdev Singh *et al.*, (1984) and Patel and Bains, (1984).

The main objectives of this study are to test the effect of three nitrogen levels; 30, 60 and 90 Kg N/fed on the different genetic components controlling grain yield and its components and identifying the most promising genotypes of 21 genotypes studied i.e., 6 parents + 15 F₁'s to be involved in breeding programme for low input of nitrogen fertilizer to sustain clean environment and hoping to produce high grain yield with less nitrogen through estimating:

- 1- Combining ability effects of both general (GCA) (6 parents) and specific (SCA) for 15 F₁'s resulted from half diallel aiming to isolate good general combiners and good crosses to be involved in breeding programme for low input of nitrogen fertilizer.
- 2- Genetic components of variance under the studied environments for planning the effective and desirable breeding programme under Egyptian conditions.

MATERIALS AND METHODS

I. Description of the materials studied:

Six genetically diverse bread wheat genotypes were crossed in a half diallel mating system to obtain 21 genotypes; 15 F₁'s seeds + 6 parents during the winter season of 2004/2005 at Kafr El-Hammam Agriculture, Research Station, Zagazig, Sharkia Governorate, Agriculture Research Center (ARC), Giza, Egypt. The pedigree and origin of the parents studied are given in Table (1).

Table (1): pedigree and origin of the studied wheat genotypes :

No.	Genotypes	Pedigree	Origin
1	Sakha 93	Sakha 92 / LTR 810328	Egypt
2	Giza 168	Mn / Bue // seri	Egypt
3	Sids 1	HD 2172/pavon "s"//1158.57 Sr/ Maya 74 "s"	Egypt
4	Line 116	ALD / CEP75630 // CEP75234 / PT7219 / 3 / BUC / BGY / 4 /	CIMMYT
5	Line 28	SARA // JUP / BGY / 3 / KAUZ / 4 / BABAX / 6 / FRTL	CIMMYT
6	Gemmiza 10	MAY47 "s" / ON // 1160-147 / 3 / BB / GLL / 4 / CHAT "s" / 5 / CROW "s"	Egypt

These six parents and their respective 15 F₁'s seeds were sown on 15th November 2005 in a randomized complete block design with three replicates. Each of the three nitrogen levels i.e., 30 Kg N/fed (low), 60 Kg N / fed (recommended) and 90 Kg N/fed (High level) were applied and each nitrogen level represented a separate experiment., (21 genotypes × 3 replicates),

aiming to search the effect of nitrogen levels on combining ability effects, general (additive) and specific combining ability (non-additive) and partitioning the total genetic variance into its components of additive and dominance gene effects using diallel analysis techniques developed by Hayman, (1954 a and b) .

The experimental plot consisted of two rows (female parent), 1 row (F_1) and two rows (male parent). Row to row spacing was 20 cm, plant to plant distance was 10 cm. The row length was 3m. The plot area was 3m².

II. Recorded data:

The following characters were recorded at the proper time employing 10 guarded and competitive plants at harvest .

1. Plant height (cm.).
2. Spike length (cm.).
3. Number of spikes/plant .
4. Number of grains/plant : average mean of 10 main spikes .
5. 1000-grain weight (gm) : average mean of two random samples and the difference between them did not exceed 3%.
6. Grain yield/plant (g) : average mean of 10 guarded and competitive plants.

III. Biometrical analysis.

The obtained data were subjected to statistical analysis according to Steel and Torrie (1980).

A. Combining ability: Combining ability effects i.e., general GCA (additive) and specific combining ability SCA (non-additive) were estimated according to Griffing (1956 a and b), Model 1, Methods 2. Rank correlation between combining ability effects and both of parents and their F_1 's mean performances were computed to detect the association between the means and combining ability effects.

B. Components of genetic variance: were estimated using the methods that outlined by Hayman (1954 a and b).

RESULTS AND DISCUSSION

I. Combining ability

1. Analysis of variances:

Mean squares for combining ability (Table, 2) showed that, genotypes item (parents and the F_1 's) were highly significant under various nitrogen levels for all characters studied, indicating the presence of fair amount of genetic variability which considered adequate for further biometrical assessment.

Variances due to general (GCA) and specific (SCA) combining ability were highly significant for all characters studied under 30, 60 and 90 Kg N/fed. suggesting the presence of additive and non-additive gene effects in the genetics of these characters.

Table (2): Mean squares for general (GCA) and specific (SCA) combining ability for some agronomic traits, grain yield and its components under different nitrogen levels (30, 60 and 90 Kg N/fed) for some bread wheat genotypes.

S.O.V	d.f.	Spike length (cm)			Plant height (cm)			Number of spikes/plant		
		(30 Kg N/fed)	(60 Kg N/fed)	(90 Kg N/fed)	(30 Kg N/fed)	(60 Kg N/fed)	(90 Kg N/fed)	(30 Kg N/fed)	(60 Kg N/fed)	(90 Kg N/fed)
Genotypes (G)	20	4.173 ^{***}	3.595 ^{***}	2.189 ^{***}	94.550 ^{***}	84.520 ^{***}	104.950 ^{***}	3.295 ^{***}	20.350 ^{***}	8.406 ^{***}
δ^2 GCA	5	2.218 ^{***}	2.326 ^{***}	1.398 ^{***}	26.602 ^{***}	28.526 ^{***}	48.654 [*]	0.762 ^{***}	7.812 ^{***}	1.162 ^{***}
δ^2 SCA	15	1.130 ^{***}	0.991 ^{***}	0.524 ^{***}	66.138 ^{***}	28.065 ^{***}	22.805	1.196 ^{***}	6.598 ^{***}	3.314 ^{***}
Error	-	0.041	0.100	0.060	9.56	12.24	23.003	0.250	0.178	0.116
δ^2 GCA δ^2 SCA		1.962	2.347	2.667	0.400	1.016	2.133	0.637	1.183	0.350
		Number of grains/spike			1000-grain weight (g.)			Grain yield/plant (g.)		
		(30 Kg N/fed)	(60 Kg N/fed)	(90 Kg N/fed)	(30 Kg N/fed)	(60 Kg N/fed)	(90 Kg N/fed)	(30 Kg N/fed)	(60 Kg N/fed)	(90 Kg N/fed)
Genotypes (G)	20	216.31 ^{***}	222.45 ^{***}	216.438 ^{***}	58.900 ^{***}	54.549 ^{***}	37.51 ^{***}	71.11 ^{***}	124.88 ^{***}	58.90 ^{***}
δ^2 GCA	5	138.71 ^{***}	74.14 ^{***}	149.77 ^{***}	25.082 ^{***}	22.570 ^{***}	25.01 ^{***}	33.522 ^{***}	40.942 ^{***}	2.17 ^{***}
δ^2 SCA	15	49.88 ^{***}	24.72 ^{***}	46.27 ^{***}	17.770 ^{***}	14.395 ^{***}	8.288 ^{***}	20.368 ^{***}	41.887 ^{***}	26.926 ^{***}
Error	-	5.304	5.659	5.106	0.672	0.532	5.406	1.879	2.800	3.017
δ^2 GCA δ^2 SCA		2.78	2.99	3.23	1.411	1.567	3.023	1.647	0.977	0.080

Variances due to GCA were higher in magnitude than SCA ones $\delta^2\text{GCA}/\delta^2\text{SCA}$ for all characters, except plant height (N1), number of spikes/plant (N1 and N3) and grain yield/plant (N2 and N3). These results indicated that additive gene action was the prevailed type in the inheritance of these characters. These results are supported by $\delta^2\text{GCA}/\delta^2\text{SCA}$ which were found to be exceeded the unity and indicated that additive gene action played great role in the inheritance of these characters. On the other hand, over dominance towards the lower parent was controlled in the inheritance of plant height (30 kg N/fed), number of spikes/plant (30 and 90 kg N/fed) and grain yield/plant under 90 kg N/fed. These results are in agreement with those obtained by (Alkaddoussi, et al., 1994, El-Beially 2002 and Abd-El Aty 2004).

Genotype - environment interaction is often described as an inconsistent differences among genotype from one environment to another. The inconsistency may arise from two reasons, one being the differences in response of the same set of genes to different environment and the other being the expression of different sets of genes in various environments (Cockerham, 1963).

The mean performance and GCA effects for spike length, plant height, number of spikes/plant, 1000-grain weight, number of grains/spike and grain yield/plant under the three levels of nitrogen; 30, 60 and 90 Kg N/fed are given in Tables (3, 4 and 5).

The results showed that the two parameters i.e., mean performance (\bar{X}) and (GCA) effects were not directly related to each others in most cases. These results are confirmed by rank correlation $r(s)$ which were insignificant in most characters. Thus, when the character is unidirectional controlled by non-additive gene effects, choice of the parents on the basis of per se performance may be ineffective.

2. General combining ability effects (GCA).

The concept of combining ability has become increasingly important in plant breeding. It is especially useful to study and compare between the performance of lines in hybrid combinations. Combining ability has been proved by many workers to explain an inherited character. Moreover, it looks to be of special interest in a way that some commercial cultivars, despite of being the best in their agronomic characters, yet they are low combiner when used as parents. Meanwhile, because of the difficulties caused by linkage of genes in the parents, genetic interpretation of statistics showed to be attempted only when the parents of diallel cross has been produced by a laborious process of a random mating followed by nonselective inbreeding. Since, few diallel experiments meet this requirement, most analysis showed to be limited for estimating general and specific combining ability mean squares and effects. Such information is useful in measuring hybrid performance or in assessing the potentialities of hybrid breeding programme (Baker, 1978).

Table (3): General combining ability effects (GCA) under various nitrogen levels and mean performance (\bar{X}) for the studied bread wheat genotypes for spike length (cm.) and plant height (cm.).

Genotypes	Spike length (cm.)						Plant height (cm.)					
	(30 Kg N/fed)		(60 Kg N/fed)		(90 Kg N/fed)		(30 Kg N/fed)		(60 Kg N/fed)		(90 Kg N/fed)	
	GCA	\bar{X}	GCA	\bar{X}	GCA	\bar{X}	GCA	\bar{X}	GCA	\bar{X}	GCA	\bar{X}
Sakha 93	-3.467 ^{***}	11.6	-5.000 ^{***}	11.3	0.033	12.0	1.550	102.6	2.400 [*]	106.3	7.270 ^{***}	100.0
Giza 168	2.833 ^{***}	11.2	5.300 ^{***}	13.2	5.835 ^{***}	12.8	2.613 ^{***}	109.0	21.100 ^{***}	114.3	31.770 ^{***}	119.3
Sids 1	0.735	9.5	2.400 ^{***}	10.1	0.433 ^{***}	10.6	0.013	93.0	-5.100 ^{***}	95.0	4.370 ^{***}	97.3
Line 116	1.133 [*]	10.9	0.700 ^{***}	10.9	0.233	11.1	-2.125 [*]	96.0	-18.200 ^{***}	104.0	-26.250 ^{***}	100.6
Line 28	-6.367 ^{***}	10.6	-4.00 ^{***}	9.9	-3.667 ^{***}	11.9	-1.65	107.0	12.800 ^{***}	104.3	-4.730 ^{***}	110.3
Gemmeiza 10	5.135 ^{***}	12.2	0.600 ^{***}	10.6	-2.867 ^{***}	10.5	-0.400	109.0	-13.000 ^{***}	106.6	-12.430 ^{***}	104.6
S.E. ¹	0.495		0.102		0.079		0.997		1.129		0.471	
r (s) ²	-0.056		0.657		0.772		0.143		0.086		0.829 [*]	

$$^1 \text{ S.E (GCA) = standard error} = \sqrt{\frac{(n-1)}{n(n+1)} \delta^2 e}$$

$$^2 r (s) = \text{rank correlation} = 1 - \frac{6 \sum d^2}{n(n^2-1)}$$

Table (4): General combining ability effects (GCA) under various nitrogen levels and mean performance (\bar{X}) for the studied bread wheat genotypes for Number of spikes/plant and Number of grains/spike.

Genotypes	Number of spikes/plant						Number of grains/spike					
	(30 Kg N/fed)		(60 Kg N/fed)		(90 Kg N/fed)		(30 Kg N/fed)		(60 Kg N/fed)		(90 Kg N/fed)	
	GCA	\bar{X}	GCA	\bar{X}	GCA	\bar{X}	GCA	\bar{X}	GCA	\bar{X}	GCA	\bar{X}
Sakha 93	-1.333	10.1	8.200	9.9	1.967	12.4	2.43	33.0	1.92	55.0	2.48	57.3
Giza 168	4.665	11.7	5.200	10.5	4.665	15.2	4.69	68.6	4.41	70.3	3.20	67.6
Sids 1	-1.533	10.1	-13.700	8.2	-3.633	10.2	-2.68	58.6	-2.71	59.6	-1.95	60.0
Line 116	0.567	11.4	-2.400	11.2	-0.433	13.8	-0.47	54.6	0.13	57.0	0.37	60.0
Line 28	-0.333	9.8	-1.900	10.8	-2.733	15.8	-0.295	58.0	-3.38	58.3	-4.07	57.0
Gemmelza 10	-2.033	9.6	4.600	11.6	0.167	13.9	-1.02	70.0	-0.67	73.3	-0.03	76.0
S.E.	0.161		0.136		0.109		0.763		0.788		0.749	
r (s)	0.086		-0.028		0.257		0.370		-0.020		0.250	

Table (5): General combining ability effects (GCA) under various nitrogen levels and mean performance (\bar{X}) for the studied bread wheat genotypes for 1000-grain weight (g.) and grain yield/plant (g.)

Genotypes	1000-grain weight (g.)						Grain yield/plant (g.)					
	(30 Kg N/fed)		(60 Kg N/fed)		(90 Kg N/fed)		(30 Kg N/fed)		(60 Kg N/fed)		(90 Kg N/fed)	
	GCA	\bar{X}	GCA	\bar{X}	GCA	\bar{X}	GCA	\bar{X}	GCA	\bar{X}	GCA	\bar{X}
Sakha 93	2.500	39.7	23.433	42.6	15.500	46.0	1.35	20.3	0.55	23.6	3.08	30
Giza 168	-0.300	39.8	-9.865	44.1	-21.600	43.4	1.15	22.2	2.00	23.2	0.38	24
Sids 1	-20.700	35.3	-5.967	48.8	-4.500	42.7	-0.18	23.2	-1.43	22.8	-0.09	22.1
Line 116	12.900	43.0	-8.967	49.3	2.200	46.4	-0.04	21.3	0.25	22.3	-1.53	24.1
Line 28	16.700	39.7	9.033	54.1	-6.600	52.4	-1.13	20.2	-0.54	20.5	-0.37	26.7
Gemmeiza 10	-11.100	37.5	-7.667	45.2	15.000	52.5	-1.15	19.3	-0.83	20.8	-1.47	21.1
S.E.	0.264		0.233		0.750		0.472		0.554		0.576	
r (s)	-0.142		0.229		-0.428		0.320		0.870		0.250	

Data in Tables (3, 4 and 5) show (GCA) effects for the studied genotypes of wheat under three levels of nitrogen fertilization 30, 60, and 90 Kg N/fed.

The results showed that, Giza 168 possessed positive and significant (GCA) effects for spike length, number of spikes/plant and number of grains/spike. Also, Line 116 exhibited desirable and significant (GCA) effects for plant height as well as Sakha 93 had positive and significant (GCA) effects for 1000-grain weight and number of grains/spike. These effects were detected under the three levels of nitrogen, indicating that these parents are good general combiners for these characters under low, medium and high nitrogen levels and may be involved in breeding programme for improving such characters under low, medium and high nitrogen levels. Similar results were obtained by Alkaddoussi *et al.*, (1994), El Nagar (2003) and Allam (2005).

Positive and significant (GCA) effects were detected under 30 and 60 Kg N/fed by Giza 168 for grain yield/plant, Line 28 for 1000-grain weight and Gemmeiza 10 for spike length. These parents are considered to be good general combiners for the above mentioned characters. Consequently, these parents could be included in breeding programme for improving these characters under low and medium input of nitrogen fertilizer in wheat.

For medium nitrogen fertilizers (60 Kg N/fed) and high ones (90 Kg N/fed), three genotypes i.e., Sakha 93 proved to be good general combiner for number of spikes/plant and grain yield/plant, Sids1 was also found to be good general combiners for spike length and Gemmeiza 10 was good combiner for plant height, spike length and grain yield/plant, Since they had positive and significant GCA effects. These results are confirmed that these cultivars would be good general combiners under both medium and high levels of nitrogen and would be of interest in breeding programmes under these conditions.

Line 116 had a positive and significant GCA effects for spike length, number of spikes/plant and 1000-grain weight under 30 Kg N/fed, giving an evidence that, this genotype may be involved in breeding programme for low input of nitrogen fertilizer in wheat, so, sustain the environment clean either soil or water and produce wheat which could be contain low concentration of nitrogen. These results are supported by Koumber and Esmail, 2005 and Abd El-Aty and Hamad, 2006.

Two parents of wheat had desirable GCA effects under 60 Kg N/fed i.e., Sids 1 for plant height, spike length and number of spikes/plant and Gemmeiza 10 for spike length, number of spikes/plant and number of grains/spike. Consequently these parents are good general combiners for the desirable characters and could be involved in breeding programme under medium nitrogen fertilizer levels. Meanwhile, Gemmeiza 10 for plant height, number of spikes/plant and 1000-grain weight gave desirable and significant GCA effect under higher nitrogen levels. The most promising parent is L116 since it showed positive and significant GCA effects for spike length, number of spikes/plant and 1000-grain weight under 30 Kg N/fed. This parent are of great interest in breeding programme under low input of nitrogen fertilizer.

Specific combining ability effects (SCA)

Specific combining ability effects which are presented in Tables (6, 7 and 8) revealed that, the best crosses displayed desirable and significant SCA effects for 1000-grain weight cross 1×4 (all N levels) and 2×6 (1st and 3rd level) as well as plant height for crosses 1×5 and 2×6. Meanwhile, under low, (30 Kg N/fed) and medium (60 Kg N/fed) nitrogen levels had desirable SCA effects for crosses 2×4 and 4×5 (grain yield/plant) Meanwhile, crosses number, 1×4, 1×5, 1×6, 2×4, and 3×5 gave desirable and significant SCA effects for no. of spikes/plant and crosses 1×4, 1×5, 1×6, 2×4 and 3×5 exhibited also, significant SCA effects for number of grains/spike. Significant and positive SCA were recorded under 60 Kg N/fed for 1×4, 2×4, 3×4, 3×5 and 5×6. Also positive and significant SCA were recorded under 90 Kg N/fed for 1×4, 1×5, 1×6, 2×4, 3×4 and 3×5 cross combinations.

The crosses number, 1×6, 2×3, 2×5, 2×6, 3×5 and 3×6 gave desirable and significant SCA effects for spike length under low nitrogen levels. On the other hand, hybrids, 1×2, 1×5, 1×6, 2×6 and 5×6 gave negative and significant SCA effects for plant height. Also, cross 3×6 gave positive and significant for number of spikes/plant, cross number, 3×4, 1×4, 1×5, 2×4 and 3×5 for number of grains/spike and 1×4, 2×4, 2×5, and 2×6 for 1000-grain weight which were positive and significant SCA effects under low nitrogen level. For the crosses 1×2, 1×4 and 4×5. These results were detected under low nitrogen level, indicating that these crosses may be involved in breeding programme for low input of nitrogen fertilizer level in wheat improvement and that may keep the environment clean. Thus, these crosses displayed high potential of heterotic effects for more than three characters, enhancing their valuable as a promising crosses and the crosses which contain Giza 168 and line 116 are expected to produce high yield and dwarf genotypes. Since, the local cultivars Sakha 93, Giza 168 and Gemeiza 10 were involved in most promising crosses and were found to have high (GCA) effects for yield and some of yield components i.e. Gemeiza 10 (spike length) and Sakha 93 (1000-grain yield) . Such properties reinforce its importance in breeding programme to improve yield under low input of nitrogen fertilizer in bread wheat.

Generally, the present investigation revealed that, both additive and non-additive gene effects were involved in the inheritance of the various characters under various levels of nitrogen; low (30 Kg N/fed), medium (60 Kg N/fed) and high (90 Kg N/fed).

Under such situation maximum grain yield may be attainable with system that can exploit additive and non-additive gene effects simultaneously. In this respect, population improvement biparental mating as well as mating of selected plants under various nitrogen levels, especially low, level for low input, in early segregating generations could help in developing populations having optimum levels of homozygosity and heterozygosity of the loci (Winder and Lebsack, 1973).

Table (6): Specific combining ability effects (SCA) and mean performance (\bar{X}) for spike length and plant height characters in bread wheat under three levels of nitrogen fertilization.

Crosses	Spike length (cm.)						Plant height (cm.)					
	(30 Kg N/fed)		(60 Kg N/fed)		(90 Kg N/fed)		(30 Kg N/fed)		(60 Kg N/fed)		(90 Kg N/fed)	
	SCA	\bar{X}	SCA	\bar{X}	SCA	\bar{X}	SCA	\bar{X}	SCA	\bar{X}	SCA	\bar{X}
1×2 = Sakha 93 × Giza 168	-0.865 ¹	11.0	0.382	12.8	0.651 ¹	13.1	-4.025 ¹	101.0	-1.503	105.0	1.208	108.0
1×3 = Sakha 93 × Sids 1	0.345	12.2	0.682 ¹	13.1	-0.249	13.2	0.275	105.3	-4.203	102.3	-2.792	104.0
1×4 = Sakha 93 × L 116	-1.255 ¹	10.6	-1.218 ¹	11.2	-1.849 ¹	10.9	2.275 ¹	107.3	0.497	107.0	-0.492	106.3
1×5 = Sakha 93 × L 28	-0.955 ¹	10.9	-1.618 ¹	10.8	-1.449 ¹	11.0	-5.725 ¹	99.3	-7.203 ¹	99.3	-9.192 ¹	99.6
1×6 = Sakha 93 × Gemmeiza 10	0.945 ¹	12.8	-0.618 ¹	11.8	-1.449 ¹	11.0	-5.725 ¹	99.3	-7.903 ¹	98.9	-6.192	100.6
2×3 = Giza 168 × Sids 1	1.495 ¹	13.3	0.372	13.0	-0.179	12.8	5.465 ¹	110.0	0.457	109.6	1.678	112.3
2×4 = Giza 168 × L 116	-1.605 ¹	10.2	-1.428 ¹	11.2	0.321	12.8	1.465	109.0	1.457	109.6	-0.322	110.3
2×5 = Giza 168 × L 28	0.795 ¹	11.6	-1.528 ¹	11.1	-0.679 ¹	11.8	5.765 ¹	110.3	1.157	109.3	-6.322	110.3
2×6 = Giza 168 × Gemmeiza 10	1.095 ¹	12.9	-0.128	12.5	-0.379	12.1	-6.535 ¹	101.0	-5.143 ¹	103.0	-9.622 ¹	101.0
3×4 = Sids 1 × L 116	0.245	10.9	0.842 ¹	11.3	-0.089	11.2	5.325 ¹	108.6	9.897 ¹	107.0	1.948	108.0
3×5 = Sids 1 × L 28	0.695 ¹	11.3	1.142 ¹	12.6	1.511 ¹	12.8	9.325 ¹	112.6	7.897 ¹	115.0	11.548 ¹	117.6
3×6 = Sids 1 × Gemmeiza 10	2.945 ¹	13.6	1.342 ¹	12.8	1.311 ¹	12.6	5.725 ¹	109.0	-2.103	108.0	4.548	110.6
4×5 = L 116 × L 28	-0.635 ¹	9.5	-0.728 ¹	9.8	-0.439 ¹	10.8	-0.815	104.0	0.557	108.6	0.178	108.6
4×6 = L 116 × Gemmeiza 10	0.265	10.4	0.772 ¹	11.3	-0.639 ¹	10.6	-4.515 ¹	100.3	-2.443	105.6	-0.822	105.6
5×6 = L 28 × Gemmeiza 10	-0.975 ¹	10.6	1.492 ¹	12.6	0.361	12.7	-2.465 ¹	103.6	-0.213	104.6	-2.152	103.3
S.E. ¹	0.195		0.292		0.179		1.380		2.560		3.510	

¹ S.E (SCA) = standard error = $\sqrt{\frac{2(n-1)}{(n+1)(n-2)} \delta^2 e}$

Table (7): Specific combining ability effects (SCA) and mean performance (\bar{X}) for Number of spikes/plant and Number of grains/spike characters in bread wheat under 3 levels of nitrogen.

Crosses	Number of spikes/plant						Number of grains/spike					
	(30 Kg N/fed)		(60 Kg N/fed)		(90 Kg N/fed)		(30 Kg N/fed)		(60 Kg N/fed)		(90 Kg N/fed)	
	SCA	\bar{X}	SCA	\bar{X}	SCA	\bar{X}	SCA	\bar{X}	SCA	\bar{X}	SCA	\bar{X}
1×2 = Sakha 93 × Giza 168	0.605	11.5	3.969 ^{***}	11.9	-0.946 ^{***}	12.4	-2.36 [*]	66.0	-1.62	68.3	1.10	71.0
1×3 = Sakha 93 × Sids 1	-1.595 ^{***}	9.3	-2.731 ^{***}	10.2	0.054	13.4	1.03	62.0	1.91	65.0	1.25	66.0
1×4 = Sakha 93 × L 116	0.105	11.0	0.469	13.4	-0.646 [*]	12.7	7.81 ^{***}	71.0	7.36 ^{***}	73.0	4.63 ^{***}	71.6
1×5 = Sakha 93 × L 28	0.305	11.2	-0.831 ^{***}	12.1	-0.946 ^{***}	12.4	10.30 ^{***}	71.0	10.47	72.6	11.98 ^{***}	74.6
1×6 = Sakha 93 × Gemmeiza 10	-1.795 ^{***}	9.1	0.369	13.3	0.254	13.6	9.38 ^{***}	72.0	6.76	71.6	4.94 ^{***}	71.6
2×3 = Giza 168 × Sids 1	-1.335 ^{***}	9.3	-1.621 ^{***}	9.9	-0.546 [*]	12.4	-0.24	63.0	1.02	66.6	-1.16	64.3
2×4 = Giza 168 × L 116	0.665	11.3	0.879 ^{***}	12.4	0.854 ^{***}	13.8	14.55 ^{***}	80.0	14.17 ^{***}	82.3	14.51 ^{***}	82.3
2×5 = Giza 168 × L 28	0.165	10.8	4.879 ^{***}	11.4	0.154	13.1	-0.36	62.6	-4.02 ^{***}	60.6	-2.34 [*]	61.0
2×6 = Giza 168 × Gemmeiza 10	-0.535	10.1	5.179 ^{***}	11.7	-0.646 [*]	12.3	-7.69 ^{***}	57.3	-5.33 ^{***}	62.0	-6.07 ^{***}	61.3
3×4 = Sids 1 × L 116	-0.915 ^{***}	9.1	1.969 ^{***}	12.6	-1.416 ^{***}	12.6	-1.47	56.6	5.69 ^{***}	57.0	7.96 ^{***}	70.6
3×5 = Sids 1 × L 28	0.685	10.7	4.260 ^{***}	14.0	1.784 ^{***}	13.8	4.71 ^{***}	60.3	2.21 [*]	60.0	3.81 ^{***}	62.0
3×6 = Sids 1 × Gemmeiza 10	1.585 [*]	11.6	-0.231	11.4	3.484 ^{***}	15.5	-9.51 ^{***}	48.0	-12.51 ^{***}	48.0	-11.22 ^{***}	51.0
4×5 = L 116 × L 28	-2.235 ^{***}	7.8	0.429	11.8	-1.516 ^{***}	11.2	-7.80 ^{***}	50.0	-7.04 ^{***}	53.3	1.49	50.0
4×6 = L 116 × Gemmeiza 10	-0.635	9.4	-1.771 ^{***}	11.6	-1.616 ^{***}	11.1	-1.72	58.0	-6.46 ^{***}	56.6	-6.55 ^{***}	58.0
5×6 = L 28 × Gemmeiza 10	0.475	10.3	3.319 ^{***}	12.5	-3.486 ^{***}	13.6	-12.24 ^{***}	45.0	4.54 ^{***}	55.0	-4.80 ^{***}	55.3
S.E	0.365		0.308		0.249		0.949		0.980		0.931	

Combining ability and genetic components for yield and its

Table (8): Specific combining ability effects (SCA) and mean performance (\bar{X}) for 1000-grain weight (g.) and grain yield/plant (g.) characters in bread wheat under 3 levels of nitrogen.

Crosses	1000-grain weight (g.)						Grain yield/plant (g.)					
	(30 Kg N/fed)		(60 Kg N/fed)		(90 Kg N/fed)		(30 Kg N/fed)		(60 Kg N/fed)		(90 Kg N/fed)	
	SCA	\bar{X}	SCA	\bar{X}	SCA	\bar{X}	SCA	\bar{X}	SCA	\bar{X}	SCA	\bar{X}
1×2 = Sakha 93 × Giza 168	-1.599 ^{***}	41.2	4.493 ^{***}	46.6	2.110	46.3	7.43 ^{***}	30.4	5.42 ^{***}	32.3	4.31 ^{***}	34.6
1×3 = Sakha 93 × Sids 1	-1.899 ^{***}	40.9	-6.807 ^{***}	45.3	5.110 ^{***}	49.3	-2.22 ^{***}	19.4	-9.18 ^{***}	19.3	2.68 ^{***}	32.5
1×4 = Sakha 93 × L 116	13.701 ^{***}	46.5	5.013 ^{***}	47.2	3.710 ^{***}	47.9	7.05 ^{***}	25.8	4.37 ^{***}	29.5	1.53 ^{***}	29.9
1×5 = Sakha 93 × L 28	-5.799 ^{***}	37.0	-5.993 ^{***}	48.1	2.810	47.0	-1.17 ^{***}	19.5	-4.14 ^{***}	20.2	6.76 ^{***}	26.3
1×6 = Sakha 93 × Gemmeiza 10	-2.099 ^{***}	40.7	3.593 ^{***}	45.7	1.810	46.0	-2.44 ^{***}	18.2	2.14 ^{***}	26.2	0.66	29.1
2×3 = Giza 168 × Sids 1	0.401	39.0	-1.977 ^{***}	40.5	-2.750	40.6	-8.43 ^{***}	18.0	-1.23	23.6	-1.12	26.0
2×4 = Giza 168 × L 116	3.501 ^{***}	42.1	-0.077	42.4	-3.350	40.0	-2.27 ^{***}	19.3	-1.98 ^{***}	24.6	-1.47 ^{***}	24.2
2×5 = Giza 168 × L 28	7.901 ^{***}	46.5	0.723	43.2	-9.50	42.4	-1.18 ^{***}	19.3	1.71 ^{***}	27.5	-1.44 ^{***}	25.4
2×6 = Giza 168 × Gemmeiza 10	1.301 ^{***}	39.9	-1.977 ^{***}	40.5	5.250 ^{***}	48.6	0.55	21.0	6.39 ^{***}	31.9	6.86 ^{***}	32.6
3×4 = Sids 1 × L 116	-0.829	39.3	-0.847	44.0	1.180	46.4	-1.73 ^{***}	18.5	1.36	24.5	0.99	26.2
3×5 = Sids 1 × L 28	-1.229 ^{***}	39.5	0.353	45.2	7.780 ^{***}	53.0	0.66	19.8	3.84 ^{***}	26.2	.63 ^{***}	33.0
3×6 = Sids 1 × Gemmeiza 10	-2.129 ^{***}	38.6	-2.147 ^{***}	42.7	1.880	47.1	0.48	19.6	-2.47 ^{***}	19.6	-0.07	25.2
4×5 = L 116 × L 28	-0.329	43.3	-1.617 ^{***}	46.9	-1.420	46.3	1.32 ^{***}	17.6	3.86 ^{***}	27.9	-1.52 ^{***}	23.4
4×6 = L 116 × Gemmeiza 10	-5.729 ^{***}	37.9	-7.317 ^{***}	41.2	-1.420	46.3	-0.25	19.0	2.46 ^{***}	21.2	-0.22	23.6
5×6 = L 28 × Gemmeiza 10	5.251 ^{***}	45.4	-3.317 ^{***}	43.1	-2.120	48.3	-0.67	17.5	0.23	23.2	1.69 ^{***}	23.3
S.E	0.60		0.529		1.701		0.579		0.707		0.733	

II. Genetic components:

Estimation of the genetic variance component of variations and the derived ratios (Tables, 9 and 10) indicated significant additive genetic variances under the three levels of nitrogen for plant height, number of spikes/plant, number of grains/spike. Meanwhile, it was significant for 1st and 3rd level of nitrogen for; 1000-grain weight and grain yield/plant as well as at 1st and 2nd nitrogen levels for spike length.

The dominance components was significant for all characters studied under all the three studied nitrogen fertilizer levels of nitrogen.

The average degree of dominance (H_1/D)^{1/2} were more than unity for all characters studied under the three studied levels of nitrogen fertilizer, confirming the role of dominance gene effects in controlling yield and yield components under various levels of nitrogen fertilizer. Similar conclusions were obtained by (Salem *et al.*, 2003 and El-Nagar 2003).

The dominance components, H_1 and H_2 were significant for all the characters studied under the three levels of nitrogen i.e., 30, 60 and 90 Kg N/fed. The magnitude of H_1 were larger than that of H_2 , indicating asymmetrical distribution of positive and negative alleles among parents. These results were confirmed by ($H_2/4H_1$) ratio which were less than 0.25 . Also, (F) values were positive for all characters studied under various levels of nitrogen which would indicate that positive alleles were more frequent than negative ones in the parents studied. Heritability in narrow sense $T_{(n)}$ were low, in general, under all studied nitrogen levels for mostly all characters studied, confirming the importance of non-additive gene effects in the genetic system of the studied characters.

Relatively the highest heritability in narrow sense $T_{(n)}$ were obtained for spike length under 30 Kg N/fed and 90 Kg N/fed, indicating that this character could be selected under 30 and 90 Kg N/fed for the longest spike. Also, under 60 Kg N/fed for grain yield/plant, exhibited the highest narrow sense heritability value which valued 0.628. These results are in agreement with those obtained by Salem *et al.*, 2003 and Abd-El Aty 2004.

Discrepancy of these results showed that, nitrogen effects varied from level to another and may be due to the high contribution of genotype-environment interaction which masked the gene expression.

Table (9): Additive (D), Dominance (H) and environmental (E) genetic components together with the derived parameters for plant height (cm.), spike length and number of spikes/plant in (6×6) half diallel cross of breed wheat number 3 levels of nitrogen.

Genetic components	Plant height (cm.)			Spike length (cm.)			Number of spikes/plant		
	(30 kg N/fed)	(60 kg N/fed)	(90 kg N/fed)	(30 kg N/fed)	(60 kg N/fed)	(90 kg N/fed)	(30 kg N/fed)	(60 kg N/fed)	(90 kg N/fed)
D	6.27 [±] 0.51	3.77 [±] 0.64	5.78 [±] 0.69	0.24 [±] 0.10	0.25 [±] 0.05	0.14 [±] 0.05	1.71 [±] 0.12	0.23 [±] 0.11	0.75 [±] 0.14
F	9.61 [±] 1.26	1.67 [±] 1.58	3.24 [±] 1.41	0.03 [±] 0.26	0.07 [±] 0.11	0.01 [±] 1.144	2.86 [±] 0.30	0.05 [±] 1.27	1.08 [±] 0.34
H ₁	18.25 [±] 1.31	12.98 [±] 1.64	8.30 [±] 1.47	0.86 [±] 0.27	0.54 [±] 0.12	0.413 [±] 0.14	1.98 [±] 0.31	4.95 [±] 0.28	3.67 [±] 0.35
H ₂	10.49 [±] 1.17	5.67 [±] 1.47	3.63 [±] 1.31	0.65 [±] 0.24	0.49 [±] 0.10	0.29 [±] 0.13	0.69 [±] 0.27	3.39 [±] 0.25	2.16 [±] 0.31
h ²	24.84 [±] 0.79	3.97 [±] 0.99	1.21 [±] 0.88	0.76 [±] 0.02	3.44 [±] 0.06	0.16 [±] 0.09	0.003 [±] 0.18	19.50 [±] 0.17	2.88 [±] 0.21
E	3.19 [±] 0.19	3.91 [±] 0.24	7.64 [±] 0.21	0.01 [±] 0.04	0.03 [±] 0.01	0.02 [±] 0.02	1.073	0.05 [±] 0.04	0.06 [±] 0.05
Derived parameters									
$\sqrt{H_1/D}$	1.705	1.854	1.198	1.900	1.467	1.693	1.073	4.583	2.212
$[H_2/4H_1]$	0.144	0.109	0.109	0.189	0.223	0.177	0.088	0.171	0.147
K_D/K_R	2.630	1.271	1.611	1.070	1.208	1.081	7.997	1.057	1.744
T_n	0.324	0.465	0.297	0.541	0.434	0.558	0.209	0.441	0.178
T_D	0.602	0.610	0.371	0.964	0.880	0.894	0.747	0.967	0.946

Table (10): Additive (D), Dominance (H) and environmental (E) genetic components together with the derived parameters for number of grains/spike, 1000-grain weight and grain yield/plant (g.) in 6×6 half diallel cross of bread wheat under 3 levels of nitrogen.

	Number of grains/spike			1000-grain weight (g.)			Grain yield/plant		
	(30 kg N/fed)	(60 kg N/fed)	(90 kg N/fed)	(30 kg N/fed)	(60 kg N/fed)	(90 kg N/fed)	(30 kg N/fed)	(60 kg N/fed)	(90 kg N/fed)
D	8.46 [±] 1.84	9.63 [±] 1.56	9.44 [±] 2.34	4.21 [±] 1.12	1.55 [±] 1.12	3.87 [±] 1.26	4.39 [±] 0.49	1.69 [±] 1.22	4.24 [±] 1.12
F	11.29 [±] 4.50	13.13 [±] 3.83	14.61 [±] 3.74	4.81 [±] 3.43	0.71 [±] 3.74	2.98 [±] 3.02	1.85 [±] 1.21	126 [±] 2.99	4.81 [±] 3.43
H ₁	62.37 [±] 4.68	74.11 [±] 3.98	61.82 [±] 3.88	15.76 [±] 3.56	11.29 [±] 2.78	6.83 [±] 3.20	12.78 [±] 1.25	9.57 [±] 3.11	15.76 [±] 3.56
H ₂	52.01 [±] 4.18	46.71 [±] 3.55	46.43 [±] 3.47	13.88 [±] 3.18	10.10 [±] 2.54	5.33 [±] 2.86	11.68 [±] 1.12	5.37 [±] 2.78	13.83 [±] 3.56
h ²	17.14 [±] 2.81	7.34 [±] 2.39	7.39 [±] 2.33	36.41 [±] 2.14	9.17 [±] 1.71	30.05 [±] 1.92	59.22 [±] 0.75	143.42 [±] 1.67	36.41 [±] 2.14
E	1.80 [±] 0.69	1.44 [±] 0.59	1.62 [±] 0.57	0.98 [±] 0.53	0.21 [±] 0.42	1.07 [±] 0.47	0.64 [±] 0.18	0.89 [±] 0.46	0.98 [±] 0.53
Derived parameters									
$\sqrt{H_1/D}$	2.715	2.772	2.568	1.928	2.697	1.327	1.707	2.378	1.428
$[H_2/4H_1]$	0.208	0.157	0.187	0.220	0.223	0.195	0.228	0.140	0.220
K_D/K_R	1.651	1.651	1.984	1.838	1.185	1.815	1.282	1.032	1.838
T_n	0.203	0.455	0.278	0.133	0.270	0.342	0.338	0.628	0.133
T_b	0.903	0.909	0.911	0.807	0.992	0.702	0.880	0.851	0.807

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القدرة للاختلاف ومكونات التباين الوراثي للمحصول ومكوناته
ومدى الاستفادة بها عند التربية للمدخلات المنخفضة
من مستويات التسميد النيتروجيني في قمح الخبز

عبد الله عبد المحسن سويلم و منال عبد الصمد حسن

مركز البحوث الزراعية (ARC) - معهد بحوث المحاصيل الحقلية قسم بحوث القمح .

الملخص العربي

تم دراسة القدرة للاختلاف والتباين الوراثي لطول السنبلة ، وارتفاع النبات ، عدد السنبال/نبات، عدد حبوب السنبلة ، وزن الألف حبة ، ومحصول حبوب/النبات وذلك بتطبيق ثلاثة مستويات من النيتروجين ٣٠ كجم نيتروجين/فدان (منخفض) ٦٠ كجم نيتروجين/فدان (متوسط) ٩٠ كجم نيتروجين للفدان (عالي) . وتم استخدام طريقة الدياليل بالتهجين بين ستة تراكيب وراثية مختلفة من القمح ، مستبعدا الهجن العكسية . وتم تحليل البيانات المتحصل عليها وراثياً وإحصائياً طبقاً لجرفنج (١٩٥٦ أ ، ب) وهايمان (١٩٥٤ أ ، ب) . أوضحت النتائج أهمية كل من تباين القدرة العامة والخاصة للاختلاف في التحكم الوراثي لكل الصفات تحت الدراسة تحت كل مستويات النيتروجين . وكان تباين القدرة العامة للاختلاف (GCA) أكثر من القدرة الخاصة للاختلاف (SCA) لكل الصفات تحت الدراسة تحت المستويات المختلفة من النيتروجين ما عدا صفات ارتفاع النبات (٣٠ كجم نيتروجين/فدان) ، عدد السنبال/نبات (٣٠ كجم نيتروجين/فدان) ومحصول الحبوب/نبات (٦٠ ، ٩٠ كجم نيتروجين/فدان) حيث أن تباين القدرة الخاصة للاختلاف كان يشمل معظم الاختلافات الكلية وكان الارتباط بين القدرة العامة للاختلاف ومتوسط السلوك تحت المستويات المختلفة من النيتروجين غير معنوياً ، مشيراً إلى أن التراكيب الوراثية ذات القدرة للاختلاف الجيدة لا يمكن التعرف عليها على أساس متوسط السلوك .

وكان الصنفان المحليان من القمح جيزة ١٦٨ ، سخا ٩٣ بالإضافة للسلالة ١١٦ قد احتوت على قدرة عامة للاختلاف جيدة وعالية ومعنوية تحت الثلاث مستويات للنيتروجين لصفات طول السنبله عدد حبوب السنبله وعدد السنابل/نبات (جيزة ١٦٨) ووزن الألف حبة (سخا ٩٣) ، وارتفاع النبات ومحصول النبات (السلالة ١١٦) . وهذه الآباء جيدة الاختلاف عند تطبيق المستويات المنخفضة ، المتوسطة والعالية من النيتروجين ، وتعتبر السلالة ١١٦ أكثر الآباء تبشيراً لأنها تحتوي على قدرة عامة جيدة للاختلاف لصفات طول السنبله ، عدد السنابل/نبات ووزن الألف حبة تحت المستوى المنخفض من النيتروجين (٣٠ كجم نيتروجين/فدان) مشيرة إلى أن هذا الأب يجب أن يؤخذ في الاعتبار في برامج التربية للمدخلات المنخفضة من النيتروجين لتحسين محصول القمح .

أعطت الهجن جيزة ١٦٨ × جيزة ١٠ ، سخا ٩٣ × السلالة ٢٨ ، سدس ١ × السلالة ٢٨ فيما مرغوبة ومعنوية للقدرة الخاصة للاختلاف لارتفاع النبات تحت ثلاث مستويات من النيتروجين . بينما أعطت الهجن سخا ٩٣ × السلالة ١١٦ ، سدس ١ × السلالة ٢٨ تأثيرات موجبة ومعنوية لطول السنبله تحت ثلاث مستويات من النيتروجين . وأيضاً كان للهجين سدس ١ × سلالة ١١٦ تأثيرات خاصة للاختلاف مرغوبة لعدد الحبوب / السنبله تحت المستوى المنخفض للنيتروجين . وأعطت التوليفات الهجينية سخا ٩٣ × سدس ١ ، السلالة ٢٨ × جيزة ١٠ . تأثيرات قدرة خاصة معنوية وموجبة لعدد الحبوب السنبله وأيضاً ، كان هناك هجين من قمح الخبز ، جيزة ١٦٨ × السلالة ١١٦ والسلالة ٢٨ × جيزة ١٠ أظهرت قدرة خاصة للاختلاف موجبة ومعنوية لوزن الألف حبة تحت المستوى المنخفض من النيتروجين ولقد أظهرت التهجينات سدس ١ × جيزة ١٠ ، جيزة ١٦٨ × السلالة ١١٦ ، السلالة ٢٨ × جيزة ١٠ قدرة خاصة موجبة ومعنوية للاختلاف لطول النبات تحت المستوى المنخفض من النيتروجين.

أظهرت دراسة مكونات التباين الوراثي ، أن التأثيرات السيادية الجينية هي المكونة للجزء الأعظم من الاختلافات الكلية لكل الصفات تحت الدراسة وكان ذلك واضح في درجة السيادة $(H1/D)^{1/2}$ حيث كانت أكبر من الوحدة وأيضاً كانت الجينات السالبة والموجبة غير التوزيع بين الآباء لكل الصفات تحت الدراسة تحت مستويات النيتروجين الثلاثة . ومن جهة أخرى كانت قيم كفاءة التوريث في المعنى الضيق منخفضة في معظم الحالات ، ما عدا لطول السنبلة تحت ٣٠ كجم نيتروجين/فدان (٠,٥٤) ، ٩٠ كجم نيتروجين/فدان (٠,٥٥٨) بالإضافة لمحصول الحبوب/نبات تحت المستوى المتوسط من النيتروجين (٠,٦٢٨) .

وهذه المعلومات ذات اهتمام كبير لمربي القمح بهدف تربية التراكيب الوراثية من القمح التي تكون أكثر إنتاجاً تحت المستويات المنخفضة من النيتروجين كمدخل إنتاجي والمحافظة على نظافة البيئة خاصة التربة والمياه الجوفية ومحصول الحبوب .