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GENETIC ANALYSIS OF SOME BREAD WHEAT GENOTYPES UNDER DROUGHT STRESS IN SANDY SOILS

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ABSTRACT: A half diallel cross was performed between six bread wheat (*Triticum aestivum* L.) genotypes, Line Yr5, Shandwell 1, Gemmeiza 11, Misr 4, Sakha 95, and Sids 14 during the 2022/2023 winter season. The resulting 15 F_1 crosses were evaluated during the 2023/2024 season under normal irrigation and drought stress conditions using strip plot design in RCB arrangement with 3 replications at Khattara Research Station, Sharqia, Egypt, to calculate mean performance, drought stress tolerance measurements, effects of general and specific combining abilities, mode of gene action, and heritability. Results were taken on number of days to heading, number of days to maturity, plant height, chlorophyll content, number of spikes plant^{-1}, number of grains spike^{-1}, weight of thousand grain, and grain yield plant^{-1}. Results cleared that mean squares due to genotypes, parents, and crosses, and parents *vs.* crosses were highly significant for most studied characters under both conditions. Moreover, general and specific combining abilities mean squares were highly significant for most studied characters under two conditions. Wheat genotype Line Yr5, as well as the F_1 crosses (Line Yr5 x Shandwell 1), (Line Yr5 x Misr 4), and (Gemmeiza 11 x Sakha 95), exhibited the lowest reduction ratio (R%), tolerance index (TOL), and drought sensitivity index (SSI) values for grain yield^{-1}. Hence, these genotypes exhibited greater tolerance to drought stress compared to others. The additive genetic component (D) was greater than the dominance component (H_1 and H_2) for number of days to heading, number of days to maturity, and plant height under normal irrigation, resulting in $(H1/D)^{0.5}$ being less than unity. Nonetheless, the dominance genetic component was more than the corresponding additive one for total chlorophyll content, number of spikes plant^{-1}, number of grains spike^{-1}, weight of thousand grain and grain yield plant^{-1} under the two conditions as well as number of days to heading, number of days to maturity and plant height under drought stress condition, resulting in average degree of dominance $(H1 /D)^{0.5}$ was more than unity. The highest heritability in the narrow sense (Tn) was observed for number of days to heading, number of days to maturity, and plant height under both conditions. Additionally, under normal irrigation conditions, heritability was also high for the number of spikes plant^{-1}, weight of thousand grains, and the number of grains spike^{-1}. On the other hand, chlorophyll content showed moderate heritability under specific conditions, including grain yield plant^{-1} and the number of spikes plant^{-1}, along with the number of grains spike^{-1} and the weight of thousand grains under drought stress conditions. In contrast, the heritability for grain yield plant^{-1} under drought stress conditions was low.

Key words: Wheat genotypes, drought tolerance, mean performance, combining ability effects, heritability, sandy soils.

INTRODCTION

Wheat is of great importance among the world's food crops. In fact, it occupies the main position in feeding most of the world's population. Also, wheat occupies one of the most important grain crops in Egypt and comes first in terms of its importance as food for the Egyptian people. In fact, it has become the

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most important winter crop of all, and this is due to its importance and high economic return for the farmer. The global yearly output total was 799 million metric tons, up from 2204 million ha. In Egypt, the cultivated area of wheat reached to 1.35 million hectares with production of 9.7 million tons (**FAOSTAT, 2025**). The increase or decrease in the cultivated area may be due to the availability of water needed to grow the wheat crop. The agricultural sector also resorts to vertical development by planting new short-lived and drought-tolerant varieties with the same amount of water it consumes. Furthermore, determining drought-tolerant genotypes for great efficient water use is needed to reduce the negative effects of water stress under soil conditions **(Farhan *et al.*, 2025)**. Therefore, improving wheat for water deficit tolerance is becoming a great challenge concerning climate change and limited irrigation water.

Combining ability analysis is a widely used biometrical tool that helps identify parental lines based on their ability to produce hybrids (**Griffing, 1956)**. This method divides the total genetic variation into two components: the variance effects of general combining ability, which measures additive gene action, and specific combining ability, which measures non-additive gene action **(Bakhet *et al*., 2024; El-Karamity *et al*., 2025).**

Estimates of the types and magnitudes of gene action for earliness traits and yield characteristics may help plant breeders to choose the appropriate method to develop grain yield under both conditions indirectly. Several studies were implemented to ascertain the type of gene action in wheat. They reported that the additive gene effect is more important than the non-additive ones in controlling number of days to heading and thousand grain weight with high narrow sense heritability (**Yadav *et al*., 2022; Kaur *et al.*, 2023)**. Nevertheless, non-additive gene effects were more important for grain yield plant^{-1} with moderately low heritability in the narrow sense **(Elmassry *et al*., 2020; Feltaous, 2020; Kaur and Kumar, 2024).**

The current study aimed to analyze the average performance, general and specific combining ability effects, and the mode of gene action related to earliness traits, yield, and yield attributes under both normal irrigation and drought stress conditions. Additionally, the investigation sought to identify the most drought-tolerant wheat genotypes through stress tolerance measurements.

MATERIALS AND METHODS

This study was carried out at the Experimental farm, Faculty of Agriculture, Zagazig University at Khattara, Sharqia, Egypt, during the two winter seasons of 2022/2023 and 2023/2024. Six wheat genotypes were used in a half-diallel cross, excluding reciprocal crosses. The parental materials were selected based on significant differences in the traits being studied. Table 1 presents the pedigree and origin of the wheat genotypes. The experimental site's soil mechanical and chemical analysis is presented in Table 2 The optimum quantity of irrigation water for crops established on water requirements of crops, factors of the soil and climate in various districts in Egypt is fixed annually by the Department of Water Requirement and Field Irrigation, Agricultural Research Center (ARC). The recommended amount of irrigation water for wheat in sandy soil in Khattara region under drip irrigation system is 1356 m^3/fad. Thus, wheat genotypes were evaluated under two irrigation water regimes:

1- Normal irrigation (1356 m^3/fad) was divided to: 130 m^3/fad from sowing to beginning of the tillering stage, 410 m^3/fad from tillering to heading stage, and 816 m^3/fad from heading stage to maturity.

2- Deficit irrigation (745 m^3/fad) was divided to: 130 m^3/fad from sowing to beginning of the tillering stage, 207 m^3/fad from tillering to heading stage, and 408 m^3/fad from heading stage to maturity.

Treatments of irrigation water regimes were started from the beginning of the tillering stage up to maturity. The irrigation schedule was twice weekly. the site exhibited variations in temperature, humidity and precipitation (Table 3).

Table 1. Pedigree of the evaluated 6 bread wheat genotypes

Code	Name	Pedigree
G1	**Line Yr5**	AOC-YR/QUAIU#3
G 2	**Shandaweel 1**	SITE//MO/4/NAC/TH.AC//3*PVN/3MIRLO/BUC.CMSS93B00567S-72Y-010M-010Y-010M-0HTY-0SH.
G 3	**Gemmeiza 11**	Bow"s"/Kz"s"//7C/aeri 82/3/Giza 168/Sakha 61. GM78922-GM-1GM-2GM-1GM-0GM.
G 4	**Misr 4**	NS732/HER/3/PRL/ SARA// TSI/VEE 5/6/FRET 2/5/WHEAR/SOKOLL
G 5	**Sakha 95**	PASTOR//Site/MO/3/CHEN/AEGILOPSSQUARrOSA (T AUS)// BCN/ 4/WbLL.CMSA01Y00158S-040P0Y-040M030ZTM-040SY-26M0Y0SY-0S.
G 6	**Sids 14**	SW8488*2/ KUKUNA- CGSS01Y00081T-099M-099Y-099M-099B-9Y-0B-0SD

Table 2. Soil mechanical and chemical analyses of the experimental site at 30 cm soil depth.

Soil characteristics	
Mechanical analysis :	
Sand	87.27 %
Silt	1.52 %
Clay	10.52 %
O. M	0.69 %
Soil texture	Sandy loam
Chemical analysis :	
Soil reaction pH	7.46
Soil salinity Ec	520 ppm
Nitrogen (Total)	0.02 %
Available phosphorus	5.60 ppm
Available potassium	36.44 ppm
Soluble Cations and Anions :	
Na^+	0.92 meq./L.
K^+	0.09 meq./L.
Ca^{++}	4 meq./L.
Mg^{++}	1.4 meq./L.
Cl^-	3 meq./100 g soil
CO_3^{--}	-
HCO^- ;3	0.4 meq./100 g soil
SO_4^{--}	3.04 meq./100 g soil

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Table 3. Meteorological data for the monthly average during the 2023/2024 growing season

Month	Minimum temperature (°C)	Maximum temperature (°C)	Humidity (%)
	Season 2023-2024		
November	17.54	25.79	56.52
December	14.42	23.45	62.04
January	13.51	22.13	59.73
February	12.97	19.41	58.79
March	15.46	25.31	51.92
April	17.96	27.75	46.17
May	20.53	30.74	47.46

Crossing and experimental layout

In the first season of 2022/2023, six parent plants were crossed to produce a half diallel set of crosses, resulting in 15 F_1 cross seeds (without reciprocals). In the second season (2023/2024), both the parents and their F_1 crosses were grown using strip plot design in RCB arrangement with three replications. In the vertical plots, the wheat genotypes were distributed randomly, while irrigation treatments will be assigned in the horizontal plots. The evaluation was conducted under both normal irrigation and drought stress conditions. Each experimental plot consisted of three rows for each parent and one row for each F_1 cross. The row length was 3 meters, with a spacing of 20 cm between rows and 10 cm between plants.

Data Analysis

Twenty plants were randomly selected from each parents genotypes and their F_1's and labeled to record data on number of days to heading, number of days to maturity, chlorophyll content (SPAD reading), plant height (cm), number of spikes plant^{-1}, number of grains spike^{-1}, weight of thousand grain (g) and grain yield plant^{-1} (g). The recorded data were analyzed statistically by using conventional two-way analysis of variance and differences among genotype means were tested using a revised LSD test at the 0.05 level according to **Steel *et al.* (1997)**.

The following stress tolerance indices, inclusive tolerance index (TOL), stress sensitivity index (SSI), reduction ratio (R%), mean productivity (MP), harmonic mean (HM), drought tolerance (DT), and relative performance (RP), were calculated using the formula below (Table 4).

General and specific combining ability were estimated as described by **Griffing (1956),** method-2, model-1. Diallel analysis procedure, as outlined by **Hayman (1954 a and b) and Mather and Jinks (1971)** was used to estimate the relative magnitude of the genetic components of variance and their derived parameters.

Heritability in narrow (T_n) sense was calculated according to **Mather and Jinks (1982).** using the following equation:

$$\text{Heritability}(\text{Tn}) = \frac{\frac{1}{2}D + \frac{1}{2}H_1 - \frac{1}{2}H_2 - \frac{1}{2}F}{\frac{1}{2}D + \frac{1}{2}H_1 - \frac{1}{4}H_2 - \frac{1}{2}F + E}$$

The covariance (Wr) between the parents and offspring was plotted against the variance (Vr) of one array (one cultivar and all crosses involving it considered) to construct the Wr/Vr graph according to **Hayman (1954a and b) and Jinks (1954)**.

Table 4. Drought tolerance indices, formula, and reference

No.	Index name and formula	Reference
The low values of these indices indicate to drought stress tolerance.		
1	Tolerance index (TOL) =Yn−Ys	**Rosielle and Hamblin (1981)**
2	Stress sensitivity index= (SSI) [1 −(Ys / Yn)] / [1−(Ýs / Ýn)	**Fischer and Maurer (1978)**
3	Reduction % =(R%) (Yn −Ys) / (Yn) × 100	**Rybiñski *et al.* (2003)**
The high values of these indices indicate to drought stress tolerance.		
4	Mean productivity =(MP) (Yn + Ys)/2	**Rosielle and Hamblin (1981)**
5	Harmonic mean (HM) ={2∗(Yn∗Ys)}/(Yn +Ys)	**Jafari *et al.* (2009)**
6	Drought tolerance= (DT) Ys / Yn	**Fereres *et al.* (1986)**
7	Relative performance =(RP) (Ys / Yn)/ (Ýs / Ýn)	**Abo-Elwafa and Bakheit (1999)**

Where: Yn and Ys indicate to average grain yield of each genotype under normal and stress conditions, respectively. Ýn and Ýs indicate to average grain yield overall genotypes under normal and stress conditions, respectively.

RESULTS AND DISCUSSION

Analysis of Variance

Genotypes, parents, and their F1 crosses cleared significant mean squares for all studied traits under both normal irrigation and drought stress conditions (Table 5). This study utilized a diverse set of genetic materials. This result supports the findings of **Qabil, Naglaa (2017), Aboshosha *et al.* (2018), Hassan *et al*. (2020), Rijal *et al.* (2021), Fouad *et al*. (2022), Bakhet *et al.* (2024), El-Karamity *et al*. (2025) and Farhan *et al*. (2025).** The mean squares attributed to parents and crosses, as indicated by average heterosis, were significant for all studied traits under both conditions. Additionally, the mean squares for general combining ability and specific combining ability were significant for all characters, suggesting that both additive and non-additive gene actions play a crucial role in their inheritance. These findings are in general harmonic with the results reported in previous studies **El-Hosary *et al*. (2019), El Ameen *et al.* (2020), Regmi *et al.* (2021), Dragov (2022), Bakhet *et al.* (2024), Fareed *et al.* (2024) and El-Karamity *et al.* (2025).**

To find out the genetic effects of greater importance, GCA/SCA ratio was computed. The GCA/SCA ratio was less than unity for number of spikes plant^{-1} under normal irrigation conditions. These results indicated that the non-additive gene action predominantly controlled this character. These findings are in agree with the results of **Shamsabadi *et al.* (2020), El-Nahas and Ali (2021), Chaudhary *et al*. (2022), Dragov *et al.* (2022), Fouad and Mohamed (2023), Amzeri *et al.* (2024), Bakhet *et al.* (2024) and Farhan *et al.* *et al.* (2025)**. The ratio of GCA / GCA was more than unity for number of days to heading, number of days to maturity, chlorophyll content, plant height, number of grains spike^{-1}, weight of thousand grain and grain yield plant^{-1} under the both conditions as well as number of spikes plant^{-1} under drought stress condition, indicating the preponderance of the additive gene action in controlling the inheritance of these characters. Similarly, **Shamsabadi *et al.* (2020), Roy *et al*. (2021), Kumari and Sharma (2022), Dawwam *et al*. (2023), Bakhet *et al.* (2024) and El-Karamity *et al.* (2025)** recorded predominance of the additive gene effects in controlling the inheritance of days to heading.

Mean Performance

Results presented in Table 6 indicate the mean performance of the traits studied of six parental wheat genotypes and their 15 F_1 crosses under normal irrigation and drought stress conditions.

Table 5. Analysis of variance of bread wheat for earliness characters, yield and its attributes under normal irrigation and drought stress conditions as well as combined analyses

S.o.V	d.f		Days to heading			Days to maturity			Total chlorophyll content (%)		
	S	Com.	Normal	Stress	Com.	Normal	Stress	Com.	Normal	Stress	Com.
Irrigation (I)		1			2484.45**			7351.67**			861.31**
Reps/I.	2	4	7.74**	0.21	3.97**	0.06	0.60	0.33**	11.10	8.56	9.83**
Genotype (G)	20	20	6.81**	10.42**	14.70**	2.97**	16.60**	15.56**	19.17**	21.97**	38.42**
Parents	5	5	11.89**	11.47**	53.99**	4.66**	18.02**	48.12**	28.66**	39.54**	169.02**
F1's	14	14	5.21**	10.31**	39.09**	2.38**	15.93**	43.78**	12.83**	14.74**	74.76**
P. Vs. F1	1	1	3.72**	6.69**	10.19**	2.72*	18.89**	17.98**	60.36**	35.24**	93.92**
GCA	5	5	19.96**	25.58**	41.29**	8.42**	36.83**	39.75**	32.72**	36.75**	69.07**
SCA	15	15	2.42**	5.36**	5.84**	1.15*	9.85**	7.50**	14.65**	17.04**	28.20**
Error	40		0.83	1.23		0.52	0.98		3.07	2.27	
G x I		20			2.52**			4.00**			2.72 ns
Parents x E		5			1.76			3.44**			0.60 ns
F1's x E		14			2.96**			4.23**			3.54 ns
P. Vs. F1 x E		1			243.85**			234.83**			715.77**
GCA x I		5			4.24**			5.49**			0.41ns
SCA x I		15			1.95**			3.50**			3.48 ns
Pooled Erorr		80			1.03			0.75			2.67
σ2 GCA			6.38	8.11	13.42	2.63	11.95	13.00	9.88	11.50	22.13
σ2 SCA			1.60	4.13	4.81	0.62	8.87	6.75	11.58	14.77	25.54
σ2 GCA/ σ2 SCA			0.89	0.80	0.85	0.89	0.73	0.79	0.63	0.61	0.63
GCA x I / GCA					9.74			7.23			170.30
SCA x I / SCA					3.00			2.14			8.09

*,** and ns indicate significant at 0.05, 0.01 levels and insignificant, respectively.

Table 5. Cont.

	d.f		Plant height (cm)			Number of spikes plant^{-1}			Number of grains spike^{-1}		
S.o.V	**S**	**Com.**	**Normal**	**Stress**	**Com.**	**Normal**	**Stress**	**Com.**	**Normal**	**Stress**	**Com.**
Irrigation (I)	**1**	1			8882.27**			462.73**			11092.94**
Reps/I.	**2**	4	8.82**	4.24**	6.53**	0.19	0.71	0.45	1.36	4.99	3.17**
Genotype (G)		20	64.98**	115.19**	139.30**	1.11**	0.89**	1.69**	60.55**	95.65**	118.96**
Parents	**5**	5	124.08**	55.03**	417.54**	1.22**	0.91**	4.92**	53.19**	61.17**	250.67**
F1' s	**14**	14	46.89**	134.75**	402.55**	1.09**	0.90**	5.34**	62.29**	104.87**	416.15**
P. Vs. F1	**1**	1	22.78**	142.22**	139.42**	0.78**	0.58**	0.01**	73.15**	138.87**	5.22ns
GCA	**5**	5	187.43**	242.05**	382.25**	3.17**	1.61**	4.30**	134.69**	174.72**	280.82**
SCA	**15**	15	24.16**	72.91**	58.32**	0.42**	0.65**	0.83**	35.84**	69.29**	65.01**
Error	**40**		5.51	5.56		0.16	0.14		2.39	3.63	
G x I		20			40.88**			0.31**			37.24**
Parents x E		5			12.09ns			0.17**			14.08**
F1's x E		14			52.25**			0.28**			33.40**
P. Vs. F1 x E		1			1994.05**			29.11**			1841.20**
GCA x I		5			47.23**			0.48**			28.58**
SCA x I		15			38.76**			0.25**			40.13**
Pooled Erorr		80			5.54			0.15			3.01
σ2 GCA		1	60.64	78.83	125.57	1.00	0.49	1.38	44.10	57.03	92.61
σ2 SCA		4	18.65	67.35	52.78	0.27	0.51	0.68	33.46	65.67	62.00
σ2 GCA/σ2 SCA		20	0.87	0.70	0.83	0.88	0.66	0.80	0.72	0.63	0.75
GCA x I / GCA		5			8.09			8.92			9.83
SCA x I / SCA		14			1.50			3.33			1.62

*,** and ns indicate significant at 0.05, 0.01 levels and insignificant, respectively.

Table 5. Cont.

	d.f		1000-grain weight (g)			Grain yield plant^{-1} (g)		
S.o.V	**S**	**Com.**	**Normal**	**Stress**	**Com.**	**Normal**	**Stress**	**Com.**
Irrigation (I)	**1**	1			2109.70			9711.65**
Reps/I.	**2**	4	3.91	0.51	2.21	6.12	7.90	7.01**
Genotype (G)		20	43.06**	30.68**	65.02	127.56**	18.31**	105.83**
Parents	**5**	5	9.69**	56.69**	200.30	42.10*	6.92*	98.45**
F1, s	**14**	14	408.53**	19.26**	127.20	155.89**	14.25**	362.25**
P. Vs. F1	**1**	1	7.93**	60.55**	327.37	158.18*	132.01**	289.59**
GCA	**5**	5	80.60**	70.41**	147.41	160.04**	18.34**	133.80**
SCA	**15**	15	30.55**	17.44**	37.55	116.73**	18.30**	96.51**
Error	**40**		3.67	3.94		13.34	2.45	
G x I		20			8.73**			40.03**
Parents x E		5			3.70^{ns}			9.65^{ns}
F1,s x E		14			7.56**			53.70**
P. Vs. F1 x E		1			1176.02**			1316.54**
GCA x I		5			3.60ns			44.59**
SCA x I		15			10.44ns			38.51**
Pooled Erorr		80			3.80			7.89
σ2 GCA		1	25.64	22.16	47.87	48.90	5.30	41.97
σ2 SCA		4	26.88	13.50	33.75	103.39	15.85	88.62
σ2 GCA/ σ2 SCA		20	0.66	0.77	0.74	0.49	0.40	0.49
GCA x I / GCA		5			40.96			3.00
SCA x I / SCA		14			3.60			2.51

*, ** and ns indicate significant at 0.05, 0.01 levels and insignificant, respectively.

Table 6. Mean performance of parental bread wheat genotypes and their F_1 crosses for earliness characters, yield and its attributes under normal irrigation and drought stress conditions

Genotypes	Days to heading		Days to maturity		Total chlorophyll content (%)		Plant height (cm)	
	Normal	**Stress**	**Normal**	**Stress**	**Normal**	**Stress**	**Normal**	**Stress**
Line Yr5	94.33	86.00	153.80	136.67	43.56	37.70	96.93	77.76
Shandwell 1	96.83	87.83	155.05	138.83	49.09	44.23	108.80	85.62
Gemmeiza 11	97.08	88.08	154.72	139.08	51.63	47.76	95.07	79.93
Misr 4	100.44	90.44	157.24	142.11	44.29	39.43	95.15	78.20
Sakha 95	98.00	91.17	156.47	143.17	47.23	42.36	92.53	76.20
Sids 14	96.67	87.33	155.80	138.33	45.29	40.43	104.87	86.33
Line Yr5 x Shandwell 1	94.67	86.33	154.47	138.67	48.49	44.30	101.00	78.33
Line Yr5 x Gemmeiza 11	97.67	86.67	154.80	139.00	45.09	38.23	98.00	75.89
Line Yr5 x Misr 4	96.33	86.33	156.13	139.00	46.29	42.76	95.67	75.89
Line Yr5 x Sakha 95	95.67	88.33	155.13	140.00	49.16	44.30	105.33	77.67
Line Yr5 x Sids 14	95.00	87.33	155.47	139.33	48.26	41.40	102.67	91.33
Shandwell 1 x Gemmeiza 11	97.00	87.67	157.13	144.67	52.83	46.96	103.33	88.44
Shandwell 1 x Misr 4	97.33	89.00	156.80	144.33	47.73	40.53	102.67	85.56
Shandwell 1 x Sakha 95	97.67	88.33	156.80	140.67	49.76	44.90	102.67	91.67
Shandwell 1 x Sids 14	96.67	87.67	155.80	141.67	49.36	44.50	109.00	94.00
Gemmeiza 11 x Misr 4	98.33	89.33	156.47	140.33	48.63	45.76	97.33	75.00
Gemmeiza 11 x Sakha 95	97.67	91.33	156.47	140.33	51.19	43.33	97.00	81.56
Gemmeiza 11 x Sids 14	95.00	83.33	154.80	137.33	46.49	43.30	98.00	85.00
Misr 4 x Sakha 95	99.00	90.00	157.33	145.00	50.89	44.70	96.00	88.67
Misr 4 x Sids 14	97.00	87.00	156.00	142.33	50.59	44.06	96.00	79.33
Sakha 95 x Sids 14	95.33	87.67	156.00	141.00	50.46	45.60	98.67	91.67
Mean	96.84	87.96	155.84	140.56	48.39	43.16	99.84	83.05
revised LSD $_{0.05}$	1.50	1.83	1.19	1.63	2.89	2.48	3.87	3.89
revised LSD $_{0.01}$	2.01	2.45	1.60	2.19	3.87	3.32	5.18	5.21

Table 6. Cont.

Genotypes	Number of spikes plant^{-1}		Number of grains spike^{-1}		1000- grain weight (g)		Grain yield plant^{-1} (g)	
	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
Line Yr5	9.01	6.00	54.25	42.61	43.85	36.84	28.20	13.60
Shandwell 1	9.78	5.74	53.40	42.97	45.95	37.77	28.81	13.68
Gemmeiza 11	10.11	6.67	61.83	46.97	49.60	45.51	36.73	16.04
Misr 4	9.84	6.27	60.98	43.46	47.80	42.57	34.55	14.55
Sakha 95	8.41	5.04	51.49	33.68	41.41	34.01	27.56	11.41
Sids 14	9.71	6.10	55.60	39.57	47.82	42.60	31.85	14.36
Line Yr5 x Shandwell 1	9.03	5.67	51.46	43.02	47.50	40.42	25.90	15.78
Line Yr5 x Gemmeiza 1	9.54	5.87	59.95	42.54	51.21	43.61	29.70	17.27
Line Yr5 x Misr 4	9.04	5.33	52.92	30.07	47.35	42.10	24.95	15.44
Line Yr5 x Sakha 95	9.08	5.62	53.32	31.03	45.72	38.40	33.40	16.82
Line Yr5 x Sids 14	9.74	5.11	56.27	30.37	51.10	37.39	32.53	12.52
Shandwell 1 x Gemmeiza 1	10.11	6.27	63.44	44.29	51.02	40.04	40.03	19.98
Shandwell 1 x Misr 4	10.14	5.64	60.78	34.27	53.61	43.75	39.83	16.40
Shandwell 1 x Sakha 95	9.14	5.32	58.31	33.57	51.53	41.62	29.03	16.85
Shandwell 1 x Sids 14	10.84	6.50	66.25	47.87	56.21	47.13	49.95	20.96
Gemmeiza 1 x Misr 4	10.61	7.10	65.42	46.13	55.18	44.57	45.38	20.67
Gemmeiza 1 x Sakha 95	9.31	5.37	54.80	38.58	48.76	42.32	26.33	16.84
Gemmeiza 1 x Sids 14	9.78	5.35	60.33	39.72	53.47	44.89	35.33	16.31
Misr 4 x Sakha 95	9.58	6.01	56.23	39.63	48.95	40.94	38.23	17.67
Misr 4 x Sids 14	10.54	6.00	62.50	40.07	54.60	42.51	33.98	18.10
Sakha 95 x Sids 14	9.34	5.20	57.67	32.70	49.35	41.10	37.32	15.55
Mean	9.65	5.81	57.96	39.20	49.62	41.43	33.78	16.22
revised LSD` $_{0.05}$	0.66	0.62	2.55	3.14	3.16	3.28	6.03	2.58
revised LSD` $_{0.01}$	0.88	0.82	3.41	4.20	4.23	4.38	8.06	3.45

Under normal irrigation conditions, the traits studied in wheat increased compared to those under drought stress. This suggests that drought stress has a negative impact on wheat grain yield a result that others have also reported by **Moustafa and Hussein (2020), Bakhet *et al.* (2024) and Farhan *et al.* (2025)**.

Number of days to heading (Table 6) indicates that the parental wheat genotypes Line Yr5, Shandwell 1, and Sids 14 exhibited desirable levels of earliness, which reflex in the performance of their F_1 crosses (Line Yr5 x Shandwell 1) and (Gemmeiza 11 x Sids 14) under both conditions, (Line Yr5 x Sids 14) under normal irrigation condition and (Line Yr5 x Misr 4) under drought stress conditions. The results propose that genes controlling earliness in heading have been transmitted from the parents to the progeny. The results indicate these crosses are promising for identifying new genotypes with early heading traits. While the two parental genotypes, Misr 4 and Sakha 95, as well as their F_1 crosses (Gemmeiza 11 x Misr 4) and (Misr 4 x Sakha 95) under both conditions, and (Gemmeiza 11 x Sakha 95) under drought stress conditions, were later in heading.

The mean performance of parental genotypes and their F_1 crosses regarding days to maturity indicated that the two parental genotypes, Line Yr5 and Gemmeiza 11, under normal irrigation, and Line Yr5 and Sids 14 under drought stress conditions, were the earliest. The good level of earliness pronounced in these parental genotypes was reflected in the performance of their F_1 crosses (Line Yr5 x Shandwell 1), (Line Yr5 x Gemmeiza 11), and (Gemmeiza 11 x Sids 14) under the two conditions, as well as (Line Yr5 x Misr 4) under drought stress conditions. These results denote that the genes responsible for early maturity have been transferred from the parents to their F_1 progeny. Consequently, these genotypes are promising candidates for early maturity. While, the parental wheat genotypes Misr 4 and Sakha 95 and their F_1 cross (Misr 4 x Sakha 95) were the latest under both conditions.

Chlorophyll content (Table 6) indicated that parental wheat genotypes Shandwell 1, Gemmeiza 11, and Sakha 95 under both conditions and their F_1 crosses (Shandwell 1 × Gemmeiza 11) and (Gemmeiza11 × Sakha 95) under normal irrigation conditions as well as (Shandwell 1 × Gemmeiza 11) and (Gemmeiza 11 × Misr 4) under drought stress conditions gave the highest values of total chlorophyll content among the studied wheat genotypes. Therefore, these genotypes could be used for selecting new recombinations characterized by high concentrations of chlorophyll content. Furthermore, Sakha 95 under the two conditions and the F_1 crosses (Line Yr5 × Misr 4), (Misr 4 × Sakha 95) and (Misr 4 x Sids 14) under normal irrigation conditions in addition to (Line Yr5 × Gemmeiza 11), (Line Yr5 × Misr 4) and (Gemmeiza 11 x Misr 4) under drought conditions gave the shortest plants among the genotypes. Otherwise, the two parental wheat genotypes, Shandwell 1 and Sids 14, and their respective cross (Shandwell 1 x Sids 14) under both conditions gave the tallest plants among the genotypes. Previous genotypes are promising candidates in wheat breeding programs aimed at improving plant height.

Regarding yield and components, Table 6 presents mean performance of the parental genotypes Gemmeiza 11 and Misr 4, as well as their F_1 cross (Gemmeiza 11 x Misr 4), along with (Shandwell 1 x Sids 14) under both conditions produced greatest number of spikes plant^{-1}, number of grains spike^{-1}, weight of thousand grain and grain yield plant^{-1}. Also, parental wheat genotype Sids 14 under both conditions, as well as their F1 cross (Gemmeiza 11 x Sids 14) under drought stress conditions, had high mean values for weight of thousand grain, denoting the importance of these crosses in wheat breeding programs for improving grain yield and its components. Hereby, genes controlling grain yield were transferred from the parents to the progeny. The results of this study suggest that these crosses may be promising for isolating new recombinants with high productivity. This means that these genotypes could be used for selecting new recombinants characterized by great grain yield.

Drought Stress Tolerance Measurements

Results given in Table 7 showed stress sensitivity index (SSI), tolerance index (TOL), reduction ratio (R%), mean productivity (MP), harmonic mean (HM), drought tolerance (DT), and relative performance (RP) of 21 wheat genotypes under normal irrigation and drought stress conditions. Results showed that parental wheat genotype Line Yr5, as well as the F_1 crosses (Line Yr5 x Shandwell 1), (Line Yr5 x Misr 4), and (Gemmeiza 11 x Sakha 95), gave lower values of stress sensitivity index, tolerance index, and reduction ratio. These results indicate that the genotypes above, which exhibited lower values of these measurements, were more tolerant to drought stress. Furthermore, parental wheat genotype Line Yr5 as well as the F_1 crosses (Line Yr5 x Shandwell 1), (Line Yr5 x Misr 4) and (Gemmeiza 11 x Sakha 95) exhibited higher values of drought tolerance and relative performance, also, Gemmeiza 11 and Misr 4 as well as the F_1 crosses (Shandwell 1 x Sids 14) and (Gemmeiza 11 x Misr 4) gave greater values of mean productivity and harmonic mean, indicating that previous genotypes were more tolerant to drought stress, whereas, the other wheat genotypes showed various levels of tolerance to drought stress. In this connection, **Arifuzzaman *et al.* (2020), El-Rawy and Hassan (2021), Emam *et al.*, (2022), Amzeri *et al.*, (2024), Bakhet *et al.*, (2024), Sallam *et al.*, (2024) and Farhan *et al.*, (2025)**, recorded varietal differences in respect to drought stress tolerance measurements.

General and Specific Combining Ability

General combining ability effects for earliness traits, yield, and yield attributes under normal irrigation and drought stress conditions are shown in Table 8. For the number of days to heading and maturity, results show that (GCA) effects were negative and significant for the parental wheat genotypes Line Yr5 under both conditions and Sids 14 under drought stress conditions. These parents are effective combiners and can enhance breeding programs for earlier results. Also, negative and significant GCA effects for plant height were obtained from the parental wheat genotypes Gemmeiza 11and Misr 4 under the two conditions, Sakha 95 under normal irrigation conditions, and Line Yr5 under

Table 7. Mean performance of stress sensitivity index, tolerance index, reduction %, mean productivity, harmonic mean, drought tolerance and relative performance for 21 bread wheat genotypes under normal irrigation and drought stress conditions.

Genotypes	Stress sensitivity index (SSI)	Tolerance index (TOL)	Reduction % (R%)	Mean productivity (MP)	Harmonic mean (HM)	Drought tolerance (DT)	Relative performance (RP)
Line Yr5	1.00	14.60	51.76	20.90	18.35	0.48	1.00
Shandwell 1	1.01	15.13	52.52	21.24	18.55	0.47	0.99
Gemmeiza 1	1.09	20.69	56.34	26.38	22.32	0.44	0.91
Misr 4	1.12	20.00	57.88	24.55	20.48	0.42	0.88
Sakha 95	1.13	16.15	58.60	19.48	16.14	0.41	0.86
Sids 14	1.06	17.49	54.91	23.11	19.80	0.45	0.94
Line Yr5 x Shandwell 1	0.75	10.12	39.08	20.84	19.61	0.61	1.27
Line Yr5 x Gemmeiza 1	0.81	12.43	41.85	23.48	21.84	0.58	1.21
Line Yr5 x Misr 4	0.74	9.51	38.13	20.19	19.07	0.62	1.29
Line Yr5 x Sakha 95	0.96	16.58	49.64	25.11	22.37	0.50	1.05
Line Yr5 x Sids 14	1.19	20.01	61.51	22.52	18.08	0.38	0.80
Shandwell 1 x Gemmeiza 1	0.97	20.04	50.07	30.00	26.66	0.50	1.04
Shandwell 1 x Misr 4	1.14	23.42	58.82	28.11	23.23	0.41	0.86
Shandwell 1 x Sakha 95	0.81	12.17	41.94	22.94	21.32	0.58	1.21
Shandwell 1 x Sids 14	1.12	28.99	58.03	35.46	29.53	0.42	0.87
Gemmeiza 1 x Misr 4	1.05	24.71	54.45	33.02	28.40	0.46	0.95
Gemmeiza 1 x Sakha 95	0.70	9.49	36.04	21.58	20.54	0.64	1.33
Gemmeiza 1 x Sids 14	1.04	19.01	53.82	25.82	22.32	0.46	0.96
Misr 4 x Sakha 95	1.04	20.56	53.78	27.95	24.17	0.46	0.96
Misr 4 x Sids 14	0.90	15.87	46.72	26.04	23.62	0.53	1.11
Sakha 95 x Sids 14	1.13	21.77	58.33	26.43	21.95	0.42	0.87

Table 8. General and specific combining ability effects of bread wheat genotypes for earliness characters. yield and its attributes under normal irrigation and drought stress conditions

Genotypes	Days to heading		Days to maturity		Total chlorophyll content (%)		Plant height (cm)	
	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
				GCA				
Line Yr5	-1.24**	-1.09**	-0.91**	-1.83**	-1.79**	-1.97**	-0.29	-3.34**
Shandwell 1	-0.11	-0.13	0.03	0.46	0.95*	0.93*	4.67**	3.49**
Gemmeiza 1	0.24	-0.15	-0.22	-0.52*	1.09*	1.37**	-1.89*	-1.95*
Misr 4	1.37**	0.85*	0.79**	1.41**	-0.76	-0.69	-2.62**	-2.56**
Sakha 95	0.43	1.53**	0.47*	1.17**	0.89	0.67	-1.77*	0.28
Sids 14	-0.70	-1.01**	-0.15	-0.70*	-0.38	-0.31	1.90*	4.08**
LSD 5% (gi-gi)	0.52	0.64	0.42	0.57	1.01	0.87	1.36	1.36
LSD 1% (gi-gi)	0.70	0.86	0.56	0.76	1.35	1.16	1.81	1.82
				SCA				
Line Yr5 x Shandwell 1	-0.83	-0.40	-0.49	-0.53	0.94	2.17*	-3.22	-4.86*
Line Yr5 x Gemmeiza 1	1.82*	-0.05	0.09	0.78	-2.60*	-4.33**	0.34	-1.87
Line Yr5 x Misr 4	-0.65	-1.39	0.41	-1.15	0.45	2.26	-1.26	-1.26
Line Yr5 x Sakha 95	-0.37	-0.07	-0.27	0.09	1.66	2.43*	7.56**	-2.33
Line Yr5 x Sids 14	0.09	1.47	0.69	1.30	2.04	0.51	1.22	7.54**
Shandwell 1xGemmeiza 1	0.03	-0.01	1.49*	4.15**	2.39	1.50	0.71	3.86*
Shandwell 1 x Misr 4	-0.77	0.32	0.14	1.90*	-0.86	-2.88*	0.77	1.58
Shandwell 1 x Sakha 95	0.51	-1.03	0.46	-1.53*	-0.48	0.12	-0.08	4.85*
Shandwell 1 x Sids 14	0.63	0.85	0.09	1.34	0.39	0.70	2.59	3.38*
Gemmeiza 1 x Misr 4	-0.12	0.67	0.06	-1.13	-0.10	1.92	1.99	-3.54*
Gemmeiza 1 x Sakha 95	0.15	1.99*	0.38	-0.89	0.81	-1.88	0.81	0.17
Gemmeiza 1 x Sids 14	-1.39*	-3.47**	-0.66	-2.01*	-2.61	-0.93	-1.85	-0.18
Misr 4 x Sakha 95	0.35	-0.35	0.23	1.85*	2.36	1.55	0.54	7.90**
Misr 4 x Sids 14	-0.52	-0.81	-0.48	1.06	3.33*	1.89	-3.12	-5.23*
Sakha 95 x Sids 14	-1.24	-0.82	-0.16	-0.03	1.55	2.07	-1.30	4.25*
LSD 5% (Sij-Sik)	1.39	1.70	1.11	1.51	2.67	2.30	3.59	3.60
LSD 1% (Sij-Ski)	1.85	2.26	1.48	2.02	3.57	3.07	4.79	4.45

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

Table (8): Cont.

Genotypes	Number of spikes plant^{-1}		Number of grains spike^{-1}		1000- grain weight (g)		Grain yield plant^{-1} (g)	
	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
				GCA				
Line Yr5	-0.31*	-0.14	-2.91**	-1.52*	-2.09**	-1.80**	-4.20**	-1.07*
Shandwell 1	0.22*	0.02	0.16	1.82**	0.55	-0.19	0.73	0.47
Gemmeiza 1	-0.104	0.32**	2.73**	3.85**	1.44**	2.05**	1.71	1.19*
Misr 4	0.32*	0.24*	1.76**	0.34	1.00*	1.12*	1.87	0.47
Sakha 95	-0.46**	-0.39**	-2.80**	-3.94**	-2.52**	-2.20**	-2.14*	-0.88*
Sids 14	0.33*	-0.04	1.06*	-0.56	1.63**	1.03	2.04*	-0.18
LSD 5% (gi-gi)	0.23	0.22	0.89	1.10	0.89	1.15	2.11	0.90
LSD 1% (gi-gi)	0.31	0.29	1.19	1.47	1.19	1.53	2.81	1.21
				SCA				
Line Yr5 x Shandwell 1	-0.45	-0.03	-3.75**	3.51*	-0.58	0.98	-4.41	0.16
Line Yr5 x Gemmeiza 1	0.39	-0.13	2.17	1.01	2.25*	1.93	-1.59	0.92
Line Yr5 x Misr 4	-0.54	-0.58*	-3.89**	-7.95**	-1.16	1.35	-6.50*	-0.19
Line Yr5 x Sakha 95	0.29	0.33	1.07	-2.71*	0.72	0.98	5.96*	2.54*
Line Yr5 x Sids 14	0.16	-0.52	0.16	-6.74**	1.94	-3.26*	0.91	-2.46*
Shandwell 1 x Gemmeiza 1	0.41	0.11	2.58*	-0.58	-0.59	-3.25*	3.80	2.10
Shandwell 1 x Misr 4	0.02	-0.44	0.89	-7.09**	2.44*	1.39	3.44	-0.77
Shandwell 1 x Sakha 95	-0.19	-0.13	2.99*	-3.51*	3.88**	2.58	-3.35	1.04
Shandwell 1 x Sids 14	0.71*	0.71*	7.06**	7.42**	4.41**	4.86**	13.40**	4.45**
Gemmeiza 1 x Misr 4	0.82*	0.73*	2.97*	2.74*	3.12*	-0.04	8.01*	2.78*
Gemmeiza 1 x Sakha 95	0.31	-0.38	-3.09*	-0.54	0.22	1.04	-7.04*	0.30
Gemmeiza 1 x Sids 14	-0.02	-0.74*	-1.42	-2.77*	0.78	0.38	-2.21	-0.93
Misr 4 x Sakha 95	0.15	0.34	-0.69	4.04*	0.86	0.59	4.71	1.85
Misr 4 x Sids 14	0.31	-0.01	1.72	1.10	2.36*	-1.07	-3.71	1.58
Sakha 95 x Sids 14	-0.10	-0.18	1.45	-2.00	0.63	0.85	3.63	0.38
LSD 5% (Sij-Sik)	0.61	0.57	2.36	2.91	2.35	3.03	5.58	2.39
LSD 5% (Sij-Ski)	0.81	0.76	3.15	3.88	3.14	4.05	7.45	2.95

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

drought stress conditions. While the parental wheat genotypes Shandwell 1 and Gemmeiza 11 under both conditions were the best combiners for chlorophyll content as they exhibited positive and significant GCA effects for this character, they could therefore be considered as best combiners for this character. For the number of spikes plant^{-1}, positive and highly substantial GCA effects were registered by the parental wheat genotypes Misr 4 under the two conditions, Shandwell 1 and Sids 14 under normal irrigation conditions, and Gemmeiza 11 under drought stress conditions. Positive and significant GCA effects would be of interest for the number of grains spike^{-1} in the parental wheat genotypes Gemmeiza 11 under the two conditions, Misr 4 and Sids 14, under normal irrigation conditions, and Shandwell 1 under drought stress conditions. Concerning the weight of thousand grain, positive and significant (GCA) effects have been shown by the parental wheat genotype Gemmeiza 11 and Misr 4 under the two conditions, and Sids 14 under normal irrigation conditions. Moreover, for grain yield /plant, the results in Table (8) show that positive and significant GCA effects were detected for the parental wheat genotype Sids 14 under normal irrigation condition and Gemmeiza 11 under drought stress conditions, these parental genotypes were also positive and significant GCA effects in one or more of yield components: number of spikes plant^{-1}, number of grains spike^{-1} and weight of thousand grain. Considering previous results, it could be suggested that the foregoing parents are considered as good combiners for improving yield and its components. These results are consistent with those published by **Abo-Sapra**

***et al.* (2018), Salam *et al.* (2019), Kajla *et al*. (2020), Gimenez *et al.* (2021), Kumawat *et al.* (2023), Amzeri *et al*. (2024), Bakhet *et al.* (2024), Fareed *et al.* (2024), El-Karamity *et al.* (2025) and Farhan *et al.* (2025)**.

Regarding SCA effects for earliness characters, yield and yield attributes under normal irrigation and drought stress conditions (Table 8), negative and significant SCA effects were detected by the wheat cross (Gemmeiza 11 x Sids 14) under both conditions for number of days to heading, (Shandwell 1 x Sakha 95) and (Gemmeiza 11 x Sids 14) under drought stress condition for number of days to maturity. Furthermore, for plant height, negative and significant SCA effects were recorded by the wheat crosses (Line Yr5 × Shandwell 1), (Gemmeiza 11 × Misr 4), and (Misr 4 × Sids 14) under drought stress conditions. Wherefore, the abovementioned crosses are considered promising for varietal improvement purposes for these characters. While, positive and significant SCA effects have been registered by the wheat cross (Misr 4 x Sids 14) under normal irrigation condition in addition to (Line Yr5 x Shandwell 1) and (Line Yr5 x Sakha 95) under drought stress condition for chlorophyll content; (Shandwell 1 x Sids 14) and (Gemmeiza 11x Misr 4) under both conditions for number of spikes plant^{-1}; (Shandwell 1 x Sids 14) and (Gemmeiza 11 x Misr 4) under both conditions, (Shandwell 1 x Gemmeiza 11) and (Shandwell 1 x Sakha 95) under normal irrigation condition, (Line Yr5 x Shandwell 1) and (Misr 4 x Sakha 95) under drought stress condition for number of grains spike^{-1}; (Shandwell 1 x Sids 14) under both conditions, (Line Yr5 x Gemmeiza 11), (Shandwell 1 x Misr 4) , (Shandwell 1 x Sakha 95), (Gemmeiza 11 x Misr 4) and (Misr 4 x Sids 14) under normal irrigation condition for weight of thousand grain as well as (Line Yr5 x Sakha 95), (Shandwell 1 x Sids 14) and (Gemmeiza 11 x Misr 4) under both conditions for grain yield plant^{-1}. These crosses could be employed in breeding programs to advance these characteristics in wheat. Overall, the above crosses appear to be effective F_1 cross combinations for enhancing wheat grain yield.

Generally, the SCA effects for grain yield and yield components (Table 8) were positive and significant, the F_1 crosses (Shandwell 1 x Sids 14) and Gemmeiza 11 x Misr 4) under both conditions detected positive and significant SCA effects for grain yield/plant. Furthermore, the abovementioned crosses are considered superior F_1 hybrids for being greater in one or more yield components: number of spikes plant^{-1}, number of grains spike$^{-1,}$ and weight of thousand grain.

Mode of Gene Action, Genetic Ratios and Heritability

Table 9 presents the genetic components of variation and their derived parameters for earliness traits, yield, and yield attributes under normal irrigation and drought stress conditions. The results indicated that both additive and dominance (H_1 and H_2) genetic components were statistically significant for chlorophyll content and number of spikes plant^{-1} under both conditions, number of grains spike^{-1}, and weight of thousand grain under normal irrigation conditions and plant height under drought conditions, revealing the importance of both additive and dominance gene action in the genetics of these characters. Furthermore, the results cleared that additive component was significant for the number of days to heading and maturity under both conditions, plant height under normal irrigation conditions, and weight of thousand grain under drought conditions, reinforcing the importance of additive gene action in the inheritance of these traits. Furthermore, the dominance (H1 and H2) genetic component was significant for grain yield plant^{-1} under the two conditions and number of grains spike^{-1} under the drought condition, suggesting that exploiting dominance gene action through hybridization is more pronounced for improving these characters.

The results showed that, additive component (D) was greater in magnitude than the corresponding dominance (H_1 and H_2) for number of days to heading, maturity, and plant height under normal irrigation condition, resulting in $(H_1/D)^{0.5}$ was less than unity, indicating that the presence of partial dominance and the improvement can occur through individual phenotypic selection in early generations for these traits. In this respect, the additive genetic portion was the main type controlling these characters (**Ahmad *et al*., 2020; Elmassry *et al*., 2020; Yadav *et al*., 2022;**

Table 9. Additive, dominance, genetic variances, and their derived parameters for earliness characters, yield and its attributes in the studied bread wheat genotypes under normal irrigation and drought stress conditions

Genetic parameters	Days to heading		Days to maturity		Total chlorophyll content (%)		Plant height (cm)	
	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
D+S.E	3.58**	3.43*	1.39**	5.69**	8.41*	12.33**	39.47**	16.51*
	±0.34	±1.22	±0.24	±1.83	±1.95	±2.27	±5.51	±5.32
H_1+S.E	2.34	6.07	1.12	12.51	16.13*	21.40*	29.38	98.97**
	±0.87	±3.11	±0.60	±4.65	±4.96	±5.77	±13.98	±13.51
H_2+S.E	2.05	5.90	0.96	10.87	13.10*	17.44*	24.55	76.38**
	±0.78	±2.78	±0.54	±4.16	±4.43	±5.15	±12.49	12.07
F+S.E	0.74	-0.79	0.18	0.78	6.79	11.66	15.54	-13.92
	±0.84	±2.99	±0.58	±4.48	±4.77	±5.55	±13.45	±13.00
h^2+S.E	0.59	1.23	0.50	3.90	12.40*	7.14	3.87	29.71*
	±0.53	±1.87	±0.36	±2.80	±2.98	±3.47	±8.40	±8.12
E+S.E	0.38	0.39	0.17	0.32	1.15	0.86	1.89	1.83
	±0.13	±0.46	±0.09	±0.69	±0.74	±0.86	±2.08	±2.01
Derived Parameters								
$[H_1 / D]^{0.5}$	0.81	1.33	0.90	1.48	1.39	1.32	0.86	2.45
$H_2 / 4H_1$	0.22	0.24	0.21	0.22	0.20	0.20	0.21	0.19
h^2 / H_2	0.29	0.21	0.52	0.36	0.95	0.41	0.16	0.39
KD / KR	1.29	0.84	1.16	1.10	1.82	2.12	1.59	0.71
$T_{(n)}$	63.46	53.97	62.66	51.82	34.46	30.69	64.17	55.88

*and**indicate significant at 0.05 and 0.01 levels of probability, respectively. $T_{(n)}$: Narrow sense heritability.

Table 9. Cont.

Genetic parameters	Number of spikes $plant^{-1}$		Number of grains $spike^{-1}$		1000- grain weight (g)		Grain yield $plant^{-1}$ (g)	
	Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
D+S.E	0.41*	0.25*	16.95*	19.16	7.82*	17.64**	9.70	1.41
	±0.09	±0.09	±5.45	±10.39	±2.54	±2.93	±13.72	±1.58
H_1+S.E	0.85*	0.75*	49.16*	89.14*	27.20*	19.15	149.02*	18.18*
	±0.22	±0.24	±13.83	±26.37	±6.45	±7.43	±34.83	±4.02
H_2+S.E	0.67*	0.69*	37.37*	79.61*	25.06*	17.00	130.32*	16.62**
	±0.20	±0.21	±12.35	±23.56	±5.76	±6.63	±31.11	±3.59
F+S.E	0.06	0.05	1.90	-5.51	-5.27	10.11	-6.44	-0.58
	±0.22	±0.21	±13.31	±25.38	±6.20	±7.15	±33.52	±3.87
h^2+S.E	0.75**	0.09	15.37	29.32	67.82**	12.38	31.77	28.02**
	±0.13	±0.13	8.31	±15.86	±3.88	±4.47	±20.94	±2.42
E+S.E	0.05	0.06	±0.78	1.23	1.23	1.26	4.33	0.90
	±0.03	±0.04	±2.06	±3.93	±0.96	±1.11	±5.19	±0.60
Derived Parameters								
$[H_1 / D]^{0.5}$	1.45	1.73	1.70	2.16	1.87	1.04	3.92	3.60
$H_2 / 4H_1$	0.20	0.23	0.19	0.22	0.23	0.22	0.22	0.23
h^2 / H_2	1.12	0.14	0.41	0.37	2.71	0.73	0.24	1.69
KD / KR	1.11	1.12	1.07	0.87	0.69	1.76	0.84	0.89
$T_{(n)}$	54.07	36.63	57.00	44.73	50.40	46.76	32.06	25.96

*and** indicate significant at 0.05 and 0.01 levels of probability. respectively. $T_{(n)}$: Narrow sense heritability.

Darwish *et al*., 2024; Kaur *et al.*, 2023). However, the dominance genetic component had a greater magnitude compared to the additive components for total chlorophyll content**.**, number of spikes plant^{-1}, number of grains spike^{-1}, weight of thousand grain and grain yield plant^{-1} under both conditions as well as number of days to heading, number of days to maturity and plant height under drought stress condition, resulting in average degree of dominance $(H_1 /D)^{0.5}$ was more than unity, confirming the significance of over-dominance gene action in regulating these traits. Therefore, the hybrid breeding method could be used to improve these characters. **Feltaous (2020), Kaur *et al.* (2023) and kaur and kumar (2024)** emphasized the importance of dominance genetic component in the inheritance of these characters.

The (F value) was positive for number of days to maturity, chlorophyll content and number of spikes plant^{-1} under both conditions as well as days to heading, plant height and number of grains spike^{-1} under normal irrigation condition, indicating a higher frequency of dominant alleles compared to recessive ones in the parental populations, which was supported by high value of KD/KR than unity for these traits. Nevertheless, the F values were negative for grain yield /plant under the both conditions as well as number of days to heading, plant height and number of grains spike^{-1} under drought stress conditions, The analysis cleared that the values of (F) indicated a higher prevalence of recessive alleles in the parents for these traits, supported by the KD/KR ratio, which was less than one for previous traits.

The overall dominance effects of heterozygous loci (h^2) were positive and significant for total chlorophyll content, number of spikes plant^{-1}, weight of thousand grain under normal irrigation conditions, and plant height and grain yield plant^{-1} under drought stress conditions. This indicates that dominance was primarily due to heterozygous loci and appeared to act positively. Environmental variance (E) had an insignificant effect on all studied characters under both conditions.

The frequency of gene distribution in the parents (H_2 /4H_1) deviated from its theoretical value (0.25) for plant height under drought stress conditions and number of grains spike^{-1} under normal irrigation conditions, suggesting asymmetric distribution of positive and negative alleles among the parental population. Nevertheless, H_2 /4H_1 ratio was around the maximum value (0.25) for number of days to heading, number of days to maturity, chlorophyll content, number of spikes plant^{-1}, weight of thousand grain and grain yield plant^{-1} under both conditions, plant height under normal irrigation condition as well as number of grains spike^{-1} under drought stress condition, provide evidence for symmetrical distribution of positive and negative alleles among the parental populations.

The ratio of additive genetic variance to the total genetic variance, as indicated by heritability in narrow sense (T_n), was high for number of days to heading, number of days to maturity, and plant height under the two conditions, as well as number of spikes plant^{-1}, number of grains spike^{-1}, and thousand grain weight under normal irrigation conditions. Therefore, phenotypic selection could be used to enhance these traits. In this context, high narrow-sense heritability was recorded for these traits by **Wasaya *et al*. (2023), Amzeri *et al.* (2024) and Darwish *et al*. (2024).** Furthermore, it was moderate for total chlorophyll content under both conditions, grain yield plant^{-1} under normal irrigation conditions, and number of spikes plant^{-1}, number of grains spike^{-1}, and weight of thousand grain under drought stress conditions. At the same time, grain yield plant^{-1} was low under drought stress conditions. Thus, selection did not effectively enhance these traits in early segregating generations. In this context, grain yield per plant has been observed to have low narrow-sense heritability **Farhan *et al.*, 2025).**

Graphical Analysis

Figs. 1 and 2 illustrate Wr/Vr relationship for earliness characters, yield and yield attributes under normal irrigation and drought stress conditions, respectively.

Under normal irrigation conditions, the regression line cuts the Wr-axis below the point of origin for total chlorophyll content and grain yield plant^{-1}, showing the great role of over-dominance gene action in genetic of these characters suggests, that selection for desirable

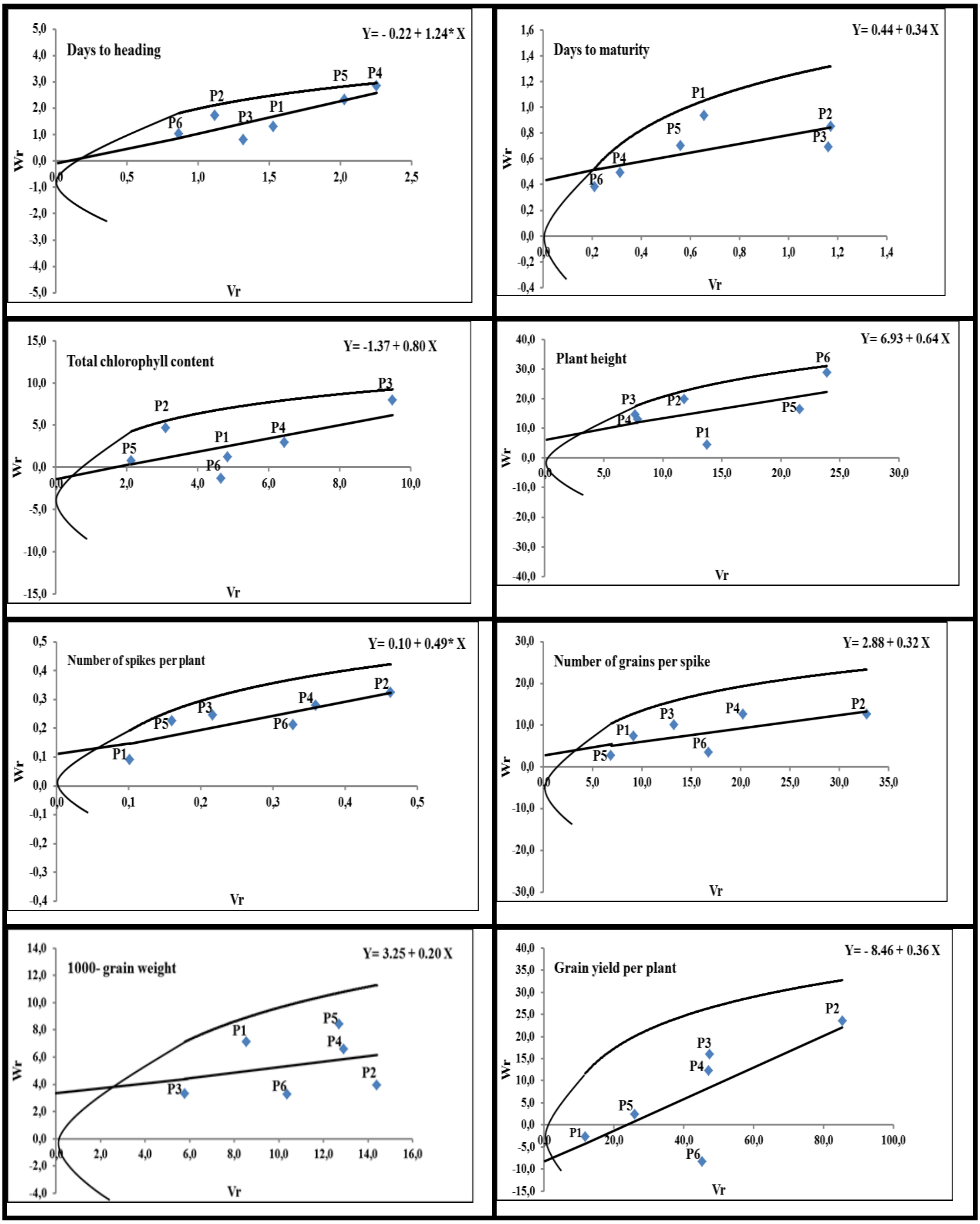

Fig. 1. Wr-Vr graph for different agronomic characters of parental bread wheat genotypes under normal irrigation conditions. P_1, P_2, P_3, P_4, P_5 and P_6 indicate to bread wheat genotypes *i.e.*, Line Yr5, Shandwell 1, Gemmeiza 11, Misr 4, Sakha 95 and Sids 14, respectively

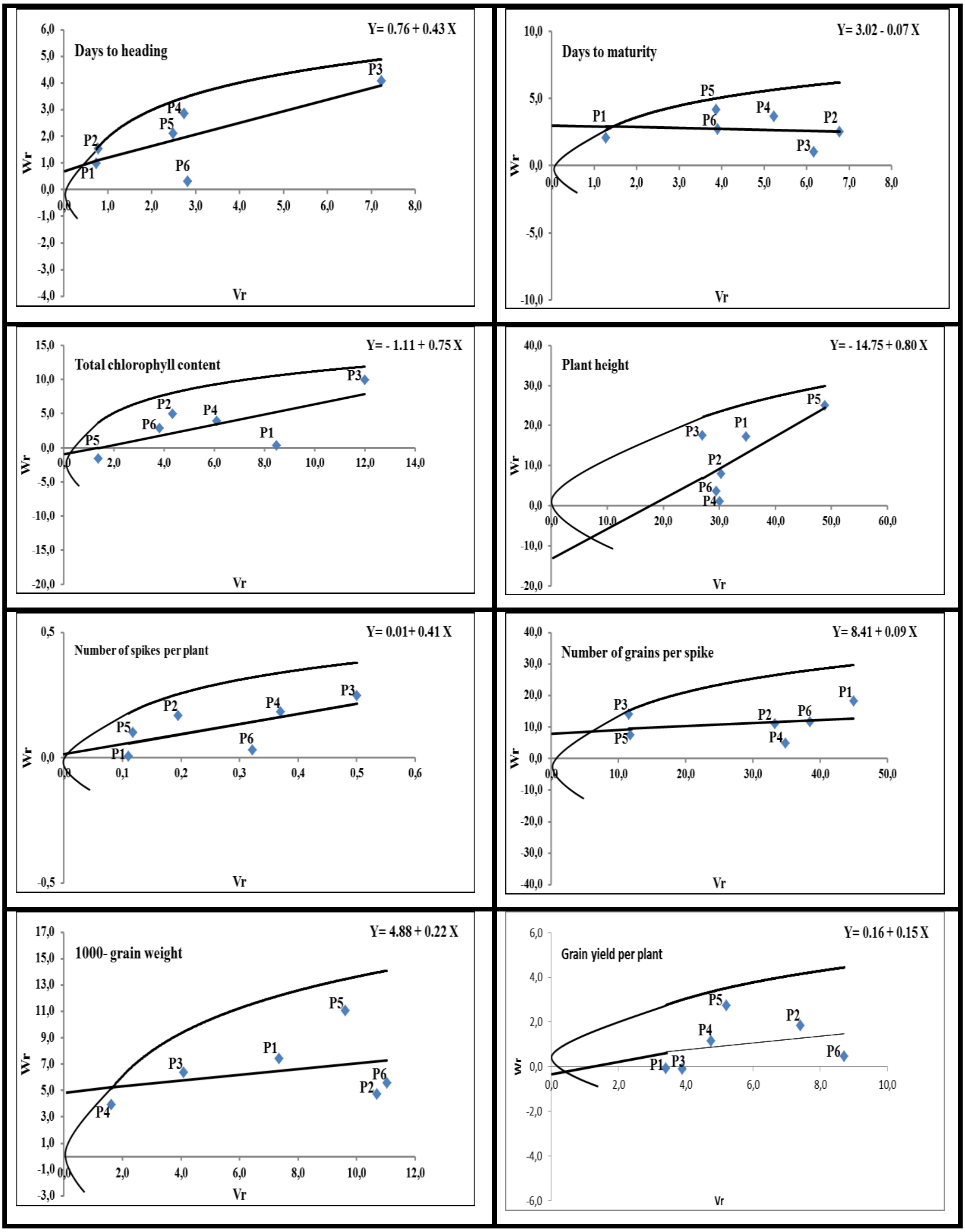

Fig. 2. Wr-Vr graph for different agronomic characters of parental bread wheat genotypes under drought stress conditions. P_1, P_2, P_3, P_4, P_5 and P_6 indicate to bread wheat genotypes *i.e.*, Line Yr5, Shandwell 1, Gemmeiza 11, Misr 4, Sakha 95 and Sids 14, respectively

transgressive segregates would not be possible through selection in the early generations. Similar findings related to grain yield plant^{-1} were reported by **Darwish *et al.* (2024)**. But we should also consider that the regression line cuts the Wr-axis above the origin for number of days to heading, number of days to maturity, plant height, number of spikes plant^{-1}, number of grains spike^{-1}, and weight of thousand grain, showing an additive type of gene action with partial dominance controlling the genetic mechanism of these characters. The genetic component supports these results, which indicate that additive gene action is the prevailing type in the genetics of these traits. Similar results were reported by **Ljubičić *et al*. (2017), Darwish *et al.* (2024), and Ali *et al.* *(*2025).** The pattern of distribution of wheat parental genotypes along the regression lines under normal irrigation conditions for all studied characters (Fig.1) indicates that genotype Shandwell 1 possessed the most recessive genes for number of spikes plant^{-1}, number of grains spike^{-1}, weight of thousand grain, and grain yield plant^{-1}. Moreover, Misr 4 for number of days to heading; Gemmeiza 11 for chlorophyll content; Sids 14 for plant height, and Shandwell 1 and Gemmeiza 11 for number of days to maturity. However, Sids 14 for number of days to heading and number of days to maturity had the most dominant genes. Furthermore, Sakha 95 for chlorophyll content; Gemmeiza 11 and Misr 4 for plant height; Gemmeiza 11 for weight of thousand grain, as well as Line Yr5 and Sakha 95 for number of spikes plant^{-1}, number of grains spike^{-1}, and grain yield plant^{-1} all possessed more dominant genes.

Under drought stress conditions, the regression lines intercept Wr -axis below the point of origin for total chlorophyll content and grain yield plant^{-1}. This denotes the appearance of over-dominance gene action in the genetics of these traits. While the regression lines intercept Wr-axis above the point of the origin for number of days to heading, number of days to maturity, plant height, number of spikes plant^{-1}, number of grains spike^{-1}, and weight of thousand grain, display additive type of gene action with partial dominance controlling the genetic mechanism of these traits. Distribution of wheat parental genotypes along the regression line presented that, Line Yr5 and Shandwell 1 for number of days to heading; Sakha 95 for total chlorophyll content; Gemmeiza 11 for plant height; Line Yr5 and Sakha 95 for number of spikes plant^{-1}; Gemmeiza 11 and Sakha 95 for number of grains spike^{-1}; Misr 4 for weight of thousand grain as well as Line Yr5 for number of days to maturity and grain yield plant^{-1} possessed the most dominant genes for these traits. While Gemmeiza 11 for number of days to heading, chlorophyll content, and number of spikes plant^{-1}; Shandwell 1 for number of days to maturity; Sakha 95 for plant height; Line Yr5 for number of grains spike^{-1}, as well as Shandwell 1 and Sids 14 for weight of thousand grain and grain yield plant^{-1}, displayed the most recessive genes for these traits.

Conclusion

Generally, for mean squares due to genotypes, parents, crosses, parents *vs.* crosses as well as general and specific combining abilities, were highly significant for most studied characters under both conditions. Furthermore, the most promising wheat genotypes for grain yield were Gemmeiza 11 and Misr 4, as well as their F_1 cross (Gemmeiza 11 x Misr 4), along with (Shandwell 1 x Sids 14) under both conditions, these genotypes were also superior in one or more of yield components *i.e.*, number of spikes plant^{-1}, number of grains spike^{-1} and weight of thousand grain. Also, the genotypes Line Yr5 as well as the F_1 crosses (Line Yr5 x Shandwell 1), (Line Yr5 x Misr 4) and (Gemmeiza 11 x Sakha 95) were more tolerant in respect to drought stress tolerance measurements. So, it could be recommended in breeding wheat programs to produce promising new genotypes.

REFERENCES

Abo-Elwafa, A. and B.R. Bakheit (1999). Performance, correlation and path coefficient analysis in faba bean. Assiut J. of Agric. Sci., 30: 77-91.

Abo-Sapra, H.M., K.A. Kheiralla, A., Abo-Elwafa, E.A. Hassaballa and M.A.F. Habouh (2018). Performance and combining ability of some agronomic traits of bread wheat under normal and water stress conditions. Assiut Journal of Agricultural Sciences, 49 (4): 1-14.

Aboshosha, A. A. M., H. E. Galal and A. A. Youssef (2018). Combining ability and heterosis analyses for earliness and yield potential in some bread wheat crosses under optimum and late sowing. J. Plant Prod, 9(4): 377-386.

Ahmad, I., F. Mohammad, S.A. Jadoon, A. Zeb, F. Munsif and W. Ahmad (2020). Diallel analysis for the inheritance study of phytic acid along with morpho-yield traits in bread wheat. Afr. J. Biotechnol, 19(5): 259-264.

Ali, M. A., M. S. Hassan and Asmaa A. H. A. Hassan (2025). Effect of heat stress on the inheritance and selection for earliness in bread wheat. SVU-International Journal of Agricultural Sciences, 7 (1): 178-195.

Amzeri, A., Suhartono, S. Fatimah, G. Pawana and K.P.W. Sukma (2024). Combining ability analysis in maize diallel hybrid populations under optimum and drought stress conditions. SABRAO J. Breed. Genet,56 (2): 476-492.

Arifuzzaman, Mohammed, S. Berman, S. Haider, M.A.K.Azad, M.T.S. Turin, M.A. Amzad and M.S. Masuda (2020). Subjected to multivariate analysis. Grain Communications, 48, 301-308.

Bakhet, B.R., M. A. F. Habouh, M.N.T. Abd El-Kade and M. A.M. Abd El-Galil (2024). Genetic analysis of yield and its components in diallel crosses of wheat (*Triticum aestivum* L.) under normal and drought condition. Aswan Uni., J. Sci. Techn, 4:15-27.

Chaudhary, D., K. Nagar and R. Dhyani (2022). Genetic analysis of yield and its attributes in bread wheat (*Triticum aestivum* L.) under irrigated and rainfed conditions. Euphytica, 218(9): 1-9.

Darwish, M. A., Z.E. Ghareeb, A.I. Muhammad, I AL-Ashkar and A. EL-Sabagh (2024). Determining the gene action and combining ability of F_2 bread wheat by diallel analysis. *Pak. J. Bot*., 56(4): 1407-1417.

Dawwam, H. A., Marwa, M. El-Nahas, A. A. Morad and H. G. Abdelmageed (2023). Combining ability for yield and its components in bread wheat under different nitrogen rates by line × tester analysis. Menoufia J. Plant Prod, 8(12): 229-245.

Dragov, R. G. (2022). Combining ability for quantitative traits related to productivity in durum wheat. Vavilov Journal of Genetics and Breeding, 26(6), 515.

El Ameen, M.T., A.G.A. Khaled and I.F.O. Elshazly (2020). Genetic analysis of eight parents and their 28 hybrids under salinity tolerance in bread wheat. Asian J Biol Sci., 2(1):37-48.

El-Hosary A. A., M. El. M. El-Badawy, S. A. S. Mehasen, A. A. A. El-Hosary, T. A. ElAkkad and A. El-Fahdawy (2019). Genetic diversity among wheat genotypes using RAPD markers and its implication on genetic variability of diallel crosses. Bioscience Research, 16(2): 1258-1266.

El-Karamity, A. E., M. Kh. Sarhan, Sh. Th. El-Sherif and H. M. Fouad (2025). Heterosis and combining ability of F1 bread wheat diallel crosses. J. of Plant Production, Mansoura Univ., 16 (1):13-19.

Elmassry, E., S. Arab and M. Al-Farouk (2020). Combining ability of some bread wheat genotypes for yield and its components under normal watering and water-stress conditions. J Plant Prod, 11(12): 1517-1527.

El-Nahas, Marwa M. and O. A. M. Ali (2021). Estimation of combining ability and heterosis for wheat yield and Its components under water stress conditions. Egypt. J. Agron., 43(2): 277-293.

El-Rawy, M.A. and M.I. Hassan (2021). Assessment of genetic diversity in durum and bread wheat genotypes based on drought tolerance and SSR marker. Plant Breed Biotech, 9(2): 89-103.

Emam, M. A., A. M. Abd EL-Mageed, G. Niedbała, S. A. Sabrey, A. S.Fouad, T. Kapiel, and S. A. Mahmoud (2022). Genetic characterization and agronomic evaluation of drought tolerance in ten Egyptian wheat (*Triticum aestivum* L.) Cultivars. Agronomy, 12(5), 1217.

FAOSTAT (2025). Food and Agriculture Organization of the United Nations.

Statistical Database. Availabe online: http://www.fao.org/faostat/en/" \l "data (accessed on 17 August 2025).

Fareed, G., A.A. Keerio, S.N. Mari SN, S. Ullah, A.A. Mastoi and M.A. Arain (2024). Estimation of heterosis in F_1 hybrids of bread wheat genotypes. J. Appl. Res Plant Sci., 5(1) :120-123.

Farhan , Z.A., G.A.R.El-Sherbeny ,E.A.Maher and A.G.A. Khaled (2025). Combining ability and gene action controlling morpho-agronomical traits in bread wheat genotypes under non-stressed and drought-stressed conditions. Journal of Sohag Agriscience (JSAS), 10(1): 204-220.

Feltaous, Y.M. (2020). Inheritance of yield and its components in two bread wheat crosses under normal and water stress conditions. Ass J Agric Sci., 51:74-90.

Fereres, E., C. Gimenez, and J.M. Fernandez (1986) Genetic variability in sunflower cultivars under drought. I. Yield relationships. Australian Journal of Agricultural Research 37: 573-582.

Fischer, R.A. and R. Maurer (1978) Drought resistance in spring wheat cultivars. I. Grain yield responses. Aust. J. Agric. Res. 29: 897-912.

Fouad, H. M. and A. M. El. Mohamed (2023). Line x Tester analysis to estimate combining ability and heterosis in bread wheat (*Triticum aestivum* L.). Egypt. J. Agron., 45(2): 127-137.

Fouad, H. M., Manar M. Mohamed, M. A. Salim, M. M. Mohiy and M. M. Abd El-Mageed (2022). Half diallel analysis and heat stress tolerance indices for grain yield in bread wheat. J. of Plant Prod, 13(10): 763-773.

Gimenez, K., P. Blanc, O. Argillier, J.B. Pierre, J. Le Gouis and E. Paux (2021). Dissecting Bread wheat heterosis through the integration of agronomic and physiological traits. Biol (Basel), 13:10(9): 907.

Griffing, J.B. (1956) Concept of general and specific combining ability in relation to diallel crossing system. *Australian J. Biol. Sci.* 9, 463-493.

Hassan, M. S., M. A. Ali and I. G. Shahat (2020). Effect of heat stress on combining ability and heterosis in some bread wheat genotypes (*Triticum aestivum* L.). SVU-Int. J. Agric. Sci., 2(2): 438-450.

Hayman, B.I. (1954a) The theory and analysis of diallel crosses. *Genetics*, 39,789-809.

Hayman, B.I. (1954b) The analysis of variance of diallel tables. *Biometics*, 10, 235-244.

Jafari, A., F. Paknejad and J. Al-Ahmadi (2009). Evaluation of selection indices for drought tolerance of corn (*Zea mays* L.) hybrids. Int J Plant Prot 3: 33-38.

Jinks, J.L. (1954) The analyses of continuous variation in a diallel crosses of (*Nieotiana rustica* L.) varieties. *Genetics*, 39, 767-788.

Kajla, S.L., A.K. Sharma and H. Singh (2020). Heterosis analysis in F_1 hybrids of bread wheat (*Triticum aestivum* L.) over environments. Int J Curr Microbiol App Sci., 9(5): 2052-2057.

Kaur, K. and S. Kumar (2024). Enhancing productivity through effective irrigation and nitrogen scheduling in wheat (*Triticum aestivum* L.). J. Cereal Res., 16(2): 177-183.

Kaur, S., R. Kumar and Monika (2023). Heterosis and combining ability analysis in F_1 hybrids of bread wheat. J Agric, Ecol., 15: 55-61.

Kumari, A. and H. Sharma (2022). Combining ability analysis in bread wheat (*Triticum aestivum* L.) under different environmental conditions. Ann. Plant Soil Res., 24(1): 69-73.

Kumawat. S., A. Sharma, A. Kumar, M.R. Sahoo, H.K. Jaiswal and S. Choudhary (2023). Exploitation of heterosis for yield and yield components in wheat (*Triticum aestivum* L.). Biol Forum, 15(2): 938-943.

Ljubičić, N., S. Petrović, M. Kostić, M. Dimitrijević, N. Hristov, A. Kondić-Špika and R. Jevtić (2017). Diallel analysis of some important grain yield traits in bread wheat crosses. Turk. J. Field Crops, 22(1): 1-7.

Mather, K. and J.L. Jinks (1971) "*Biometrical Genetics*" 2nd ed. Chapman and Hall Ltd. London.

Mather, K. and J.L. Jinks (1982) "*Biometrical Gentics*" 3rd ed. Chapman and Hall Ltd. London.

Moustafa, A. and A. H. A. Hussein (2020). Performance of some bread wheat cultivars under new land conditions at Middle Egypt. Egyptian Journal of Plant Breeding, 24(4), 721-742.

Qabil, Naglaa (2017). Genetic Analysis of Yield and Its Attributes in Wheat (*Triticum aestivum* L.) Under Normal Irrigation and Drought Stress Conditions. Egypt. J. Agron. 39(3),337 – 356.

Regmi, S., B. Poudel, B. Raj Ojha, R. Kharel, P. Joshi, S. Khana and P.K. Bishnu (2021). Estimation of genetic parameters of different wheat genotype Traits in Chitwan, Nepal. Int. J. Agron., 1-10.

Rijal, B., P.Baduwal, M.Chaudhary, S.Chapagain, S.Khanal and P. B. Poudel (2021). Drought stress impacts on wheat and its resistance mechanisms. Malays. J. Sustain. Agric, 5, 67-76.

Rosielle, A, J. Hamblin (1981) Theoretical aspects of selection for yield in stress and non-stress environment. Crop Sci. 21: 943-946.

Roy, A., A. Kumar, V. Rawat and A. Singh (2021). Analysis of combining ability and gene action studies for grain yield and its component traits in bread wheat utilizing line x tester mating design. Environ. Cons, J., 22(3): 289-298.

Rybiñski, W., S. Pietruszewski and K. Kornarzyñski (2003). Influence of magnetic field with chemomutagen and gamma rays on the variability of yielding parameters in barley (*Hordeum vulgare* L.). Int. Agrophysics, 17: 85-91.

Salam, M. A., H. J. Hammadi and M. R. Azzam (2019). Estmation of heterosis and combining ability for yield and its components of wheat. Supplement 1, 19: 2691-2696

Sallam, M., A. Ghazy, A. Al-Doss and I. Al-Ashkar (2024). Combining genetic and phenotypic analyses for detecting bread wheat genotypes of drought tolerance through multivariate analysis techniques. Life 14, 183.

Shamsabadi E. E., H. Sabouri, H. Soughi and S. J. Sajadi (2020). Genetic analysis of spike traits in wheat (*Triticum aestivum* L.).Genetika, 52 (2): 559-569.

Steel, R. G. D., J. H. Torrie and D. Dickey (1997). Principles and procedure of statistics. A Biometrical Approach 3rd Ed. McGraw Hill BookCo, Inc., New York. pp. 352-358.

Wasaya, A., I. Rehman, A. Mohi Ud Din, M. Hayder Bin Khalid, T. Ahmad Yasir, M. Mansoor Javaid and A. El Sabagh (2023). Foliar application of putrescine alleviates terminal drought stress by modulating water status, membrane stability, and yield-related traits in wheat (*Triticum aestivum* L.). Frontiers in Plant Science, 13, 1000877.https://doi.org/ 10.3389/ fpls. 2022. 1000877.

Yadav, M.R., M. Choudhary, J. Singh, Lal, M.K. Jha, P.K. Udawat (2022). Impact, tolerance, adaptation and mitigation of heat stress on wheat under changing climates. Int J Mol Sci., 23, 2838. https://doi.org/-10.3390/ ijms23052838.

التحليل الوراثي لبعض التراكيب الوراثية لقمح الخبز تحت ظروف إجهاد الجفاف فى الأراضي الرملية

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أُجري تهجين النصف دياليل بين ستة تراكيب وراثية من قمح الخبز هى (Line Yr5، Shandwell 1، Gemmeiza 11، Misr 4، Sakha 95 وSids 14)، خلال الموسم الشتوي 2023/2022. وقُيِّمت التهجينات الخمسة عشر الناتجة من الجيل الأول والآباء خلال الموسم 2024/2023 تحت ظروف الري العادي وإجهاد الجفاف باستخدام تصميم الشرائح بنظام القطاعات الكاملة العشوائية فى ثلاث مكررات بمحطة أبحاث كلية الزراعة بالخطارة، الشرقية، مصر، لتقدير متوسط السلوك، قياسات تحمل إجهاد الجفاف، القدرة العامة و الخاصة على الائتلاف وكذلك طرز الفعل الجينى وكفاءة التوريث. تم تسجيل النتائج المتعلقة بعدد الأيام حتى الطرد، عدد الأيام حتى النضج، محتوى الكلوروفيل الكلي، ارتفاع النبات، عدد السنابل/النبات، عدد الحبوب/السنبلة، وزن الألف حبة ومحصول الحبوب/النبات. وأظهرت النتائج وجود أختلافات عالية المعنوية للتباين الراجع للتراكيب الوراثية، الآباء، الهجن والآباء مقابل الهجن فى معظم الصفات المدروسة تحت ظروف الري العادي وإجهاد الجفاف. كما كان التباين الراجع الى القدرة العامة (GCA) والخاصة (SCA) على الائتلاف عالي المعنوية لمعظم الصفات المدروسة في كل من الحالتين. كما أوضحت النتائج أن التراكيب الوراثية للقمح Line Yr5 وكذلك الهجن (Line Yr5 x Shandwell 1)، (Line Yr5 x Misr 4) و (Gemmeiza 11 x Sakha 95)أظهرت أقل نسبة لانخفاض محصول الحبوب (R%)، دليل التحمل (TOL) وقيم دليل الحساسية للجفاف (SSI)، لذلك، تعتبرهذه التراكيب الوراثية الأكثر تحملاً لإجهاد الجفاف. و كان المكون الوراثي المضيف (D) أعلى من السيادي (H_1 and H_2) لصفات عدد الأيام حنى الطرد، عدد الأيام حتى النضج و ارتفاع النبات تحت ظروف الري العادى، ومن ثم كانت قيمة متوسط درجة السيادة $(H_1/D)^{0.5}$ أقل من الوحدة لهذة الصفات. بينما، كان المكون السيادى أعلى من المضيف لصفات محتوى الكلوروفيل الكلي، عدد السنابل/النبات، وعدد الحبوب/السنبلة، وزن الالف حبة ومحصول الحبوب/النبات تحت ظروف الرى العادى و اجهاد الجفاف، وكذلك في عدد الأيام حتى الطرد، عدد الأيام حتى النضج، ارتفاع النبات تحت ظروف الجفاف. لذلك، كانت قيمة $(H_1/D)^{0.5}$ أعلى من الوحدة لهذة الصفات. و اختلفت قيم كفاءة التوريث بالمعنى المحدود (T_n)، حيث كانت مرتفعة لصفات عدد الأيام حتى االطرد، عدد الأيام حتى النضج وارتفاع النبات تحت ظروف الري العادي وإجهاد الجفاف وكذلك عدد السنابل/النبات، عدد الحبوب/السنبلة و وزن الالف حبة تحت ظروف الري العادي الى متوسطة لمحتوى الكلوروفيل الكلي تحت ظروف الري العادي وإجهاد الجفاف، محصول الحبوب/النبات تحت ظروف الري العادي وكذلك عدد السنابل/النبات،عدد الحبوب/السنبلة ووزن الالف حبة تحت ظروف إجهاد الجفاف، بينما كانت منخفضة لمحصول الحبوب/النبات تحت ظروف إجهاد الجفاف.

المحكمـــــون:

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