International Journal of Chemical and Biochemical Sciences
(ISSN 2226-9614)
Journal Home page: www.iscientific.org/Journal.html

Effects of Nitrogen Fertilization on Mean Performance, Heterosis and Combining Ability of Six Bread Wheat Cultivars and Their F1 Crosses

Ragab Fathy Mohamed Nada

Lecture of Plant Production Department. Faculty of Technology and Development. Zagazig Universtiy, Egypt

Abstract

The field experiment was performed during two successive 2021/2022 and 2022/2023 seasons at the experimental farm, faculty of Technology and Development, Zagazig University. Six diversified bread wheat cultivars (Giza-171, Sids-14, Gemmeiza-12, Sakha-96, Misr-1 and Misr-3). All possible parental combinations, excluding reciprocates were made among the six parental cultivars to produce fifteen hybrids. The seed of the fifteen F_1 hybrids along with the six parents were grown under N treatments (35 and 70 N Kg/fad). Using split plot design with three replicates. The main plots were devoted for N fertilization, while sub plots were allotted six parents and their F_1 crosses. For evaluation effects of nitrogen fertilization on mean performance, heterosis and combining ability for height of plant, tillers and spikes number/plant, area of flag leaf, length of spike, grains number of spike, weight of spike and 1000- grain /g and grain yield/plant. The results showed that difference significant and highly significant among N levels fertilization and genotypes for all characters, but the interaction between them was shown significant and highly significant for all study traits except length of spike and spikes number/plant. The combined revealed that the cultivars Sids-14 and Misr-3, on the other hand the crosses (Giza-171×Misr-1), (Misr-3×Sids-14), (Sids-14×Misr-1) and (Giza-171×Misr-3) gave the highest productivity for grain yield/plant. The heterosis were positive and highly significant relative to better parent for grain yield/plant by the crosses (Giza-171×Sakha-96), (Misr-3×Gemeiza-12), (Misr-3×Sids-14), (Misr-3×Misr-1), (Misr-3×Sakha-96), (Gemeiza-12×Sids-14), (Gemeiza-12×Misr-1), (Sids-14×Misr-1) and (Misr-1×Sakha-96). The results of GCA and SCA effects indicating that the cultivar Misr-1 was good general combiner, the cross (Giza-171×Sakha-96) was good specific combiner for grain yield, therefore, these cultivar and hybrid considered to the promising for grain yield improvement under low input of nitrogen.

Keywords: Nitrogen, Mean performance, Heterosis, Heterobeltosis and combining ability.

Full length article **Corresponding Author*, e-mail: ragabnada@zu.edu.eg

1. Introduction

Wheat is widely cultivated crop whose is the cereal grain that is used as a staple food in the world. The most important wheat varieties are common wheat (*Triticum aestivum* L.). Egypt imports more than 45% of its wheat consumptions. The increasing of wheat production to narrowing the gap between production and consumption is an importance vital in Egypt. This deficit of production requires the efforts of plant breeders to increase wheat production, for that the identification of high yielding cultivars is main thrust of the wheat breeders, there is an urgent need to increase wheat production potential, as crop acreage cannot be extended beyond a certain limit. In response to this challenge, there is a strong breeding interest in developing high productivity genotypes of wheat [1].

The nitrogen and compounds is important of growth and It is part of complex and simple proteins, amino acids, nucleic acids, chlorophyll in winter wheat [2]. The deficiency of nitrogen in winter wheat plants leads to a change in the intensity of the clorophille of leafs, which affects the decrease in the rate of growth and development. in the growing season the wheat with grain yield of 25-30 ton/ha consumes 80-100 kg of nitrogen. The plant growth increases the consumption of nitrogen from the soil increases [3]. Nitrogen consumption by wheat plants begins from the first days of germination and continues until the end of the grain filling. So, in the tillering phase, nitrogen consumption is 20-25%, in the period of going into the tube - earing - 50-55%, flowering - the beginning of waxy ripeness 5-10% of the maximum amount of nitrogen consumed. The deficiency of nitrogen in individual phases of culture development cannot be compensated for by introducing it into subsequent phases [4].

To bridge the gap between production and consumption in Egypt, we must work to increase the productivity per unit area and also increase the cultivated areas of wheat by breeding new, highly productivity varieties that have a good ability to adaptation. And high yield components selection of suitable parents due to their phenotypic performance only is non-right method, since phenotype superior lanes may be gives poor cross combination of yield. Therefore, it important that parents should be selected for the basis of their genetic. The general combining ability effects were due to additive gene action and specific combining ability effects were due to dominance and epistasis gene effects which are important to selects the best parents for hybridization to product he superior cross combination and to launch a successful wheat breeding program. Parent's performance may not necessarily reveal it to be good or poor combiners [5]. Therefore, it is necessary to collect information about nature of gene effects and their expression in term of combining ability. As well as it also elucidates the nature of gene action involved in the inheritance of the characters. Many researchers give reviews, which revealed that both general and specific combining abilities were involved in improving yield and its components, characters in wheat [6,7]. In the programs of breeding, the selection of parents genotypes with desirable characteristics having good general combining ability effects for grain yield and its components, high heterosis and high evaluation of specific combining ability effects. These parameters help in contrive a functional and operative breeding way to achieve fast and suitable crop enhancement [8].

Heterosis or heterobeltosis is the genetic expression of the superior of F1 crosis in relation, growth and yield to its parents. This phenomenon manifests in increased growth and yield, or other parameters resulting from the increase in hetrozygosity in the F_1crosses between two genotypes. In general, based on parents used, two major types of estimation of heterosis or better parent, which is the increased vigor of the F_1 over the mean of two parents. Therefore, the objectives of the research were to estimate the mean performance, heterosis and combining ability for six cultivars of bread wheat and their F_1 crosses under two levels of nitrogen fertilization.

2. Material and Methods

The field experiment was performed during two successive 2021/2022 and 2022/2023 seasons at the experimental farm, Faculty of Technology and Development, Zagazig University. Six difference bread wheat genotypes (Giza-171, Sids-14, Gemmeiza-12, Sakha-96, Misr-1 and Misr-3). The bread wheat cultivars were obtained from Agricultural Research Center, Cairo, Egypt. The pedigree and origin of the six wheat cultivars are presented in Table (1).

Table 1: The pedigree and origin of the six parent’s wheat cultivars

Number	Cultivars	Pedigree	Origin
P1	Giza-171	"Sakha-93/Gemmeiza-9" and its selection history is "Gz 2003-101-1Gz-4Gz-1Gz-2Gz-0Gz"	Egypt
P2	Misr-3	Rohf 07*2/Kiriti and its selection history is CGSS05B00123T-099T-0PY-099M-099NJ-6WGY-0B-0BGY-0GZ.	
P3	Gemmieza-12	OTUS/3/SARA/THB//VEE (CMSS97YOO27S-5Y-010M-010M-2Y-1M-OY-OGM).	Egypt
P4	Sids-14	BOW "S"/Vee "S"//BOW "S"TSI/3/Bani Sewef 1 and SD293-ISD-2SD-2SD-4SD-OSd, respectively.	Egypt
P5	Misr-1	OASIS/SKAUZ//4*BCN/3/2*PASTORCMSSOOYO188IT-050M-0304-030M-030WGY-33M-OY-OS	Egypt
P6	Sakha-95	PAOSTOR//SITE/MO/3/CHEN/AEGILOPS SQURROSA (TAUS)//BCN/4/WBLL1 and CMSA01Y00158S-040P0Y-030ZTM-040SY-26M-0Y-0SY-0S	Egypt

The six wheat cultivars were sown in the first season 2021/2022 at three sowing dates (15, 22 and 30 November), for overcome the differences in heading time and to facilitate hybridization. All possible parental combinations, excluding reciprocates were made among the six parental cultivars to produce fifteen hybrids. Requisite precautions were adopted during the hybridization operations to avoid contaminations of the genetic material. The seed of the fifteen F_1 hybrids and their parents were grown in the second 2022/2023 season at 15 November and estimate under two levels nitrogen fertilizers, the different N treatments (35 and 70 kg/fad). The mineral source of nitrogen was ammonium sulphates (20.6% N). Using split plot design with three replicates. The main plots were devoted for N fertilization; moreover, sub plots were allotted six parents and their F1 crosses. The experimental plot consists six rows 3m., long (two for each parents of each cross and two for their F1), inter row was kept at 15 cm and inter plant distances was 5 cm. All recommend operations for wheat productions were applied from sowing to harvesting. The physical and chemical properties of the experimental field are shown in Table (2).

The following data were recorded individual plant basis: Height of Plant (cm), tillers number /plant, area of flag leaf /cm^2, length of spike /cm, spikes number /plant, grains number /spike, weight of spike grain /g, weight of 1000-grain /g and grain yield/plant (g).

Statistical analysis of variance technique [9]. Significant differences where indicated were further subjected to Duncan's new multiple range test. The percent increase (+) or decrease (-) of F_1 over mid parent as well as better parent was calculated to observe possible heterotic effects for above mentioned traits following [10]:

$$\% \text{ Ht} = \frac{(F1-M.P)}{M.P} \times 100$$

Ht = Heterosis, M.P = Mid parent.

$$\% \text{ Ht} = \frac{(F1-B.P)}{B.P} \times 100$$

Hbt = Heterobeltiosis, B.P = Better parent**.**

The method 2 model 1 of [11]. The fixed model was used to analyze general combining ability for parents GCA and specific SCA for F_1 crosses with sufficient and insufficient nitrogen, according to the following mathematical model:

$$Yijk = \mu + gi + gj + Sij + Rk + eijk$$

The Effect of the General Combining Ability (for Parental genotypes); on the sufficiency and insufficiency of the nitrogen element it was calculated according to the following equation: $\hat{g}i = \frac{1}{r(n+2)}[zi.. - \frac{2y..}{2}]$

The effect of the specific combining ability (for F_1 crosses). On the sufficiency and insufficiency of the nitrogen element it was calculated according to the following equation:

$$Sij = \frac{ij}{r} - \frac{1}{r(n+2)}(zi + z.j.) + \frac{2y...}{r(n+1)(n+2)}$$

$$\text{Asif: } \sum \hat{g}i = 0$$

$$\sum Sij + Sii = 0$$

3. Result and Dissection

The analysis of variance in Table (3), for height of Plant (cm), tillers number /plant, area of flag leaf /cm^2, length of spike /cm, spikes number /plant, grains number /spike, weight of spike grain /g, weight of 1000-grain /g and grain yield/plant (g), the results were showed significant and highly significant differences among N levels fertilization and genotypes for all characters, but the interaction between them was shown significant and highly significant for all studied characters except length of spike (cm) and spikes number/plant. These results were harmony with those reported by [12,13,14,15].

Table 2: Physical and chemical properties of the experimental site at 30 cm soil depth

Soil properties	Value
Physical properties	
Sand %	16.7%
Silt %	22.5%
Clay %	60.8%
Soil texture	Clay
Chemical analysis	
pH	7.85
EC dS/m	3.21±0.2
Available N(ppm)	18.1±0.1
Available P (ppm)	19.12±0.55
Available k (ppm)	350

Table 3: Analysis of variance for yield and its attributes for six parents and their f1 crosses under two different N fertilization levels

S.V	d.f	Height of plant (cm)	Tillers number /plant	Area of flag leaf (cm^2)	Length of spike /cm	spikes number /plant	Grains number /spike	Weight of spike grain (g)	Weight of 1000-grain (g)	Grain yield/ plant (g)
Replication	2	2.04	0.20	6.05	0.43	0.046	14.63	0.11	12.26	1.1
Nitrogen	1	2276.8**	92.6**	1702.9**	60.73**	90.1**	4953.1**	46.05**	2109.6**	422.7**
Error	2	0.17	0.02	4.16	0.23	0.025	6.91	0.052	1.06	3.3
Genotypes	20	227.6**	1.63**	252.7**	7.30**	1.52**	151.46**	0.93**	130.48**	8.39**
N × G	20	33.5**	0.42*	64.3**	0.54ns	0.25ns	42.59**	0.36*	52**	1.56*
Error	80	6.03	0.16	4.97	0.39	0.17	8.73	0.13	13.65	0.58
Total	125									

"*Significant at 0.05 and ** 0.01 levels probability, respectively"

3.1. Mean performance

The results in Tables (4, 5 and 6) showed significant differences among six parents and their F1 crosses under two N different fertilization. Generally, application of 70 kg N/fad; increased all studied characters as compared to the 35 kg N/fad. The height of plant under 35 kg N/fad varied from 93.3 cm, (Misr-3×Sakha-96) to 111.8cm (Giza-171×Sids-14), while, it ranged from 95.3 cm (Misr-3×Sakha-96) to 118.6 cm (Giza-171×Sids-14) under 70 kg N/fad the combined revealed that wheat cross Gemeiza-12×Misr-1 (96.7 cm) and Sids-14 (97.0 cm) were the shortest genotypes compared to the other studied wheat genotypes. On the other hand, Giza-171 (112.6 cm) and Giza-171×Sids-14 (115.2 cm) were the tallest wheat genotypes. These results revealed that height of plant was more heritable characters; these results indicate that genes controlling plant height were transmitted from the parents to the F_1 progeny. Tillers number /plant under 35 kg N/fad; varied from 3.7 (Gemieza-12) to 5.5 (Misr-3×Sids-14), moreover, under 70 kg N/fad ranged from 5.0 (Misr-3) to 7.2 (Sids-14×Sakha-96). The combined revealed that wheat genotypes Misr-3 (4.4) and Gemieza-12 (4.5) were the lowest genotypes for tillers number/plant compared to the other studied wheat genotypes. As well as crosses (Giza-171×Misr-3), (Misr-3×Sids-14) and (Sids-14×Sakha-96) as thy exhibited good levels of this trait compared with the other genotypes. Area of flag leaf /cm^2 under 35 kg N/fad it changed from 22.1 cm^2 (misr-3) to 47.1 cm^2 (Giza-171×Gemeiza-12). Meanwhile, under 70 kg N/fad it was varied from 27.5 cm^2 (Misr-3×Sakha-96) to 56.4 cm^2 (Giza-171×Gemeiza-12). The parental cultivars Misr-1 and Misr-3 as well as F_1 crosses (Misr-3×Sakha-96), (Gemeiza-12×Misr-1) and (Misr-1×Sakha-96) were the lowest values, wears hand parental genotypes Giza-171 and Sids-14 on the other hand the crosses (Giza-171×Gemeiza-12), (Giza-171×Sids-14) and (Giza-171×Misr-1) had broad area of flag leaf. The mean performance for length of spike/cm; under 35 kg N/fad it changed from 10.1 cm (Misr-3 × Misr-1) to 10.5 cm; (Misr-3). Meanwhile, under 70 kg N/fad it was varied from 11.7 cm (Misr-3×Sakha-96) to 15.7 cm (Giza-171×Gemeiza-12). The combined revealed that parental genotypes Sids-14 and Misr-3 as well as F_1 crosses (Misr-3×Misr-1) and (Misr-3×Sakha-96) were the lowest values, meanwhile parental genotypes Giza-171 and Sakha-96 on the other hand the crosses (Giza-171×Gemeiza-12), (Giza-171×Sids-14) and (Giza-171×Misr-1) exhibited the highest values of spike length/cm. The spikes number/plant under 35 kg N/fad varied from 3.2 (Gemeiza-12) to 4.9 (Giza-171×Misr-3), while, it ranged from 4.6 (Gemeiza-12) to 6.5 (Sids-14×Misr-1) under 70 kg N/fad. The combined revealed that wheat crosses (Giza-171×Misr-3) (5.7 spike), Giza-171×Sids-14 (5.5 spike) and Sids-14×Misr-1 (5.5 spike) were the highest values of spikes genotypes compared to the other wheat genotypes under this study. The mean performance for grains number /spike under 35 kg N/fad it changed from 55.3 grain (Sids-14) to 73.3 grain (Giza-171×Sakha-96). Meanwhile, under 70 kg N/fad it was varied from 63.3 grain (Gemeiza-12) to 83.3 grain (Gemeiza-12×Misr-1). The combined revealed that parental genotypes Sids-14 and Misr-3 as well as F_1 crosses (Gemeiza-12×Sakha-96) and (Misr-3×Gemeiza-12) were the lowest grains number/spike, meanwhile parental Misr-1, on the other hand the crosses (Giza-171×Sakha-96), (Gemeiza-12×Misr-1) and (Sids-14×Misr-1) produced the greatest number of grains/spike. The mean performance for weight of spike grains /g; under 35 kg N/fad it changed from 2.0 g (Sids-14) to 3.3 g; (Misr-1×Sakha-96). Meanwhile, under 70 kg N/fad it was varied from 2.6 g (Misr-3×Sids-14) to 5.0 g (Sids-14×Misr-1). The combined revealed that parental genotypes Sids-14 and Misr-3 as well as F_1 crosses (Misr-3×Sids-14) and (Misr-3×Gemeiza-12) were the lowest values, meanwhile parental genotypes Gemeiza-12 and Misr-1 on the other hand the crosses (Misr-1×Sakha-96), (Sids-14×Misr-1), (Sids-14×Sakha-96) and (Giza-171×Gemeiza-12) exhibited the highest values of spike grain weight/g. Mean performance of weight of 1000-grain /g; under 35 kg N/fad fluctuated from 39.0 g; (Misr-3) to 56.3 g., (Giza-171×Sids-14), while, it ranged from 45.4 g; (Misr-3×Sids-14) to 64.8 g (Sids-14×Misr-1) under 70 kg N/fad. The combined revealed that wheat crosses Gemeiza-12× Sakha-96 (58.8 g), Giza-171×Sids-14 (60.5 g), Misr-1×Sakha-96 (58.4 g) and Sids-14×Misr-1 (56.1 g), exhibited the heaviest weight of 1000-grain /g; of wheat genotypes compared to the other wheat genotypes under this study. The performance for grain yield/plant (g) for six parental wheat cultivars and their F_1 crosses under two levels N fertilization. The result revealed that the under, 35 kg N/fad it changed from 7.3 g (Misr-3×Sakha-96) to 11.1g (Giza-171×Misr-1). Meanwhile under, 70 kg N/fad it was varied from 10.3 g (Gemeiza-12) to 15.7 g (Giza-171 × Misr-1). These results provide evidence for the presence of great variation for grain yield of plant among studied genotypes. The combined revealed that parental genotypes Sakha-96 and Giza-171 as well as F1 crosses (Gemeiza-12 × Sakha-96) and (Misr-3 × Sakha-96) were the lowest grain yield/g, meanwhile parental Sids-14 and Misr-3, on the other hand the crosses (Giza-171×Misr-1), (Misr-3×Sids-14), (Sids-14×Misr-1) and (Giza-171×Misr-3) gave the highest productivity for grain yield of plant/g. in addition [13 and 16] found that the cross (Kirchanff×Cam-6) had the highest grain yield and its component compared to the parents. [14 and 17].

Table 4: Mean performance of 21 genotypes of bread wheat (six parental and their F1 hybrids) for height of plant, tillers number and area of flag leaf under two levels of N fertilization

Traits	Height of plant (cm)			Tillers number/plant			Area of flag leaf (cm^2)		
Treatment Genotypes	35 kg N/fad	70 kg N/fad	Mean	35 kg N/fad	70 kg N/fad	Mean	35 kg N/fad	70 kg N/fad	Mean
Giza-171	110.5	114.6	112.6	4.3	5.7	5.0	41.6	53.6	47.6
Misr-3	95.6	104.2	99.9	3.7	5.0	4.4	22.1	28.2	25.2
Gemeiza-12	95.1	101.7	98.4	3.7	5.2	4.5	29.9	37.7	33.8
Sids-14	93.9	100.1	97.0	4.1	6.7	5.4	34.8	47.6	41.2
Misr-1	93.4	114.0	103.7	4.6	5.5	5.1	24.7	37.1	30.9
Sakha-96	94.6	114.5	104.6	5.3	6.6	6.0	28.0	42.7	35.4
Giza-171 × Misr-3	98.7	112.4	105.6	5.2	7.2	6.2	39.8	51.4	45.6
Giza-171 × Gemeiza-12	105.2	116.5	110.9	4.4	6.5	5.5	47.1	56.4	51.8
Giza-171 × Sids-14	111.8	118.6	115.2	4.5	6.7	5.6	41.2	54.2	47.7
Giza-171 × Misr-1	105.2	117.8	111.5	4.5	7.0	5.8	38.7	50.7	44.7
Giza-171 × Sakha-96	109.9	113.3	111.6	4.9	6.2	5.6	38.3	44.9	41.6
Misr-3 × Gemeiza-12	93.5	102.3	97.9	4.4	6.5	5.5	38.1	34.7	36.4
Misr-3 × Sids-14	93.7	100.3	97.0	5.5	6.9	6.2	32.3	39.4	35.9
Misr-3 × Misr-1	93.8	101.2	97.5	4.9	6.5	5.7	37.0	33.7	35.4
Misr-3 × Sakha-96	93.3	97.3	95.3	4.7	7.1	5.9	35.3	27.5	31.4
Gemeiza-12 × Sids-14	100.2	106.5	103.4	4.5	6.2	5.4	33.8	41.2	37.5
Gemeiza-12 × Misr-1	94.6	98.8	96.7	5.1	6.4	5.8	34.5	33.2	33.9
Gemeiza-12 × Sakha-96	95.2	101.0	98.1	4.5	5.4	5.0	36.9	44.1	40.5
Sids-14 × Misr-1	97.8	104.2	101.0	4.6	7.1	5.9	34.9	49.3	42.1
Sids-14 × Sakha-96	103.1	110.9	107.0	5.2	7.2	6.2	30.8	44.4	37.6
Misr-1× Sakha-96	98.7	106.3	102.5	4.7	5.9	5.3	33.8	35.9	34.9
Mean	99.0	107.5		4.6	6.3		34.9	42.3	
Radiation %	7.91			26.98			17.49		
$LSD_{0.05}$									
Nitrogen	0.31			0.11			1.56		
Genotypes	2.8			0.47			2.56		
Nitrogen × genotypes	3.99			0.66			3.77		

Table 5: Mean performance of 21 genotypes of bread wheat (six parental and their F1 hybrids) for length of spike, spikes number and grains number /spike under two levels of N fertilization

Traits	Length of spike /cm			Spikes number /plant			Grains number /spike		
Treatment Genotypes	35 kg N/fad	70 kg N/fad	Mean	35 kg N/fad	70 kg N/fad	Mean	35 kg N/fad	70 kg N/fad	Mean
Giza-171	13.3	15.1	14.2	3.5	5.4	4.5	57.7	64.7	61.2
Misr-3	10.5	11.3	10.9	3.3	4.0	3.7	58.0	64.0	61.0
Gemeiza-12	11.8	12.7	12.3	3.2	4.6	3.9	56.0	72.0	64.0
Sids-14	11.0	13.9	12.5	4.1	6.3	5.2	55.3	63.3	59.3
Misr-1	11.6	12.8	12.2	3.9	5.2	4.6	63.7	75.0	69.4
Sakha-96	12.6	13.8	13.2	4.5	5.8	5.2	59.3	68.7	64.0
Giza-171 × Misr-3	12.5	14.5	13.5	4.9	6.4	5.7	60.0	75.3	67.7
Giza-171 × Gemeiza-12	14.6	15.7	15.2	4.2	6.2	5.2	57.3	78.3	67.8
Giza-171 × Sids-14	14.2	15.1	14.7	4.7	6.2	5.5	68.3	81.0	74.7
Giza-171 × Misr-1	13.9	14.3	14.1	4.3	5.6	5.0	61.7	79.3	70.5
Giza-171 × Sakha-96	13.1	14.0	13.6	4.1	5.4	4.8	73.3	79.0	76.2
Misr-3 × Gemeiza-12	11.7	13.6	12.7	4.3	6.4	5.4	60.7	66.3	63.5
Misr-3 × Sids-14	12.6	14.2	13.4	4.2	6.4	5.3	57.0	74.3	65.7
Misr-3 × Misr-1	10.1	11.9	11.0	4.2	6.2	5.2	59.3	78.3	68.8
Misr-3 × Sakha-96	10.8	11.7	11.3	4.2	6.4	5.3	59.3	68.3	63.8
Gemeiza-12 × Sids-14	12.2	13.2	12.7	4.3	6.2	5.3	58.3	76.3	67.3
Gemeiza-12 × Misr-1	12.3	13.0	12.7	4.4	6.1	5.3	69.3	81.7	75.5
Gemeiza-12 × Sakha-96	11.6	13.5	12.6	4.0	5.4	4.7	57.7	66.7	62.2
Sids-14 × Misr-1	11.8	13.7	12.8	4.5	6.5	5.5	65.0	81.7	73.4
Sids-14 × Sakha-96	12.6	14.6	13.6	4.1	6.0	5.1	65.7	71.3	68.5
Misr-1× Sakha-96	12.2	14.0	13.1	3.7	5.5	4.6	62.7	83.3	73.0
Mean	12.2	13.6		4.1	5.8		61.2	73.8	
Radiation %	10.29			29.31			17.07		
$LSD_{0.05}$									
Nitrogen	0.36			0.038			2.01		
Genotypes	0.72			0.47			3.39		
Nitrogen × genotypes	1.04			0.67			4.98		

Table 6: Mean performance of 21 genotypes of bread wheat (six parental and their F1 hybrids) for spike grain weight, 1000-grain weight and grain yield of plant under two levels of N fertilization

Traits	Weight of spike grains (g)			weight of 1000-grain (g)			Grain yield /plant (g)		
Treatment Genotypes	35 kg N/fad	70 kg N/fad	Mean	35 kg N/fad	70 kg N/fad	Mean	35 kg N/fad	70 kg N/fad	Mean
Giza-171	2.1	3.7	2.9	41.0	57.8	49.4	7.9	11.3	9.6
Misr-3	2.3	3.2	2.8	39.0	50.5	44.8	8.9	12.8	10.9
Gemeiza-12	2.9	3.7	3.3	45.4	54.3	49.9	8.3	11.3	9.8
Sids-14	2.0	3.4	2.7	45.1	52.1	48.6	9.7	12.0	10.9
Misr-1	2.7	4.2	3.5	42.9	56.1	49.5	9.0	12.3	10.7
Sakha -96	2.2	3.4	2.8	47.1	45.8	46.5	8.4	10.3	9.4
Giza-171 × Misr-3	2.6	3.8	3.2	44.2	51.9	48.1	10.7	14.3	12.5
Giza-171 × Gemeiza-12	2.8	4.5	3.7	52.8	57.3	55.1	10.7	14.3	12.5
Giza-171 × Sids-14	2.3	4.6	3.5	56.3	64.6	60.5	10.5	14.0	12.3
Giza-171 × Misr-1	2.6	3.8	3.2	46.1	48.4	47.3	11.1	15.7	13.4
Giza-171 × Sakha-96	2.4	3.5	3.0	47.7	44.3	46.0	10.3	13.2	11.8
Misr-3 × Gemeiza-12	2.2	3.3	2.8	46.3	50.3	48.3	10.3	13.3	11.8
Misr-3 × Sids-14	2.1	2.6	2.4	46.8	45.4	46.1	11.0	14.8	12.9
Misr-3 × Misr-1	2.3	3.7	3.0	43.8	56.0	49.9	8.3	14.0	11.2
Misr-3 × Sakha-96	2.4	3.3	2.9	46.5	58.9	52.7	7.3	13.7	10.5
Gemeiza-12 × Sids-14	2.9	3.5	3.2	44.1	50.3	47.2	9.0	13.6	11.3
Gemeiza-12 × Misr-1	2.7	3.6	3.2	40.7	53.7	47.2	10.3	14.2	12.3
Gemeiza-12 × Sakha-96	3.0	3.3	3.2	53.6	64.0	58.8	8.0	11.7	9.9
Sids-14 × Misr-1	2.6	5.0	3.8	47.4	64.8	56.1	11.0	14.6	12.8
Sids-14 × Sakha-96	3.0	4.3	3.7	46.2	61.4	53.8	8.6	12.5	10.6
Misr-1× Sakha-96	3.3	4.3	3.8	54.8	61.9	58.4	11.1	13.7	12.4
Mean	2.5	3.8		46.6	54.7		9.6	13.2	
Radiation %	34.21			14.81			27.27		
$LSD_{0.05}$									
Nitrogen	0.175			0.79			1.39		
Genotypes	0.427			4.24			0.881		
Nitrogen × genotypes	0.607			6.00			1.72		

3.2. Analysis of variance

The results for analysis of variance (Tables 7 and 8) revealed that, mean of squares due to genotypes for height of Plant (cm), tillers number /plant, area of flag leaf /cm^2, length of spike /cm, spikes number /plant, grains number/spike, weight of spike grain /g, weight of 1000-grain/g and grain yield/plant (g), were highly significant for all studies characters under 35 and 70 kg N/fad. The mean of square due to parents were highly significant for height of plant, tillers number/plant, area of flag leaf, length of spike, spikes number of plant, grains number of spike, weight of spike grain and weight of 1000-grain, while non-significant for grain yield under 35 kg N/fad. Moreover, mean of square due to parents under 70 kg N/fad show highly significant for all study traits except weight of spike grain and weight of 1000-grain were significant. While mean of square due to F_1s crosses were significant and highly significant for all study characters under 35 kg N/fad except spikes number of plant was non-significant, moreover under 70 kg N/fad; mean of square due to F_1s crosses were significant and highly significant for all study traits. The mean of square due to (P vs. C) under 35 and 70 kg N/fad; were highly significant for all studies traits, indicating the attainability of heterosis for these traits in the studied genotypes and indicating the presence of adequate genetic variability in the used genetic material. The results were harmony obtained by [13] and [18]. In addition, with [16] and [19] who found that mean squares of genotypes, parents, crosses and parents versus crosses were significant and highly significant for morpho-physiological characters and biological yield under normal and N-stress conditions, except each of; crosses for tillers no./plant at normal condition. [14] found that analysis of variance due to nitrogen fertilization levels for height of plant, length of spike, spikes number of plant, kernels number/spike, weight of 100-kernels and grain yield/plant were significant, Moreover, significant differences were detected between each of genotypes, parents and crosses at both nitrogen levels and combined analyses.

3.3. Heterosis as percentage of mid parent (MP) and better parent (BP)

The results in (Tables 9, 10 and 11), for height of plant showed positive and highly significant heterosis over MP in the crosses (Giza-171×Sids-14), (Gemeiza-12 × Sids-14), (Sids-14 ×Misr-1), (Sids-14 ×Sakha-96) and (Misr-1× Sakha-96). Moreover, heterosis were positive and highly significant relative to BP in the crosses (Gemeiza-12 ×Sids-14), (Sids-14×Misr-1), (Sids-14×Sakha-96) and (Misr-1×Sakha-96) under 35 kg N/fad; while under 70 kg N/fad; showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Misr-3), (Giza-171 ×Gemeiza-12) and (Giza-171×Sids-14). Moreover, heterosis relative to BP in the crosses (Giza-171×Gemeiza-12), (Giza-171×Sids-14) and (Giza-171×Misr-1). Tillers number/plant showed positive and highly significant heterosis over MP in the crosses (Giza-171×Misr-3), (Giza-171 × Sakha-96), (Misr-3 × Sids-14), (Misr-3 × Misr-1), (Misr-3 × Sakha-96), (Gemeiza-12 × Misr-1), (Gemeiza-12 × Sakha-96) and (Sids-14 × Sakha-96). Moreover, heterosis were positive and highly significant relative to BP in the crosses (Giza-171 × Misr-3), (Giza-171 × Sakha-96), (Misr-3 × Gemeiza-12), (Misr-3 × Misr-1), (Misr-3 × Sakha-96), (Gemeiza-12 × Misr-1) and (Gemeiza-12 × Sakha-96) under 35 kg N/fad. Whereas under 70 kg N/fad; showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Misr-3), (Giza-171 × Gemeiza-12), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Misr-3 × Sakha-96), (Gemeiza-12 × Misr-1), (Sids-14 × Misr-1) and (Sids-14 × Sakha-96). As well as, heterosis were a positive and highly significant relative to BP by the crosses (Giza-171 × Misr-3), (Giza-171 × Gemeiza-12), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Misr-3 × Sakha-96), (Gemeiza-12 × Misr-1), (Sids-14 × Misr-1), (Sids-14 × Sakha-96) and (Misr-1× Sakha-96) for tillers number /plant. area flag leaf showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Misr-3 × Gemeiza-12), (Misr-3 × Sids-14), (Misr-3 × Misr-1), (Misr-3 × Sakha-96), (Gemeiza-12 × Sids-14), (Gemeiza-12 × Misr-1), (Gemeiza-12 × Sakha-96), (Sids-14 × Misr-1), (Sids-14 × Sakha-96) and (Misr-1× Sakha-96). Moreover, heterosis were positive and highly significant relative to BP in the crosses (Giza-171 × Gemeiza-12), (Misr-3 × Gemeiza-12), (Misr-3 × Misr-1), (Gemeiza-12 × Sids-14), (Gemeiza-12 × Misr-1), (Gemeiza-12 × Sakha-96), (Sids-14 × Misr-1), (Sids-14 × Sakha-96) and (Misr-1× Sakha-96), under 35 kg N/fad. Whereas under 70 kg N/fad; showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Gemeiza-12 × Sakha-96), (Sids-14 × Misr-1) and (Sids-14 × Sakha-96). As well as heterosis were positive and highly significant relative to BP by the crosses (Giza-171 × Gemeiza-12), (Gemeiza-12 × Sakha-96), (Sids-14 × Misr-1) and (Sids-14 × Sakha-96). Length of spike /cm showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Giza-171 × Sakha-96) and (Misr-1× Sakha-96). Moreover, heterosis were positive and highly significant relative to BP in the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1) and (Misr-1× Sakha-96) under under 35 kg N/fad. Whereas under 70 kg N/fad; showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sakha-96), (Gemeiza-12×Sakha-96), (Sids-14 × Sakha-96) and (Misr-1× Sakha-96). Moreover, heterosis were positive and highly significant relative to BP in the crosses (Giza-171 × Gemeiza-12), (Gemeiza-12 × Sakha-96), (Sids-14 × Sakha-96) and (Misr-1× Sakha-96). Spikes number/plant showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Misr-3), (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Misr-3 × Gemeiza-12), (Gemeiza-12 × Misr-1) and (Gemeiza-12 × Sakha-96). Moreover, heterosis were positive and highly significant relative to BP in the crosses (Giza-171 × Misr-3), (Giza-171 × Gemeiza-12), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Gemeiza-12 × Misr-1) and (Gemeiza-12 × Sakha-96) under 35 kg N/fad. Whereas under 70 kg N/fad; showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sakha-96), (Misr-3 × Gemeiza-12), (Misr-3 × Sakha-96), (Gemeiza-12 × Sids-14), (Gemeiza-12 × Misr-1), (Gemeiza-12 × Sakha-96), (Sids-14 × Misr-1), (Sids-14 × Sakha-96) and (Misr-1× Sakha-96). As well as heterosis were positive and highly significant relative to BP by the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Gemeiza-12 × Sids-14), (Gemeiza-12 × Misr-1), (Gemeiza-12 × Sakha-96), (Sids-14 × Misr-1) and (Misr-1× Sakha-96) gives the highest values of heterobeltosis for spikes number/plant. Grains number/spike showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Sids-14), (Giza-171 × Sakha-96), (Misr-3 × Gemeiza-12), (Gemeiza-12 × Misr-1) and (Sids-14 × Sakha-96). Moreover, heterosis were positive and highly significant relative to BP in the crosses (Giza-171 × Misr-3), (Giza-171 × Sids-14), (Giza-171 × Sakha-96), (Misr-3 × Gemeiza-12), (Gemeiza-12 × Misr-1) and (Sids-14 × Sakha-96) under 35 kg N/fad. Whereas under 70 kg N/fad; showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Misr-3), (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Misr-3 × Sids-14), (Misr-3 × Misr-1), (Gemeiza-12 × Sids-14), (Gemeiza-12 × Misr-1), (Sids-14 × Misr-1), and (Misr-1× Sakha-96). As well as heterosis were positive and highly significant relative to BP by the crosses (Giza-171 × Misr-3), (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Misr-3 × Sids-14), (Misr-3 × Misr-1), (Misr-3 × Sakha-96), (Gemeiza-12 × Sids-14), (Gemeiza-12×Misr-1), (Sids-14 × Misr-1), (Sids-14 × Sakha-96) and (Misr-1× Sakha-96) give highest values of heterobeltosis for number of grains/spike. Weight spike grains/g showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Misr-3), (Sids-14 × Sakha-96) and (Misr-1× Sakha-96). Moreover, heterosis were positive and highly significant relative to BP in the crosses (Giza-171 × Misr-3), (Sids-14 × Sakha-96), and (Misr-1× Sakha-96), under 35 kg N/fad. Whereas under 70 kg N/fad; showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Sids-14 × Misr-1) and (Sids-14 × Sakha-96). As well as heterosis were positive and highly significant relative to BP by the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Sids-14 × Misr-1) and (Sids-14 × Sakha-96) were the maximum heterobeltosis for weight of spike grain. Weight of 1000-grain /g showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Misr-3 × Sakha-96), (Gemeiza-12 × Sakha-96) and (Misr-1× Sakha-96). Moreover, heterosis were positive and highly significant relative to BP in the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Gemeiza-12 × Sakha-96) and (Misr-1× Sakha-96). under 35 kg N/fad. Whereas under 70 kg N/fad; showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Sids-14), (Misr-3×Sakha-96), (Gemeiza-12×Sakha-96), (Sids-14×Misr-1), (Sids-14×Sakha-96) and (Misr-1×Sakha-96). As well as heterosis were positive and highly significant relative to BP by the crosses (Giza-171 × Sids-14), (Misr-3 × Sakha-96) (Gemeiza-12 × Sakha-96), (Sids-14 × Misr-1), (Sids-14 × Sakha-96) and (Misr-1× Sakha-96), were the maximum heterobeltosis for weight of 1000-grain. Grain yield/plant showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Misr-3), (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Misr-3 × Sids-14), (Gemeiza-12 × Misr-1), (Sids-14 × Misr-1) and (Misr-1× Sakha-96). Moreover, heterosis were positive and highly significant relative to BP in the crosses (Giza-171 × Misr-3), (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Misr-3 × Gemeiza-12), (Misr-3 × Sids-14), (Gemeiza-12 × Sids-14), (Gemeiza-12 × Misr-1), (Sids-14 × Misr-1) and (Misr-1× Sakha-96), under 35 kg N/fad. Whereas under 70 kg N/fad; showed positive and highly significant heterosis over MP in the crosses (Giza-171 × Misr-3), (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Misr-3 × Gemeiza-12), (Misr-3 × Sids-14), (Misr-3 × Misr-1), (Misr-3 × Sakha-96), (Gemeiza-12 × Sids-14), (Gemeiza-12 × Misr-1), (Sids-14 × Misr-1) and (Misr-1× Sakha-96). As well as, heterosis were positive and highly significant relative to BP by the all crosses (Giza-171 × Misr-3), (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Misr-3 × Gemeiza-12), (Misr-3 × Sids-14), (Misr-3 × Misr-1), (Misr-3 × Sakha-96), (Gemeiza-12 × Sids-14), (Gemeiza-12 × Misr-1), (Sids-14 × Misr-1) and (Misr-1× Sakha-96), were the maximum heterobeltosis for grain yield/plant. [18] showed that the useful heterosis of grain yield/ plant relative to better parent varied from 6.22 to 38.91% in F1 crosses. In addition, these results have been in agreement with [16] and [17]. In addition, [20] reported that the ten crosses exhibited positive and significant heterosis over standard variety. [21] found that the crosses (Atilla × HUWL-1723) and (HUW-234 × DBW), were found these crosses significant positive heterosis over both the better and mid-parent for grain yield.

Table 7: Mean of square of 6 parents and F1 progenies of bread wheat for grain yield attributes characters under two levels nitrogen fertilization

S.V	DF	Height of plant (cm)		Tillers number /plant		Area of Flag leaf (cm^2)		length spike /cm	
		35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad
Relocation	2	1.07	1.13	0.12	0.11	10.11	0.09	0.63	0.04
Genotypes	20	115.06**	146.09**	0.68**	1.38**	99.96**	217.09**	4.05**	3.80**
Parents	5	129.55**	143.38**	1.08**	1.48**	150.84**	237.23**	3.09**	4.87**
Crosses	14	112.48**	156.60**	0.35*	0.83*	48.50**	223.08**	4.34**	3.43**
P vas F_1	1	78.69**	12.58ns	3.37**	8.51**	565.99**	32.56**	4.82**	3.68**
Error	40	5.59	6.47	0.13	0.21	4.62	5.32	0.48	0.31
Total	62								

"*Significant at 0.05 and ** 0.01 levels probability, respectively"

Table 8: Mean of square of 6 parents and F1 progenies of bread wheat for grain yield and its components characters under two levels nitrogen fertilization

S.V	DF	spikes number /plant		grains number /spike		Weight of spike grains (g)		Weight of 1000-grain (g)		Grain yield of /plant (g)	
		35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad
Relocation	2	0.01	0.03	1.21	20.33	0.01	0.14	5.98	7.34	0.99	3.41
Genotypes	20	0.52**	1.26**	68.51**	125.54**	0.37**	0.93**	61.76**	120.76**	4.58**	5.38**
Parents	5	0.75**	2.12**	26.67**	68.59**	0.39**	0.37*	27.30**	55.29*	1.23	2.35**
Crosses	14	0.23	0.43*	73.33**	93.93**	0.35**	1.16**	60.56**	145.72**	4.84**	2.68**
P vas F_1	1	3.33**	8.58**	210.3**	852.84**	0.65**	0.59**	250.8**	98.69**	17.67**	58.45**
Error	40	0.15	0.19	6.66	10.80	0.10	0.17	5.26	22.05	0.75	0.43
Total	62										

"*Significant at 0.05 and ** 0.01 levels probability, respectively"

Table 9: Heterosis as percentage of mid-parent (MP) and better-parent (BP) for height of plant, tillers number of plant and area flag leaf /cm^2 of bread wheat under two N levels fertilization

Traits	Height of plant (cm)				Tillers number /plant				Area of Flag leaf (cm^2)			
Treatment Genotypes	35 kg N/fad		70 kg N/fad		35 kg N/fad		70 kg N/fad		35 kg N/fad		70 kg N/fad	
	H.M.P	H.B.P	H.M.P	H.B.P	H.M.P	H.B.P	H.M.P	H.B.P	H.M.P	H.B.P	H.M.B	H.B.P
Giza-171 × Misr-3	-3.44*	-10.71**	4.71**	-1.92**	24.80**	21.88**	17.30**	8.50**	4.27	-4.18**	1.64	-4.13**
Giza-171 × Gemeiza-12	2.35	-4.78**	7.75**	1.69**	10.00	3.12	20.62**	15.29**	31.7**	13.19**	23.44**	5.14**
Giza-171 × Sids-14	9.07**	1.20*	3.56**	3.53**	-4.90	-13.92**	8.99*	1.52	18.3**	-0.96	12.57**	1.05
Giza-171 × Misr-1	3.19*	-4.78**	3.11*	2.85**	2.26	-1.45	24.40**	22.94**	16.79**	-6.95**	11.85**	-5.42**
Giza-171 × Sakha-96	6.61**	-0.56	3.63*	-1.08	24.37**	15.63**	15.63**	8.82**	20.15**	-7.94**	9.71*	-16.31**
Misr-3 × Gemeiza-12	-1.01	-1.65**	1.45	0.66	12.82*	8.20**	9.86*	-2.50	17.72**	9.36**	-18.52**	-26.93**
Misr-3 × Sids-14	-0.59	-0.95	-6.48**	-12.37**	17.14**	3.80*	4.28	3.50*	2.88	-7.19**	-12.76**	-17.24**
Misr-3 × Misr-1	0.19	-0.04	-5.48**	-11.26**	14.08**	7.46**	6.01	-3.00	24.24**	6.11**	-20.42**	-29.18**
Misr-3 × Sakha-96	-1.50	-2.42**	-4.68**	-6.56**	22.41**	16.39**	21.71**	6.50**	23.83**	1.26	-27.49**	-42.24**
Gemeiza-12 × Sids-14	5.68**	5.38**	-1.46	-6.99**	0.74	-13.92**	5.11	-6.09**	16.83**	13.17**	2.46	-3.46*
Gemeiza-12 × Misr-1	0.38	-0.50	-8.35**	-13.3**	23.20**	11.59**	19.00**	15.06**	26.28**	15.26**	-11.27**	-12.05**
Gemeiza-12 × Sakha-96	-0.18	-0.46	-1.83	-3.01**	21.62**	20.54**	6.89	5.16*	41.73**	23.35**	33.74**	16.84**
Sids-14 × Misr-1	4.04**	3.43**	-8.83**	-9.02**	-7.43	-13.29**	17.36**	8.12**	32.35**	24.45**	23.71**	15.60**
Sids-14 × Sakha-96	8.45**	7.83**	1.43	-3.14**	16.42**	-1.27	25.07**	10.15**	22.89**	10.01**	25.40**	4.13**
Misr-1× Sakha-96	4.43**	3.23**	-2.52	-6.73**	12.90*	1.45	11.39*	6.02**	44.42**	37.00**	10.08*	-3.10*

"*Significant at 0.05 and ** 0.01 levels probability, respectively"

Table 10: Heterosis as percentage of mid-parent (MP) and better-parent (BP) for length spike, spikes number /plant and grains number /spike of bread wheat under two N levels fertilization

Traits	Length of spike /cm				Spikes number /plant				Grains number /spike			
Treatment Genotypes	35 kg N/fad		70 kg N/fad		35 kg N/fad		70 kg N/fad		35 kg N/fad		70 kg N/fad	
	H.M.P	H.B.P	H.M.P	H.B.P	H.M.P	H.B.P	H.M.P	H.B.P	H.M.P	H.B.P	H.M.B	H.B.P
Giza-171 × Misr-3	2.61	-6.03**	0.23	-3.8**	28.95**	20.49**	8.22	0.53	6.19*	4.05**	17.71**	16.49**
Giza-171 × Gemeiza-12	16.33**	10.05**	12.98**	3.98**	23.76**	17.92**	23.59**	14.11**	0.88	-0.58	14.63**	8.80**
Giza-171 × Sids-14	9.71**	7.04**	4.68*	0.11	15.70**	2.94	9.47*	5.71**	16.81**	15.17**	21.50**	17.96**
Giza-171 × Misr-1	11.80**	4.77**	2.75	-4.9**	16.22**	11.21**	5.03	2.45	1.65	-3.14**	13.60**	5.78**
Giza-171 × Sakha-96	10.52**	-1.01	6.06**	-7.1**	19.42**	16.04**	14.49**	-0.61	26.80**	26.44**	22.80**	22.16**
Misr-3 × Gemeiza-12	2.33	-1.13	2.39	-2.04*	18.35**	5.74*	16.46**	0.53	8.98**	8.33**	-1.97	-7.87**
Misr-3 × Sids-14	6.54	-0.16	2.60	2.16*	-2.33	-7.35**	4.66	0.53	-0.58	-3.93**	12.63**	8.25**
Misr-3 × Misr-1	-10.8**	-12.93**	-10.7**	-14**	5.04	2.46	7.25	-2.63	-0.28	-6.81**	13.25**	4.44**
Misr-3 × Sakha-96	0.31	-2.11	-7.41**	-15**	13.51*	3.28	23.87**	1.05	4.71*	2.30*	7.33*	6.77**
Gemeiza-12 × Sids-14	-0.22	-3.33*	-0.32	-4.2**	11.21*	-5.15*	18.21**	5.71**	1.16	-1.69	8.53**	6.02**
Gemeiza-12 × Misr-1	5.26	-2.27	1.96	1.30	24.53**	13.79**	24.91**	18.06**	15.88**	8.90**	11.11**	8.89**
Gemeiza-12 × Sakha-96	4.21	-1.66	12.50**	6.58**	21.43**	19.00**	25.58**	17.39**	1.17	-0.57	-1.96	-7.41**
Sids-14 × Misr-1	-2.28	-6.23**	2.82	-0.61	6.35	-1.47	17.58**	10.86**	5.69*	2.09*	13.69**	8.89**
Sids-14 × Sakha-96	8.85*	-0.29	16.15**	5.94**	4.24	-9.56**	22.03**	2.86	11.93**	10.67**	7.54*	3.88**
Misr-1× Sakha-96	10.71**	5.46**	15.86**	9.09**	3.70	-3.45	20.73**	7.10**	3.01	-1.57	19.90**	11.11**

"*Significant at 0.05 and ** 0.01 levels probability, respectively"

Table 11: Heterosis as percentage of mid-parent (MP) and better-parent (BP) for weight spike grains, weight 1000-grain and grain yield/ plant of bread wheat under two N levels fertilization

Traits	Weight of spike grains (g)				weight of 1000-grain (g)				Grain yield/ plant (g)			
Treatment Genotypes	35 kg N/fad		70 kg N/fad		35 kg N/fad		70 kg N/fad		35 kg N/fad		70 kg N/fad	
	H.M.P	H.B.P	H.M.P	H.B.P	H.M.P	H.B.P	H.M.P	H.B.P	H.M.P	H.B.P	H.M.B	H.B.P
Giza-171 × Misr-3	24.80**	21.88**	5.16	2.77	2.69	-1.94	-5.55	-10.2**	20.75**	9.59**	22.86**	19.44**
Giza-171 × Gemeiza-12	11.84	-3.41	21.62**	20.54**	22.22**	16.36**	2.32	-0.73	31.15**	28.00**	25.88**	25.88**
Giza-171 × Sids-14	6.15	4.55	27.76**	22.05**	27.73**	19.51**	24.74**	11.85**	29.24**	25.90**	29.23**	23.53**
Giza-171 × Misr-1	5.48	-6.1*	-3.36	-8.73**	9.86**	7.46**	-15.1**	-16.3**	31.10**	23.33**	32.39**	27.03**
Giza-171 × Sakha-96	7.58	4.41	0.48	-6.25*	19.24**	16.31**	-18.2**	-23.3**	22.53**	15.67**	8.97**	2.60*
Misr-3 × Gemeiza-12	-11.41	-25**	-7.11	-10.9**	2.30	1.98	-5.52	-7.43**	14.39*	6.16**	13.71**	10.56**
Misr-3 × Sids-14	-0.79	-4.55	-22.2**	-22.6**	1.63	-0.52	-7.21	-12.8**	21.92**	13.36**	32.24**	23.06**
Misr-3 × Misr-1	-2.10	-14.6**	-3.08	-12.7**	-0.36	-2.77*	3.42	-0.27	-11.03*	-14.4**	15.07**	13.51**
Misr-3 × Sakha-96	10.08	4.41	1.01	-0.99	10.70**	3.23*	14.79**	13.04**	-21.4**	-24.7**	10.07**	6.49**
Gemeiza-12 × Sids-14	11.69	-2.27	-1.89	-5.45	-4.51	-6.24**	0.54	-7.62**	7.78	7.57**	25.54**	20.00**
Gemeiza-12 × Misr-1	-5.88	-9.09**	-7.63	-13.5**	-7.90*	-10.4**	-2.67	-4.24*	19.23**	14.81**	19.72**	14.86**
Gemeiza-12 × Sakha-96	14.10	1.14	-3.38	-9.09**	27.14**	18.21**	22.03**	17.78**	-7.34	-10.5**	-2.90	-8.57**
Sids-14 × Misr-1	6.76	-3.66	31.58**	19.05**	5.46	0.78	27.14**	15.48**	26.68**	22.22**	28.82**	18.38**
Sids-14 × Sakha-96	35.8**	33.82**	30.65**	27.45**	7.37*	-1.84	27.49**	21.55**	-0.58	-3.73	7.91*	-2.60*
Misr-1× Sakha-96	32.**	20.73**	16.59*	3.17	33.71**	27.64**	16.03**	10.25**	23.42**	22.96**	8.61**	6.49**

"*Significant at 0.05 and ** 0.01 levels probability, respectively"

The analysis of variance for combining ability was performed using method 2 model 1 of [11]. The presented data in Tables (12 and 13) the results show that mean squares due to of GCA was fund to be significant and highly significant for all studies characters, moreover SCA significant and highly significant difference for all studied traits except number of spikes/plant, suggesting the importance of both additive and non-additive gene effects in the expression of this traits under 35 kg N/fad. While the results show that mean squares due to of GCA and SCA recorded to be significant and highly significant for all studied characters under 70 kg N/fad. The ratio of GCA/SCA variance was more than unity for height of plant, tillers number /plant, area of flag leaf /cm^2, length of spike /cm, spikes number/plant, grains number /spike and weight of spike grains/g., indicating the major role of additive gene effects in controlling the genetic mechanism of these characters and giving additional evidence that selection should be effective in the early segregating generations under 35 and 70 kg N/fad. Meanwhile, the ratio GCA/SCA variance was less than unity for wheat of 1000-grain /g and grain yield/plant., this emphasized that, dominance and epistasis gene action was the prevailed type in controlling these traits; consequently, crosses breeding program would be the most efficient method for improving these characters under 35 and 70 kg N/fad. Several researchers found that the additive gene action was important in the inheritance of grain yield [22], height of plant [23] and spikes number/plant [24]. as well as, other investigators mentioned that the dominance and epistasis genetic effects played the important role in the inheritance of grain yield [25,26,27] and length of spike [28,29] in addition [13,18] reported that the mean of square GCA/ SCA ratios indicated the relative importance of additive gene action in their inheritance for height plant, spikes number/plant, grains number/spike, weight of 200-grain and grain yield. and [16].

Table 12: Mean squares of general (GCA) and specific combining ability (SCA) of bread wheat for yield attributes traits under two levels nitrogen fertilization

S.V	DF	Height of plant (cm)		Tillers number /plant		Area of Flag leaf (cm^2)		Length of spike /cm	
		35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad
GCA	5	371.74**	425.51**	0.87**	2.58**	235.6**	569.0**	11.32**	8.58**
SCA	14	29.49**	52.95**	0.62**	0.98**	54.8*	99.8**	1.63**	2.21**
Error	40	5.59	6.47	0.13	0.21	4.62	5.32	0.48	0.31
GCA/SCA		12.6	8.03	1.4	2.63	4.3	5.7	6.94	3.88

"*Significant at 0.05 and ** 0.01 levels probability, respectively"

Table 13: Mean squares of general (GCA) and specific combining ability (SCA) of bread wheat for yield and its components traits under two levels nitrogen fertilization

S.V	DF	spikes number /plant		grains number /spike		Weight of spike grains (g)		Weight of 1000-grain (g)		Grain yield of /plant (g)	
		35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad
GCA	5	0.83**	2.65**	77.51**	197.77**	0.75**	1.38**	16.44*	41.80*	2.33*	3.07**
SCA	14	0.41	0.80**	65.51**	101.46**	0.25*	0.78**	76.86**	147.08**	5.33**	6.15**
Error	40	0.15	0.19	6.66	10.80	0.10	0.17	5.26	22.05	0.75	0.43
GCA/SCA		2.02	3.31	1.18	1.94	3	1.76	0.214	0.284	0.437	0.49

"*Significant at 0.05 and ** 0.01 levels probability, respectively"

Evaluation of general combining ability (gi) for plant height (cm), tillers number /plant, area of flag leaf /cm^2, length of spike /cm, spikes number /plant, grains number/spike, weight of spike grain /g, weight of 1000-grain /g and grain yield/plant (g), under two levels of N fertilization are given in table (14 and 15). The results reveal that the bread wheat genotypes Sids-14, Giemeza-12 and Masr-1 exhibited negative and highly significant GCA effects for height of Plant under 35 kg N/fad; meanwhile the cultivars Sids-14, Giemeza-12 and Masr-3 showed negative and highly significant GCA under 70 kg N/fad; indicating that these genotypes are considered to be good combiner for shorters and can be used in breeding programs. Tillers number/plant the results shown that cultivar Sakha-96 positive and highly significant GCA under 35 kg N/fad. While the cultivars Sids-14 and Sakha-96 recorded the positive and highly significant GCA under 70 kg N/fad; thus this genotypes are good combiner for tillering capacity in wheat under deferent nitrogen fertilization. Area of flag leaf under 35kg N/fad the present data reveal that the cultivars Giza-171 and Sids-14 were positive significant and highly significant GCA effects respectively, and can be used in breeding program for low input of N fertilization. Moreover, under, 70 kg N/fad the cultivars Giza-171 and Sakha-96 showed positive and highly significant GCA effects, suggesting that the genotypes were good combiner for area of flag leaf. Length of spike the results reveal that genotypes Giza-171 and Sakha-96 recorded highly significant and significant GCA effects under 35 kg N/fad; respectively, and highly significant GCA effects under 70 kg N/fad; this it could be improved spike length by selection in early generation. Spikes number/plant under 35kg N/fad the present data reveal that the cultivars Sids-14 was showed positive significant and Sakha -96 was positive highly significant GCA effects. Moreover, under, 70 kg N/fad the cultivars Sids-14 and Sakha-96 showed positive and highly significant GCA effects, grains number/spike under 35kg N/fad the present data reveal that the cultivars Misr-1 was showed positive highly significant and Misr-3 recorded positive and highly significant GCA effects. Meanwhile under, 70 kg N/fad the cultivars Misr-3 showed positive and highly significant GCA effects. The results of general combining ability for weight of spike grains /g; indicated that positive and highly significant GCA effects have been recorded by cultivars Gemeiza-12 and Misr-1 showed significant GCA affects under 35 kg N/fad. As well as Giza-171 and Misr-1 were showed positive significant and highly significant GCA effects respectively under 70 kg N/fad. Weight of 1000-grain /g; the results shown that cultivar Sakha-96 positive and highly significant GCA under 35 kg N/fad. While the cultivars Misr-1 and Misr-3 recorded that positive and significant GCA affects under 70 kg N/fad; thus these genotypes are good combiner for weight of 1000-grain. Grain yield/ plant; the results indicated that positive and significant GCA effects have been recorded by cultivars Misr-1 under 35 kg N/fad; moreover, under 70 kg N/fad the results showed that positive and highly significant GCA effects have been recorded by Misr-1. Indicating that the cultivar was good general combiner for grain yield. These results have been in agreement with [13,31,16], they reported that the Kukri line and Cham-6 tester were a good combiner for the grains number/spike, grain yield and weight 1000 -grain. Results were in coincidence with those obtained by [30,26,14].

Table 14: Estimates of general (GCA) combining ability of wheat genotypes for yield attributes under two levels N fertilization

Traits	Height of plant (cm)		Tillers number /plant		Area of flag leaf (cm^2)		Length of spike /cm	
Treatment Genotypes	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad
Giza-171	7.394**	6.949**	-0.039	0.058	5.464**	8.622**	1.139**	1.034**
Misr-3	-0.137	-1.864**	-0.135*	-0.329**	-3.146**	-5.347**	-0.54**	-0.631*
Gemeiza-12	-1.706**	-2.956**	-0.252**	-0.387**	0.698	-1.360*	0.052	-0.149
Sids-14	-3.989**	-4.814**	0.054	0.388**	0.962*	-1.776*	-0.75**	-0.235*
Misr-1	-1.945**	0.519	0.074	-0.075	-2.047**	-2.372**	-0.266*	-0.358**
Sakha-96	0.384	2.166**	0.298**	0.346**	-1.931**	2.233**	0.367*	0.338**
S.E.(gi-gi)	0.611	0.657	0.062	0.085	0.555	0.596	0.178	0.144

"*Significant at 0.05 and ** 0.01 levels probability, respectively"

Table 15: Estimates of general (GCA) combining ability of wheat genotypes for yield and its components under two levels N fertilization

Traits	spikes number /plant		grains number /spike		Weight of spike grains (g)		Weight of 1000-grain (g)		Grain yield of /plant (g)	
Treatment Genotypes	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad
Giza-171	0.046	-0.014	0.931*	0.750	-0.110	0.177*	0.397	-0.164	0.286	0.197
Misr-3	-0.258**	-0.493**	0.764*	-2.458**	0.094	-0.122	0.114	1.028*	-0.46*	-0.265*
Gemeiza-12	-0.163*	-0.156*	-1.653**	-0.375	0.199**	-0.093	0.286	0.126	-0.235	-0.353*
Sids-14	0.133*	0.457**	-2.694**	-3.375**	-0.268**	-0.351**	-1.013*	-2.070*	0.036	0.189
Misr-1	-0.004	-0.064	2.097**	4.750**	0.144*	0.324**	-0.922*	1.711*	0.369*	0.531**
Sakha-96	0.246**	0.269**	0.556	0.708	-0.060	0.064	1.138**	-0.630	0.003	-0.299*
S.E.(gi-gi)	0.1	0.113	0.66	0.849	0.084	0.107	0.592	1.212	0.223	0.169

"*Significant at 0.05 and ** 0.01 levels probability, respectively"

Table 16: Estimates of specific (SCA) combining ability of wheat genotypes for yield attributes under two levels N fertilization

Traits	Height of plant (cm)		Tillers number /plant		Area of Flag leaf (cm^2)		Length of spike /cm	
Crosses	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad
Giza-171 × Misr-3	-3.690**	2.777*	0.550**	0.440	-1.515*	2.39*	-0.169	0.066
Giza-171 × Gemeiza-12	0.580	5.052**	0.056	0.515*	5.972**	6.86**	1.164**	1.147**
Giza-171 × Sids-14	5.099**	2.040*	-0.361**	-0.085	2.718*	1.07	0.449	0.076
Giza-171 × Misr-1	0.819	2.910*	-0.137	0.636**	0.344	2.2*	0.781*	0.022
Giza-171 × Sakha-96	39.76**	39.420**	2.060**	2.257**	13.722**	14.79**	4.696**	4.815**
Misr-3 × Gemeiza-12	0.276	2.649*	-0.037	0.152	1.510*	-4.49**	0.151	0.332
Misr-3 × Sids-14	-1.694	-4.473**	0.479**	-0.181	-1.628*	-3.385**	0.736*	0.428
Misr-3 × Misr-1	0.815	-1.992	0.180*	-0.193	3.126**	-4.461**	-1.13**	-1.126**
Misr-3 × Sakha-96	-1.493	-3.443*	0.179*	0.694**	2.535*	-7.695**	-0.155	-1.103**
Gemeiza-12 × Sids-14	2.589*	-0.165	-0.148*	-0.139	0.129	-1.965	-0.464	-0.657*
Gemeiza-12 × Misr-1	-0.668	-6.184**	0.675**	0.482*	0.870	-5.360**	0.301	-0.128
Gemeiza-12 × Sakha-96	-1.909	-1.601	0.252**	-0.198	4.389**	8.515**	-0.119	0.645*
Sids-14 × Misr-1	0.408	-5.973**	-0.441**	0.482*	3.915**	7.18**	-0.514	0.051
Sids-14 × Sakha-96	3.934**	3.144*	0.402**	0.869**	0.968	5.262**	0.513	1.224**
Misr-1× Sakha-96	1.863	0.224	0.092	-0.077	4.068**	1.363	0.795*	1.353**
S.E.(sij-sji)	1.496	1.609	0.225	0.289	1.359	1.459	0.436	0.353

"*Significant at 0.05 and ** 0.01 levels probability, respectively"

Table 17: Estimates of specific (SCA) combining ability of wheat genotypes for yield and its components under two levels N fertilization

Traits	spikes number /plant		grains number /spike		Weight of spike grains (g)		Weight of 1000-grain (g)		Grain yield of /plant (g)	
Crosses	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad	35 kg N/fad	70 kg N/fad
Giza-171 × Misr-3	0.602**	0.113	0.542	4.196*	0.433**	0.256	-1.739	-0.631	0.79	0.730*
Giza-171 × Gemeiza-12	0.164	0.558*	-3.167*	4.196*	0.2	0.662**	5.549**	2.617	1.06*	1.205**
Giza-171 × Sids-14	0.256	0.1	5.625**	5.780**	-0.075	0.561**	8.166**	10.639**	0.69	0.884**
Giza-171 × Misr-1	0.139	-0.167	-2.583*	0.071	-0.012	-0.421*	0.057	-7.945**	0.89*	1.721**
Giza-171 × Sakha-96	1.593**	2.028**	32.183**	32.421**	0.725**	1.016**	17.038**	7.996**	4.26**	4.630**
Misr-3 × Gemeiza-12	0.21	0.254	3.792**	-3.679*	-0.275*	-0.044	0.432	-2.53	0.978*	0.213
Misr-3 × Sids-14	-0.298	-0.171	-2.083*	3.238*	-0.117	-0.834**	0.143	-6.615**	1.44**	1.659**
Misr-3 × Misr-1	-0.082	-0.037	-1.292	3.196*	-0.087	-0.06	-0.796	1.571	-1.62**	0.063
Misr-3 × Sakha-96	0.206	0.625*	0.042	0.405	-0.004	0.052	0.874	5.200**	-1.79**	0.526
Gemeiza-12 × Sids-14	0.098	0.242	-1.792	2.238	0.183	-0.259	-3.849**	-3.911	-0.322	1.034**
Gemeiza-12 × Misr-1	0.448*	0.508*	7.667**	3.530*	-0.221	-0.351	-5.278**	-2.851	0.65	0.771*
Gemeiza-12 × Sakha-96	0.268	0.237	-2.667*	-4.262*	0.129	-0.206	6.672**	8.061**	-0.86*	-0.866**
Sids-14 × Misr-1	0.106	0.450*	1.125	2.446	0.004	0.858**	0.666	8.968**	1.07**	1.151**
Sids-14 × Sakha-96	-0.007	0.413*	3.125*	-0.679	0.454**	0.637**	-1.604	6.263**	-0.497	-0.154
Misr-1× Sakha-96	-0.123	0.279	-1.417	7.280**	0.517**	0.378	8.997**	4.376*	1.6**	0.184
S.E.(sij-sji)	0.246	0.276	1.63	2.078	0.205	0.262	1.45	2.97	0.547	0.414

"*Significant at 0.05 and ** 0.01 levels probability, respectively"

The specific combining ability effects in Tables (16 and 17) the results showed positive and highly significant SCA effects for height of plant were registered by crosses (Giza-171×Sids-14), (Giza-171×Sakha-96) and (Sids-14×Sakha-96). Therefore, the crosses are considered to be the promising for longest plant improvement under 35 kg N/fad; moreover under 70 kg N/fad; the crosses (Giza-171×Gemeiza-12) and (Giza-171×Sakha-96) recorded highly significant SCA effects, meanwhile the crosses (Giza-171 × Misr-3), (Giza-171 × Sids-14), (Giza-171 × Misr-1) and (Sids-14 × Sakha-96) showed positive significant SCA effects for plant height/cm. Tillers number/plant the crosses (Giza-171 × Misr-3), (Giza-171 × Sakha-96), (Misr-3 × Sids-14), (Gemeiza-12 × Misr-1), (Gemeiza-12 × Sakha-96) and (Sids-14 × Sakha-96) showed positive and highly significant SCA effects under 35 kg N/fad; while under 70 kg N/fad; the crosses (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Misr-3 × Sakha-96), (Sids-14 × Sakha-96) revealed positive and highly significant SCA effects. Area of flag leaf/cm^2. The crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sakha-96), (Misr-3 × Misr-1) (Gemeiza-12 × Sakha-96), (Sids-14 × Misr-1) and (Misr-1× Sakha-96) were recorded positive and highly significant SCA effects under 35 kg N/fad. In addition, the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sakha-96), (Gemeiza-12 × Sakha-96), (Sids-14 × Misr-1) and (Misr-1× Sakha-96) were showed positive and highly significant SCA effects under 70 kg N/ fad., indicating these crosses are considered to be the promising improvement for flag leaf area. Length of spike/cm., SCA effects indicated positive and highly significant by the crosses (Giza-171 × Gemeiza-12) and (Giza-171 × Sakha-96), indicated these crosses could be used it in breeding program of wheat for resistance of low input of nitrogen. Moreover, under 70 kg N/fad the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sakha-96), (Sids-14 × Misr-1) and (Misr-1× Sakha-96), were positive highly significant SCA effects for length of spike. The SCA effects positive and highly significant SCA effects were registered by (Giza-171 × Gemeiza-12) and (Giza-171 × Sakha-96), under 35 kg N/fad. Meanwhile the cross (Giza-171 × Sakha-96) was showed positive and highly significant SCA effects under 70 kg N/fad for spikes number/plant. The SCA effects for grains number/spike were positive and highly significant SCA effects were recorded by (Giza-171 × Sids-14), (Giza-171 × Sakha-96), (Misr-3 × Gemeiza-12) and (Gemeiza-12 × Misr-1). Whereas under 70 kg N/fad the crosses (Giza-171 × Sids-14), (Giza-171 × Sakha-96), and (Misr-1× Sakha-96), showed positive and highly significant. The SCA effects for weight of spike grain /g were positive and highly significant SCA effects were recorded by crosses (Giza-171×Misr-3), (Giza-171 × Sakha-96), (Sids-14 × Sakha-96) and (Misr-1× Sakha-96). While under 70 kg N/fad the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Sakha-96), (Sids-14 × Misr-1), and (Sids-14 × Sakha-96), were showed positive and highly significant. Therefore, these crosses considered to be the promising for spike grain weight improvement under low input of nitrogen. The SCA effects for weight of 1000-grain /g were positive and highly significant SCA effects were recorded by (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Sakha-96), (Gemeiza-12 × Sakha-96) and (Misr-1× Sakha-96). Therefore, these crosses considered to be the promising for weight of 1000-grain improvement under low input of nitrogen. While under 70 kg N/fad the crosses (Giza-171 × Sids-14), (Giza-171 × Sakha-96), (Misr-3 × Sakha-96), (Gemeiza-12 × Sakha-96), (Sids-14 × Misr-1), and (Sids-14 × Sakha-96), were showed positive and highly significant. The SCA effects for grain yield/plant were positive and highly significant SCA effects were recorded by (Giza-171 × Sakha-96), (Misr-3 × Sids-14), (Sids-14 × Misr-1) and (Misr-1× Sakha-96). Therefore, these crosses considered to be the promising for grain yield improvement under low input of nitrogen. While under 70 kg N/fad the crosses (Giza-171 × Gemeiza-12), (Giza-171 × Sids-14), (Giza-171 × Misr-1), (Giza-171 × Sakha-96), (Gemeiza-12 × Sids-14), and (Sids-14 × Misr-1), were showed positive and highly significant. Results were in coincidence with those obtained by [13], [16,30,26,14,15], [30].

References

[1] K. Chawan, N.V. Kayande & Swati G. Bharad. (2022). Estimating heterosis in wheat for yield and yield component characteristics using line x tester mating design (*Triticum aestivum* L.). The Pharma Innovation Journal, 11(12): 3250-3254.

[2] L. Zhichkina, K. hichkin, A.V. Vlasov, A. M. Belyaev, V. N. Borobov & N. G. Lyubimova. (2022). The effectiveness of nitrogen fertilizing in the cultivation of winter wheat. IOP Conf.Ser. Earth.Environ. Sci., (979):1-9.

[3] C. R. Farnworth, C. Stirling, B. T. Sapkota, M. L. Jat, M. Misiko & S. Attwood. (2017). Gender and inorganic nitrogen: what are the implications of moving towards a more balanced use of nitrogen fertilizer in the tropics? International Journal of Agricultural Sustainability, 15 (2):136-152.

[4] S. E. Terentyev, J. V. Gnezdova & S. V. Semchenkova. (2020). Features of Machine-Technologic al Stations Organization in the System of Agro-Industrial Production. IOP Conference Series: Earth and Environmental Science, 459(6):1-5.

[5] Begna T (2021) Combining ability and heterosis in plant improvement. Open J Plant Sci 6(1): 108-117.

[6] K. Singh, S.N. Sharma, Y. Sharma & B.S. Tyagi. (2012). Combining ability for high temperature tolerance and yield contributing traits in bread wheat. *J. Wheat Res.* 4(1): 29-37.

[7] Singh, M.K.; Sharma, P.K.; Tyagi, B.S. and Singh, G. (2014). Combining ability analysis for yield and protein content in bread wheat (*Triticum aestivum L.)*. Indian J. Agric. Sci., 84(3): 328-336.

[8] S. A. Abas, N. M. Abod & Z. A. Al-Hamed. (2018). Heterosis, combining ability and some genetic parameters in wheat using half diellil mating design. J. Plant Production, Mansoura Univ., 9 (1): 1 – 5.

[9] R.G.D. Steel & J.H. Torrie. (1980). Principles and procedures of statistics. Mc Graw- Hill.New York.

[10] S. Fonseca & F. Patterson. (1968). Hybrid vigour in seven parent diallel crosses in common wheat (*Triticum aestivum* L.). Crop Sci., (8): 85–89.

[11] B. Griffing. (1956). Concept of general and specific combining ability in relation to diallel crossing systems. Aust. J. Biol. Sci., 9: 463-493.

[12] R. A. ElRefaey, E.H. ElSeidy, A.A. Hamada & S.A. Arab. (2009). Useful heterosis estimates under different nitrogen fertilizer levels in half diallel crosses of wheat. CATRINA, 4 (3): 9-21.

[13] A.M.M. Al-Naggar, R. Shabana, M. M. Abd El-Aleem, Zainab A. El-Rashidy. (2015). performance and combining ability of six wheat genotypes and their F1 diallel crosses for NUE traits under contrasting-N conditions. American Research Journal of Agriculture, 1(3):13-23.

[14] Y.T.M. Emam, K.I.M. Ibrahim, A.A. Mohamed & Y.A. El-Gabry. (2021). Combining ability for grain yield and some agronomic traits in diallel crosses of bread wheat under nitrogen stressed conditions AUJASCI, Arab Univ. J. Agric. Sci., 29(1): 293-305.

[15] D. Bayar & H. S. A. Askander. (2023). Genetic variance, heritability and correlation in some traits of bread wheat (*Triticum aestivum* L.) under different nitrogen levels. Journal of University of Duhok., 26(1): 41-52.

[16] M. Salih. (2021). Heterosis and combining ability for yield and its related traits in bread wheat (*Triticum aestivum* L.) Plant Cell Biotechnology and Moleclar Biology, 22(34):46-53.

[17] R. Amitava, A. Kumar, K. Babu, A. Singh & S. Sisodiya. (2021). Estimation of heterosis for grain yield and yield attributes in bread wheat genotypes utilizing line x tester analysis (*Triticum aestivum* L. em. Thell). Environment Conservation Journal, 22 (3):85-95.

[18] A.I.A. Yahya. (2020) Genetical study on some bread wheat crosses under two nitrogen levels. Egypt. J. Plant Breed., 24(2):273–293.

[19] M. A. Abdel-Moneam, M. S. Sultan & E. S. Dehaina. (2021). Parents' performance and F1 crosses for several bread wheat cultivars under varying levels of nitrogen fertilization. 3rd Scientific & 1st International Conference of Desert Studies, (904):1-12.

[20] N. Dahiya, I. R. Delvadiya, M. S. Dinesh & A. Dahiya. (2023). Heterosis and combining ability analysis for yield and its component traits in bread wheat (*Triticum aestivum* L.): experimental investigation. International Journal of Plant & Soil Science, 35(18): 499-517.

[21] S. Kumawat, A. Sharma, A. Kumar, M. R. Sahoo, H. K. Jaiswal & S. Choudhary. (2023). Exploitation of heterosis for yield and yield components in wheat (*Triticum aestivum* L.). Biological Forum – An International Journal 15(2): 938-943.

[22] Motawea, MH (2017) Estimates of heterosis, combining ability and correlation for yield and its components in bread wheat. J Plant Production, (8):729-737.

[23] N.S.H. Nathan & M.Y.G.H. Moubarak. (2016). Combining ability for yield and yield components in bread wheat under two nitrogen levels. Egypt J. Plant Breed., (20): 363-372.

[24] K. Kamaluddin, R.M. Singh; L.C. Prasad, M.Z. Abdin, A.K. Joshi. (2007). Combining ability analysis for grain filling duration and yield traits in spring wheat (*Triticum aestivum* L. em. Thell.) Genetics and Molecular Biology, (30): 411-416.

[25] M.U. Farooq, I. Ishaaq, R.M. Aqbool, I. Aslam, S.M.T.A. Naqvi & S.E. Mustafa. (2019). Heritability, genetic gain and detection of gene action in hexaploid wheat for yield and its related attributes. AIMS Agric. and Food, (4): 56-72.

[26] A.R.R. El-Said. (2018). Assessment of genetical parameters of yield and its attributes in bread wheat (*Triticum aestivum* L.). J. Agric. Chem. Biotech, (9): 243- 251.

[27] M.H. Ayoob. (2020). Combining ability analysis, estimation of heterosis and some genetic parameters using half diallel cross in bread wheat (*Triticum aestivum* L.). J. Edu. and Sci., (29): 93-106.

[28] A.A. El-Hosary, M.E. El-Badawy, H.A. Ashoush, A.A.A. El-Hosary & A.I. Yahya. (2012). Inheritance of yield and its components in F1 Crosses of wheat using diallel crosses under three nitrogen rates. J. Plant production Mansoura Univ., (3):2001-2015.

[29] I. Kutlu & Z. Sirel. (2019). Using line × tester method and heterotic grouping to select high yielding genotypes of bread wheat (*Triticum aestivum* L.). Turk. J. Field Crops, (24): 185-194.

[30] A.M.M. Al-Naggar, R. Shabana, M.M. Abd El-Aleem & Z.A. El-Rashidy. (2017). Genetics of low-N tolerance adaptive traits in wheat (*Triticum aestivum* L.) under contrasting nitrogen environments. *Spanish Journal of Agricultural Research* (17): 82-97.

[31] H.S. Askander, M. M. Salih & M. S. Altaweel. (2021). Heterosis and combining ability for yield and its related traits in bread wheat (*Triticum aestivum* L.). Plant Cell Biotechnology and Molecular Biology, 22(34):46-53.