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Performance and Combining Ability of Some Agronomic Traits of Bread Wheat Under Normal and Water Stress Conditions

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Abstract:

The present investigation was carried out during 2015/2016 and 2016/2017 seasons at the Experimental Research Station, Faculty of Agriculture, Assiut University. The objectives of this investigation were to obtain information about the performance and genetic components of parental wheat genotypes and their F_1s under normal and water stress conditions. The performance of all genotypes under water stress condition was lower than its performance under normal condition. The parent 6 (P_6) was the earliest flowering under both conditions and the parent P_5 under water stress condition (85.70 day), while the parents P_1, P_2, P_4 and P_6 gave the tallest spike under both of normal and water stress conditions. While, P_1 and P_2 gave the tallest spike under water stress condition. The hybrids ($P_4 \times P_5$) and ($P_1 \times P_6$) were the earliest among F_1- hybrids under normal and water stress conditions, respectively. Furthermore, the hybrids ($P_1 \times P_3$) and ($P_1 \times P_4$) gave the tallest spike under normal and water stress conditions, respectively. The mean of grain yield /plant for all genotypes was 32.70 g and 24.96 g under normal and water stress condition, respectively. The P_6 gave the highest grain yield/ plant compared with other parental genotypes under both conditions. On the other hand, the highest grain yield /plant was obtained from the hybrids ($P_4 \times P_5$) under both conditions. The results showed that the magnitude of SCA exceeded GCA ones for days from planting to 50 % heading trait, which indicating that the major portion of genetic variance was due to the non-additive gene effects. The ratio of GCA/SCA was noticed to be low for days from planting to 50 % heading trait, indicated the specific combining ability was more important than general combining ability variance. The ratio of GCA/SCA was low for Plant height except SCA under irrigation in the F1- hybrids. The ratio of GCA/SCA was 1.08 and 0.80 in the F1-hybrids under normal and water stress conditions, respectively. The good genotypes for plant height in the F1- hybrid under both environments were Entry 21 and Entry 20. While, the ratio of GCA/SCA was noticed to be low for spike length, indicated the specific combining ability was more important than general combining ability variance, which indicating that the major portion of genetic variance was due to the non-additive gene effects. The results showed that the magnitude GCA/SCA ratio for number of kernel/spike was 0.31 and 0.20 in the F1-hybrids under normal and water stress conditions, respectively, indicating that the non-additive were larger than additive effects in the inheritance of number of kernel/spike and both were highly significant. The ratios of GCA/SCA were less than the unity for grain yield/plant under both environments indicating that the non-additive gene action controlled the inheritance of grain yield/plant. The GCA/SCA ratio was 0.14 and 0.48 for 100-grain weight in the F1-hybrids under normal and water stress conditions, respectively, indicating predominance of non-additive gene effect in the inheritance of 100- grain weight.

Keywords: *Bread wheat, genetic components, water stress condition, combining ability.*

Introduction

Wheat is the most important cereal crop in Egypt. The total wheat production was 9 million ton obtained from 1.32 million ha, according to F.A.O (2016). The statistics indicate that local production of wheat is not sufficient for the consumption needs. Egypt imports about 6 million tons of wheat to fill in the gap between consumption and production of wheat Rizk and Sherif (2014). The total consumption of wheat reached 14 million tons. Therefore, increasing wheat production is an important goal to reduce the gap between production and consumption. Therefore, developing high yielding genotypes is paramount (Agricultural statistics, Arab Republic of Egypt, 2012). Drought is the main abiotic that restrains wheat yield, which reduces crop production in most areas worldwide. Development drought-tolerant wheat genotype is formidable due to difficulties in quantification of drought tolerance constituents. However, using yield and its components as selection criterion for drought tolerance can be convenient to assess drought tolerance. Information on the genetic structure of a set of parents and mode of gene action governing yield and its attributes could be useful in designing suitable breeding procedures. Therefore, the objectives of this investigation were to: (1) obtain information about the performance of wheat genotypes and determine the genetic components under normal and water stress conditions, and (2) identify superior parents and cross combination of the 6 parents half diallel procedure in the F_1 -hybrids grown under normal and water stress environments.

Materials and Methods

The present investigation was carried out during 2015/2016 and 2016/2017 seasons at the Experimental Farm, Faculty of Agriculture, Assiut Universi. The genotypes were crossed in half diallel fashion during 2015/2016 season to obtain the F_1 seeds. The parents along with their pedigree and origin are shown in Table 1. The parents, and F_1 hybrides of the 6 parents half diallel were sown during 2016/2017 in two experiments i.e. the first one (stress experiment) was irrigated two times after planting irrigation (i.e, three irrigations were given through the growing season). The second experiment (normal experiment) was irrigated regularly as recommended. A randomized complete block design with three replications was used in both seasons. Grains were sown in rows 2 m long and 20 cm apart. Twenty grains were sown in each row. Each genotype was represented by one row in each replication.

Table 1. Pedigree and origin of the six parental genotypes used in the present investigation

Parent No.	Name	Pedigree	Origin
P_1	103Mohasan	Agronomy Dep., Fac. Agric., Assiut Univ.	Egypt
P_2	Giza 171	SAKHA 93 / GEMMEIZA 9 S.6-1GZ-4GZ-1GZ-2GZ-0S	Egypt
P_3	Misr2	SKAUZ/BAV 92	Egypt
P_4	Sakha 94	Opts / Rayon // KAVZ	Egypt
P_5	Entry 21	SERI.1B*2/3/KAUZ*2/BOW//KAUZ/4/2*MUNAL	MXI13-14\M35ES22SAWHT\50
P_6	Entry20	CHEWINK #1/MUTUS	MXI13-14\M35ES22SAWHT\43

The following traits were recorded on an individual plant for the two experiments:

A- Morphological traits:

1- Days to heading: Number of days from planting to 50% of the heads emerged from the flag leaf sheath.

2- Plant height (cm): The distance from the base of the culm to the tip of the spike of the main culm.

B- Yield and its components:

1- Spike length (cm) was measured from the base of the main spike to its tip excluding awns.

2- Number of kernels/spike (K/S) counted as an average number of grains collected per spike.

3- Biological yield/plant (g) was measured as the total dry matter produced by a plant during the growing season of individual plant (excluding roots).

4- Grain yield/plant (g) was recorded as the weight of individual plant grains.

5- Harvest index is the ratio of grain yield / plot to biological yield / plot for cultivars evaluation experiment and grain yield /plant for F1.

6- 100-grain weight (g) was obtained as the weight of 100 grains, from the bulk of the guarded plants in g.

The Combining ability analysis

General combining ability (GCA) of a line is the average value of the line in all possible combination. The GCA is a measure of additive genetic variance. On the other hand, specific combining ability (SCA) is the ability of a line to do better or worse than the average value in specific cross. The SCA is a measure of non-additive genetic variances (Hlallauer and Miranda, 1981).

In this study, six parental genotypes were crossed in a half diallel mating design to produce 15 F_1 hybrids to estimate the different genotypic parameters in terms of additive and non-additive genetic variances. The procedures of this analysis were described by Griffing's method II model I (1956) and outlined by Singh and Chaudhary (1985).

Results and Discussion

A: Performance of wheat genotypes:

The analyses of variance for all studied traits of the six parents and their 15 F_1 crosses grown under normal and drought stresses are shown in (Table 2). Our results reveal that mean squares due to genotypes, parents and F_1 crosses were highly significant for all studied characters under normal and drought stresses, indicating the wide diversity among the parental materials used in the present study. In addition, the mean squares due to parents vs crosses were significant and highly significant in all characters except spike length was significant for F_1 irrigation. Furthermore, the mean squares of both general and specific combining ability of morphological traits are present in Table 2. The results showe that both mean squares for GCA and SCA were highly significant for days to 50% heading, Plant height, spike length, number of kernels/spike, grain yield /plant, biological yield /plant, harvest index and 100- grain weight. This showed the important role of both additive and non-additive gene effects in the expression of these traits.

Table 2. Mean squares for morphological traits and yield and its components traits of six parental genotypes and their F1hybrids grown under normal and water stress conditions

S.O.V.	d.F.	Morphological traits				Yield and its components											
		Days to 50% heading		Plant height		Spike length		No. of kernels/spike		Biological yield/plant		Grain yield / plant		100 grain weight		Harvest index	
		F_1 Irrig.	F_1 drought	F_1 Irrig.	F_1 drought	F_1 Irrig.	F_1 drought	F_1 Irrig.	F_1 drought	F_1 Irrig.	F_1 drought	F_1 Irrig	F_1 Stress	F_1 Irrig	F_1 Stress	F_1 Irrig	F_1 Stress
Rep	2	0.86	0.61	10.33	1.54	0.016	0.77	22.92	18.47	37	51.04	1.73	1.47	0.27	0.026	2.82	6.55
Genotype	20	10.8**	9.13**	36.10**	18.23**	0.64**	1.52**	47.63**	34.01**	500.65**	221.05**	69.79**	15.24**	0.40**	0.30**	47.49**	59.93**
Error	40	0.28	0.13	4.58	4.80	0.31	0.28	5.15	8.75	11.16	80.36	3.44	1.62	0.10	0.087	6.48	7.86
GCA	5	16.88**	15.88**	98.35**	41.36**	0.56	1.22**	83.11**	43.71**	135.58**	258.73**	5.52**	7.46**	0.42**	0.56**	27.77**	92.42**
SCA	15	8.77**	6.89**	15.35**	10.52**	0.67*	1.61**	35.80**	30.78**	622.34**	208.49**	91.21**	17.83**	0.39**	0.21**	54.07**	49.10**
Error	40	0.28	0.13	4.58	4.80	0.31	0.28	5.15	8.75	11.16	80.36	3.44	1.62	0.10	0.087	6.48	7.86
$\Sigma g^2i/\Sigma s^2ij$		0.25	0.29	1.08	0.80	0.08	0.09	0.31	0.20	0.002	0.045	0.025	0.17	0.05	0.25	0.14	0.48

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

1-Days to heading:

Mean days to 50 % heading is shown in Table 3. The earliest P_6 headed after 84.00 and 85.70 days from sowing under normal and water stress conditions, respectively. The latest parent was P_3, which headed after 93.00 and 91.00 days under normal and water stress conditions, respectively.

The earliest hybrid was ($P_4\times P_5$) which recorded 89.30 days and the latest one was ($P_2\times P_4$) which recorded 93.00 days under normal condition. Under water stress condition the hybrid of ($P_1\times P_6$) was the earliest (85.00 days) but the hybrid of ($P_3\times P_4$) was the latest one (89.00 days) towards lateness. These results indicate that (P_6) possesses genes for earliness and most of its crosses were early either under normal or water stress condition. Water stress slightly decreased days to heading as expressed in the overall mean decreased from 90.67 to 87.70 days. The hybrids of ($P_2\times P_4$) decreased by 7.20 % under stress spared to normal conditions. Dhanda and Sethi (2002) and Dencic *et al*. (2000) found that days to heading were reduced by water stress.

2- Plant height (cm):

Mean of plant height for all genotypes is presented in Table 3. The parents ranged in plant height from 95.30 and 81.70 for P_5 to 103.00 and 88.30 cm for P_2 under normal and water stress condition, respectively. Water stress reduced plant height of the parents, and the reduction ranged from 11.91 for P_6 to 16.53 % for P_1. The F_1-hybrids ranged in plant height from 91.30 (P_5×P_6) to 104.30 cm (P_1× P_5) under normal condition, and from 81.30 (P_1×P_5) to 89.30 cm (P_1× P_4) under water stress condition. Water stress reduced plant height of the parents and F_1-hybrids, and the reduction accounted for 14.40 % over all genotypes. These results are in agreement with those found by El-Beially and El-Sayed (2002) and Mohamed (1999) who found that plant height was reduced by water stress and Dencic *et al.* (2000) came to the same conclusion.

3- Spike length

Spike length of the parents ranged from 11.67 for P_3 and P_5 to 12.33 cm for P_1, P_2, P_4 and P_6 under normal condition and from 10.33 for P_3 to 11.33 cm for P_1 and P_2 under water stress condition. The reduction in spike length of the parents caused by drought ranged from 8.13 for P_1 and P_2 to 13.01% for P_6. Moreover, spike length of the F_1-hybrids under normal condition ranged from 12.33 for (P_2× P_4), (P_3×P_4), (P_4× P_5) and (P_5× P_6) to 13.67 cm for (P_1× P_3), and from 11.00 for (P_4×P_5) to 13.00 cm for (P_1× P_4), under water stress condition.

Water stress reduced spike length of the F_1-hybrids, and the reduction ranged from 0.00 for (P_1×P_5) and (P_2× P_4) to 11.02 % for (P_4× P_6). Kheiralla (1994) and Ismail *et al.* (2006) reported that drought stress reduced spike length. Generally, drought stress reduced spike length over all genotypes by 6.37 % of normal condition. Kazmi *et al.* (2003) found that ear length was reduced by 36% under water stress condition.

4 - Number of kernel /spike

The parents ranged in number of kernal/spike from 71.30 for P_6 to 81.70 for P_2 under normal condition and from 63.30 for P_1 to 71.70 for P_4 under water stress condition (Table 4). The lowest affected parent by drought was P_4, which was reduced by 3.10 %. On the other hand, the highest affected parent was P_2, which was reduced by 18.80 %.

Number of kernel/spike for the F_1-hybrids ranged from 77.00 for (P_2× P_5) and (P_5×P_6) to 88.30 for (P_2× P_3) under normal condition. These values ranged from 66.00 for (P_1× P_5) to 78.00 for (P_2× P_3) under water stress condition. Water stress reduced number of kernel/spike over all genotypes by 11.62 %. In respect to F1-hybrids the lowest reduction caused by drought was 7.80 % for (P_3× P_5), but the highest reduction was 17.90 % for (P_2× P_4). Aggarwal *et al.* (1986) showed that the number of kernel/spike was reduced by 49 % under water stress condition compared with normal irrigation one.

5- Biological yield/plant, g.

Biological yield/plant of the parents under normal condition ranged from 57.00 for P_4 to 77.70 g for P_1. For the F_1-hybrids, the biological yield/plant ranged from 72.70 for (P_1× P_5) to 109.30 g for (P_1× P_4). Under water stress condition, the parents ranged from 50.70 for P_4 to 60.30 g P_2, whilst, for the hybrids, biological yield/plant ranged from 51.00 for (P_1× P_5) to 80.00 g for (P_3× P_6) Table 4.

The effect of drought was pronounced, and the overall mean of biological yield/plant was reduced greatly from 82.50 to 61.40 g which accounted by 25.60%. The reductions in biological yield/plant for the parents were ranged from 3.70 for P_3 to 31.00 % for P_5. On the other hand, the hybrids ranged from 12.10 for ($P_3 \times P_6$) to 41.80 % for ($P_1 \times P_6$). The best three parents in biological yield/plant under normal condition were P_1 with a value of 77.70 g, P_5 with a value of 77.30 g and P5 with a value of 71.30 g. Otherwise, the best three parents of some traits under water stress condition were P_3 with a value of 60.30, P_2 with a value of 59.30 and P_1 with a value of 58.00 g. Our results were consistent with those found by Brisson *et al.* (2001) and Ahmed (2003).

6 - Grain yield/plant:

Water stress reduced the overall mean grain yield/plant (Table 4) from 32.70 g under normal condition to 24.96 g under water stress condition, which estimated by 23.70%. The lowest yielding parent was P_4 under both normal and water stress conditions with values of 23.00 and 21.00 g/plant, respectively. On the other hand, the highest yielding parent was P_6 under both conditions with values of 32.30 and 25.70 g/plant, respectively. Generally, the best four F_1-hybrids under normal condition were ($P_4\times P_5$), ($P_2\times P_4$) and ($P_1\times P_6$) and ($P_2\times P_3$) with values of 40.70, 39.30, 38.00 and 38.00 g /plant, respectively. Meanwhile, the best three hybrids under water stress condition were ($P_4 \times P_5$), ($P_3 \times P_4$) and ($P_5 \times P_6$) with values of 29.30, 29.00 and 27.30 g/plant, respectively. Generally, the parents P_4, P_3, P_5 and P_6 were repeated several times in those superior hybrids. Blum *et al.* (1989) found that variation in grain yield among landraces under an increasing water stress after tillering was largely affected by spike number per unit.

7 - 100-grain weight

The average of 100-kernel weight for the parents ranged from 4.30 for P_4 to 4.80 g for P_1 and P_6 under normal condition and ranged from 3.90 for P_4 to 4.30 g for P_2 under water stress condition. The lowest reduction caused by drought was recorded for P_2 with 2.27 %, but the highest value was (14.90 %) for P_3. The 100-kernel weight for F_1-hybrids ranged from 4.80 for ($P_1 \times P_3$), ($P_2 \times P_3$) and ($P_3 \times P_4$) to 5.70 g for ($P_2 \times P_5$), ($P_2 \times P_6$) and ($P_5 \times P_6$) and from 3.80 for ($P_3 \times P_6$) to 5.20 g for ($P_1 \times P_2$) under normal and water stress conditions, respectively. ($P_1 \times P_2$) hybrid showed the lowest reduction by water stress with a value of 1.88 %. On the other hand, ($P_3 \times P_6$) showed that highest reduction with a value of 28.30. Kheiralla (1994), Abdel-Haleem (2003) and Ismail *et al.* (2006) found reduction in grain weight by water stress.

8 - Harvest index

Under normal condition (Table 5), harvest index of the parents was ranged from 36.80 for P_1 to 45.20 % for P_6 and the F_1-hybrids ranged from 30.50 for ($P_1 \times P_4$) to 48.50 % for ($P_1 \times P_5$). Moreover, under water stress condition, harvest index of the parents were ranged from 38.80 for P_2 to 50.70 % for P_6. On the other hand, the harvest index for F_1-hybrids ranged from 34.00 for ($P_3 \times P_6$) to 51.00 % for ($P_1 \times P_5$). Generally, drought slightly reduced harvest index by 2.50 % overall genotypes. These results are consistent with those reported by Abdel-Haleem (2003), Ismail *et al.* (2006) and Ahmad *et al.* (2015).

B – Combined ability for selection criteria under study:

The analysis of variance for combining ability was performed using Method 2 and Mode II of Griffing (1956). General Combining ability variances are generally attributed to the additive gene effects, while specific combining ability variances are attributed to non-additive gene effects, which involve dominance and epistatic components of the genetic variation.

1 - Morphological traits

Mean squares of both general and specific combining ability of Morphological traits are present in Table 2. The results showed highly significant mean squares for both general (GCA) and specific (SCA) combining abilities for days to 50 % heading and Plant height reflecting the important role of both additive and non-additive gene effects in the expression of these traits. These results are in harmony with those reported by Borghi and Perenzin (1994).

2 – Yield and its components.

The analyses of variance of combining ability (GCA and SCA) are presented in Table 2. The results showed highly significant mean squares for both GCA and SCA regarding spike length, number of kernels/spike, grain yield /plant, biological yield /plant, harvest index and 100- grain weight/g, revealing the important role of both additive and non-additive gene effects in the expression of these traits. Similar results were reported by Singh and Paroda (1988).

General combining ability effects (g_i).

The estimates of general combining ability effects of each parent for morphological traits, yield and its components are presented in Table 6

A - Morphological traits

1 - Days to 50%heading

The results in Table 6 indicate that highly significant positive GCA effects were detected for P_3 and P_4 under both environments, indicating that these parents could increase days to heading in their hybrids. However, P_1 under both environments showed negative and highly significant GCA effects, indicating that promising early F_1 hybrids could be obtained from their crosses, in the presence of predominance of additive gene effects. But P_6 under normal condition showed the negative and highly significant GCA effects, indicating that promising early F_1 hybrid could be obtained of their crosses. Safan (2001) found highly significant GCA for heading date under normal condition.

2- Plant height

General combining ability effects were positive and highly significant for P_2, P_3 and P_6 under both environments. However, P_1 under normal condition showed negative and highly significant GCA effect. Under normal condition, P_4 and P_5 showed positive and highly significant SCA effects, while negative effect under water stress. Similar results were reported by Farshadfar *et al.* (2013).

B - Yield and its component traits.

The results showed that the parent P_6 was considered to be excellent general combiner for grain yield/ plant and harvest index under both environments. The parents P_2, P_4 and

P_6 were good general combiner for harvest index under both environments, respectively. On the other hand, the parent, P_1, P_2, P_3 and P_4 the poorest general combiner for biological yield /plant, spike length and grain yield /plant, under normal and water stress condition, respectively. Similar results were reported by Abdel-Haleem (2003).

Specific combining ability effects (S_{ij})

The estimates of specific combining ability effects (S_{ij}) of each cross for morphological traits, yield and its components traits are presented in Table The results showe that all studied traits exhibited significant specific combining ability effects either positive or negative sings in most cases.

1 - Morphological traits

The results indicated that the crosses ($P_1 \times P_4$), ($P_2 \times P_3$), ($P_3 \times P_4$) and ($P_3 \times P_5$) showed negative and highly significant SCA effect and desirable SCA effects for days to 50% heading under both environments. The crosses ($P_3 \times P_4$), ($P_3 \times P_5$) and ($P_4 \times P_6$) showed negative and highly significant SCA effect and desirable SCA effects for plant height, under both environments Safan (2001) found significant SCA for heading date under normal condition.

2 - Yield and its component traits

Under normal condition three hybrids showed positive significant or highly significant SCA effects such as ($P_1 \times P_6$), ($P_2 \times P_3$) and ($P_4 \times P_5$). Most of these hybrids gave high number of kernels/plant (Table 7). Highly significant and positive SCA effects were obtained by the seven crosses for biological yield / plant. It could be concluded that both additive and non-additive gene effects, and that later played the major role in the inheritance of biological yield / plant. Under normal condition while, 12 out of 15 F_1 crosses showed significant or highly significant and positive SCA effects for 100- grain weight. In the same trend 3, 7, 7 and 2 out of 15 F_1 crosses gave desirable SCA effects (significant or highly significant and positive values) towards number of kernels/plant, biological yield/plant, grain yield /plant and harvest index), respectively. Similar findings were obtained by Singh and Paroda (1988) and El-Maghraby *et al.* (2005).

Conclusion

The present study revealed that the stress tolerant parents and the 15 F_1 crosses that showed minimized yield loss under water stress conditions, and the presence of wide diversity among the parents and the 15 F_1 crosses under normal and water stress conditions. The results showed that the magnitude of SCA exceeded GCA ones for days from planting to 50% heading, which indicating that the major portion of genetic variance was due to the non-additive gene effects. It is clear the information on GCA effects should be supplemented by SCA effects and hybrid performance of cross combinations to predict the gene action for yield in segregating generation. The identified crosses hold great promise in improving the grain yield and quality attributes in future breeding programs of bread wheat.

Table 3. Average of days to heading, plant height and spike length for six parental genotypes and their F_1- crosses under normal and drought conditions.

Traits	Days to heading			Plant height, cm			Spike length, cm		
Genotypes	Normal	Drought	Reduction	Normal	Drought	Reduction	Normal	Drought	Reduction
P_1	89.30	86.70	2.90	101.00	84.30	16.53	12.33	11.33	8.13
P_2	91.00	90.00	1.10	103.00	88.30	14.27	12.33	11.33	8.13
P_3	93.00	91.00	2.20	101.70	87.30	14.15	11.67	10.33	11.97
P_4	92.00	91.00	1.10	100.70	88.00	12.61	12.33	11.00	10.57
P_5	89.30	85.70	4.00	95.30	81.70	14.27	11.67	10.67	8.55
P_6	84.00	85.70	2.00	95.70	84.30	11.91	12.33	10.67	13.01
$P_1 \times p_2$	92.30	88.30	4.30	104.00	83.70	19.51	13.00	12.33	5.38
$P_1 \times p_3$	92.00	88.70	3.60	103.30	85.70	17.03	13.67	12.67	7.29
$P_1 \times p_4$	91.00	87.00	4.40	101.00	89.30	11.58	13.33	13.00	2.26
$P_1 \times p_5$	90.00	88.00	2.20	104.30	81.30	22.05	12.67	12.67	0.00
$P_1 \times p_6$	91.00	85.00	6.60	100.00	84.00	16.00	12.67	12.33	3.15
$P_2 \times p_3$	90.30	86.70	4.00	100.00	87.30	12.7	12.67	12.33	3.15
$P_2 \times p_4$	93.00	86.30	7.20	102.30	88.00	13.97	12.33	12.33	0.00
$P_2 \times p_5$	91.30	87.70	3.90	96.30	86.00	10.70	13.00	12.33	5.38
$P_2 \times p_6$	91.70	88.70	3.30	101.30	83.00	18.06	12.67	11.67	7.87
$P_3 \times p_4$	90.30	89.00	1.40	98.00	85.00	13.26	12.33	12.00	2.44
$P_3 \times p_5$	89.70	85.70	4.50	97.00	83.00	14.43	12.67	12.33	3.15
$P_3 \times p_6$	91.30	86.00	5.80	98.30	82.30	16.27	12.67	12.00	5.51
$P_4 \times p_5$	89.30	88.00	1.50	96.00	87.70	8.64	12.33	11.00	10.57
$P_4 \times p_6$	91.70	88.00	4.00	95.30	82.70	13.22	12.67	11.33	11.02
$P_5 \times p_6$	90.30	86.00	4.80	91.30	82.7	9.41	12.33	11.33	8.13
Mean	90.67	87.70		99.3	85.00		12.56	11.76	
LSD. 5%	0.60	0.87		3.60	3.50		0.92	0.87	
Reduction %	3.27			14.40			6.37		

Table 4. Average of number of kernel /spike, biological yield/ plant and grain yield/plant for six parental genotypes and their F_1- crosses under normal and drought conditions.

Traits	Number of kernel /spike.			Biological yield/ plant, g.			Grain yield/plant, g.		
Genotypes	Normal	Drought	Reduction	Normal	Drought	Reduction	Normal	Drought	Reduction
P_1	73.70	63.30	14.10	77.70	58.00	25.30	28.70	22.70	20.90
P_2	81.70	66.30	18.80	69.70	59.30	14.80	28.70	23.00	19.90
P_3	80.70	70.67	12.40	62.70	60.30	3.70	26.00	24.00	7.70
P_4	74.00	71.70	3.10	57.00	50.70	11.10	23.00	21.00	8.70
P_5	73.30	68.00	7.30	77.30	53.30	31.00	31.70	22.00	30.60
P_6	71.30	67.00	6.10	71.30	51.00	28.50	32.30	25.70	20.40
$P_1 \times p_2$	83.70	70.30	15.90	84.30	66.00	21.70	34.70	24.00	30.80
$P_1 \times p_3$	79.30	68.00	14.30	89.30	65.70	26.50	35.30	26.70	24.40
$P_1 \times p_4$	80.00	70.30	12.10	109.30	66.30	39.30	34.00	25.30	25.60
$P_1 \times p_5$	78.30	66.00	15.70	72.70	51.00	29.80	35.30	26.00	26.30
$P_1 \times p_6$	82.00	74.00	9.80	95.00	55.30	41.80	38.00	25.70	32.40
$P_2 \times p_3$	88.30	78.00	11.70	92.70	65.00	29.90	38.00	24.00	36.80
$P_2 \times p_4$	82.00	67.30	17.90	104.00	63.70	38.80	39.30	26.70	32.10
$P_2 \times p_5$	77.00	70.00	9.10	74.70	64.70	13.40	27.00	22.70	15.90
$P_2 \times p_6$	83.30	70.00	16.00	82.30	61.70	25.10	32.30	23.67	26.70
$P_3 \times p_4$	79.00	72.30	8.40	90.30	77.30	14.40	37.30	29.00	22.30
$P_3 \times p_5$	81.30	75.00	7.80	75.70	66.30	12.30	33.30	26.70	19.80
$P_3 \times p_6$	81.00	73.70	9.00	91.00	80.00	12.10	35.00	26.00	25.70
$P_4 \times p_5$	80.00	71.00	11.30	93.30	58.00	37.90	40.70	29.30	28.00
$P_4 \times p_6$	79.70	70.70	11.30	80.00	52.00	35.00	26.30	22.70	13.70
$P_5 \times p_6$	77.00	69.30	10.00	81.70	64.30	21.20	29.70	27.30	8.10
Mean	79.36	70.14		82.5	61.4		32.70	24.96	
LSD. 5%	3.70	4.80		5.40	14.70		4.60	2.10	
Reduction %	11.61			25.6			23.7		

Table 5. Average of 100- grain weight and harvest index% for six parental genotypes and their F_1 - crosses under normal and drought conditions.

Traits	100- Grain weight, g.			Harvest index %.		
Genotypes	Normal	Drought	Reduction	Normal	Drought	Reduction
P_1	4.80	4.12	14.16	36.80	39.20	6.40
P_2	4.40	4.30	2.27	41.20	38.80	5.70
P_3	4.70	4.00	14.90	41.70	39.70	4.80
P_4	4.30	3.90	9.30	40.30	44.70	10.80
P_5	4.50	4.20	6.66	40.80	41.30	1.20
P_6	4.80	4.20	12.50	45.20	50.70	12.20
$P_1 \times p_2$	5.30	5.20	1.88	41.20	36.30	11.80
$P_1 \times p_3$	4.80	4.00	16.70	39.50	40.70	3.00
$P_1 \times p_4$	5.30	4.20	20.75	30.50	39.00	27.90
$P_1 \times p_5$	5.20	4.30	17.30	48.50	51.00	5.20
$P_1 \times p_6$	5.30	4.70	11.32	42.50	43.00	1.20
$P_2 \times p_3$	4.80	4.20	12.50	40.80	38.50	5.70
$P_2 \times p_4$	5.20	4.50	13.46	38.30	43.20	12.60
$P_2 \times p_5$	5.70	4.70	17.54	35.80	35.00	2.30
$P_2 \times p_6$	5.70	4.80	15.78	39.30	38.20	2.90
$P_3 \times p_4$	4.80	3.90	18.75	41.20	37.30	9.30
$P_3 \times p_5$	5.00	4.20	16.00	43.80	40.20	8.40
$P_3 \times p_6$	5.30	3.80	28.30	38.50	34.00	11.70
$P_4 \times p_5$	5.20	4.70	9.61	43.30	43.20	0.40
$P_4 \times p_6$	5.20	4.50	13.46	32.70	43.70	33.70
$P_5 \times p_6$	5.70	4.20	26.31	36.20	42.30	17.00
Mean	5.00	4.30		39.90	40.90	
LSD. 5%	0.53	0.49		4.20	4.60	
Reduction %	14.00			2.50		

Table 6. Estimates of general combining ability effects (g_i) of six parents for morphological traits and yield and its components traits.

Genotypes	Morphological traits						Yield and yield components									
	Days to 50%heading		Plant height		Spike length		No. of kernels/ spike		Biological yield / plant		Grain yield /plant		100 kernel weight		Harvest index	
	F_1 Irrig.	F_1 drought	F_1 Irrig.	F_1 drought	F_1 Irrig.	F_1 drought	F_1 Irrig.	F_1 drought	F_1 Irrig.	F_1 drought	F_1 Irrig.	F_1 drought	F_1 Irrig.	F_1 drought	F_1 Irrig.	F_1 drought
P_1	-1.41**	-0.24**	-3.16**	-0.06	-0.75**	-1.21**	-4.5**	-2.9**	-11.9**	3.27	-5.5**	-1.86**	-0.28**	-0.22**	-1.8**	-2.31**
P_2	-1.26**	1.27**	0.00	0.94**	-0.33**	-0.55**	-3.3**	-3.14**	-12.8**	-0.22	-3.9**	-0.03	-0.45**	-0.39**	1.6**	0.72**
P_3	1.08**	2.17**	1.16**	1.60**	-0.75**	-1.29**	-2.4**	-3.81**	-16.6**	-13.0**	-7.2**	-2.36**	-0.04**	0.205**	-0.41	2.76**
P_4	0.17**	1.59**	1.66**	-0.39*	-0.17**	-0.55**	-3.6**	0.52	-28.9**	-8.64**	-8.4**	-4.03**	-0.45**	-0.24**	3.4**	1.35**
P_5	0.00	-0.32**	0.92**	-0.56**	0.50**	-0.71**	-2.2**	-1.22**	1.02	-4.06	-1.1**	-3.28**	-0.61**	-0.15**	-1.8**	-1.64**
P_6	-4.00**	0.09**	0.75**	2.27**	-0.17**	0.04**	-5.6**	-3.31**	-9.9**	-7.47**	0.35**	0.24**	-0.54**	-0.19**	5.8**	5.64**
SE (gi)	0.0097	0.0047	0.1591	0.1669	0.0110	0.0096	0.179	0.3042	0.3877	2.7904	0.119	0.0565	0.0036	0.0030	0.225	0.2729

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

References

Abdel-Haleem, S.H. (2003). The performance stability and genetic analysis for agronomic traits in bread wheat under drought condition. Ph.D. Thesis, Assiut Univ., Fac. Agric., Agron. Dept., Egypt.

Aggarwal, P.K., A.K. Singh., G.S. Chaturvedi and S.K. Sinha. (1986). Performance of wheat and triticale cultivars in a variable soil-water environment II. Evapotranspiration, water use efficiency, harvest index and grain yield. Field Crops Res., Vol. (13): 301-315.

Agricultural statistics, Arab Republic of Egypt, (2012).

Ahmed, A.A. (2003). Diallel analysis and stability of yield and yield components in bread wheat (*Triticum aestivum* L. em Thell). M. Sci., Thesis, Fac. Agric., Assiut Univ., Egypt.

Ahmad, I., I. Khaliq., N. Mahmood and N. Khan. (2015). Morphological and physiological criteria for drought tolerance at seeding stage in wheat. J. Anim. Plant Sci., Vol. 25 (4): 1041-1048.

Blum, A., G. Gozlan., J. Mayer., B. Sinmena., L. Shpiler and J. Burra. (1989). The drought response of landraces of wheat from the northern Negev desert in Israel. Euphytica, Vol. (43): 87-96

Borghi, B and M. Perenzin. (1994). Diallel analysis to predict heterosis and combining ability for grain yield, yield components and breadmaking quality in bread wheat (*T. aestivum*). TAG Theoretical and Applied Genetics, Vol. (89): 975-981.

Brisson, N., E. Guevara., S. Meira., M. Maturano and G. Coca. (2001). Response of five wheat cultivars to early drought in the pampas. Agronomie, Vol. 21:483-495.

Dencic, S., R. Kastori., B. Kobiljski and B. Duggan. (2000). Evaluation of grain yield and its components in wheat cultivars and landraces under near optimal and drought conditions. Euphytica 113:43-52.

Dhanda, S.S and G.S. Sethi. (2002). Tolerance to drought stress among selected Indian wheat cultivars. J. Agric. Sci., Vol.139: 319-326.

El-Beially, I.E.M.A. and E.A.M. El-Sayed. (2002). Heterosis and combining ability for some bread wheat crosses. J. Agric. Sci. Mansoura Univ. Vol. 27(9):5735-5744.

El- Maghraby, M.A., M.E. Moussa., N.S. Hana and H.A. Agrama. (2005). Combining ability under drought stress relative to SSR diversity in common wheat. Euphytica, Vol. 141 (3): 301-308.

FAO. (2016). www.FAO.org. (C.F. Computer Research).

Farshadfar, E., F. Rafiee and V. Hasheminasab. (2013). Evaluation of genetic parameters of agronomic and morpho-physiological indicators of drought tolerance in bread wheat (*Triticum aestivum* L.) using diallel mating design. AJCS, Vol. 7(2):268-275.

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

Hlallauer, A.R. and J.B. Miranda. (1981). Quantitative genetics in maize breeding. Iowa State Univ. Press. Ames Iowa, U.S.A.

Ismail, A.A., T.A. Ahmed, M.B. Tawfils and E.M.A. Khalifa. (2006). Gene action and combining ability analysis of diallel crosses in bread wheat under moisture stress and non-stress conditions. Assiut J. Agric. Sci., Vol. 37: 17-33.

Kazmi, R.H., M.Q. Khan and M.K. Abbasi. (2003). Yield and yield components of wheat subjected to water stress. Acta Agronomica Hungarica, Vol. 51:315-323.

Kheiralla, K.A. (1994). Inheritance of earliness and its relation with yield and drought tolerance in spring wheat. Assiut J. Agric. Sci., Vol. 25 (5): 129-139.

Mohamed, A.I.S. (1999). Promising durum wheat genotypes under normal and stress growing conditions in northern Sudan. (C.F.Pl. Breeding Abst, Vol. 71 No.1, p.32).

Rizk, A.H and M.M. Sherif. (2014). Effect of soil moisture depletion on the yield of wheat under sprinkler irrigation at toshka area, Egypt. Middle East J. Agric. Res., 3(4): 981-987.

Safan, A.A. (2001). Diallel analysis of grain yield and other agronomic traits in bread wheat (*Triticum aestivum* L.). M.Sc. Thesis, Fac. Agric., Zagazig., Egypt.

Singh, I. and R.S. Paroda.(1988). Partial diallel analysis of combining ability in wheat. Crop Improvement, Vol. 15 (2): 115- 118.

Singh, R.K. and B.D. Chaudhary. (1985). Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers, New Delhi.

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الأداء والقدرة الأئتلافية لبعض الصفات المحصولية لقمح الخبز تحت ظروف الرى العادى والأجهاد المائى

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الملخص

أجريت هذه الدراسة خلال موسمى ٢٠١٦/٢٠١٥ و ٢٠١٧/٢٠١٦ بالمزرعة البحثية لكلية الزراعة جامعة أسيوط والهدف من هذه الدراسة التعرف على أداء بعض الطرز الوراثية للقمح (٦أباء وال ١٥هجين فردى الناتج من التهجين الدائرى بين الأباء) وتمت الدراسة تحت كلا من ظروف الرى العادى والأجهاد المائى. أوضحت الدراسة أن أداء جميع الطرز الوراثية تحت ظروف الجفاف كان أقل من أدائها تحت ظروف الرى العادى. وبالمقارنة بين الأباء، وجد أن الأب P_6 أعطى أبكر النباتات فى التزهير تحت كل من الرى العادى والأجهاد المائى فى حين أعطى الأباء P_1 و P_2 أعلى طول للسنبلة تحت كل من الرى العادى والأجهاد المائى بينما كان الهجين ($P_1×P_6$) و ($P_4×P_5$) الأبكر تزهيرا فى الجيل الأول تحت ظروف الرى العادى والأجهاد المائى على التوالى بينما كانت الهجن ($P_1×P_3$) و ($P_1×P_4$) الأكثر طولا فى السنبلة مقارنة بباقى هجن الجيل الأول الأخرى تحت كل من ظروف الرى العادى والأجهاد المائى.

كان متوسط محصول حبوب النبات الفردى كمتوسط لكل التراكيب الوراثية هو ٣٢.٧٠ و ٢٤.٩٦ جم تحت كل من ظروف الرى العادى والجفاف على التوالى. أعطى الأب P_6 أعلى محصول فردى حبوب للنبات مقارنة بباقى الأباء تحت ظروف الرى العادى والجفاف. الهجين الفردى ($P_4×P_5$) أعطى أعلى محصول فردى للنبات فى كلا البيئتين.

وأظهرت النتائج أن القدرة الخاصة على التآلف كانت أعلى من القدرة العامة على التآلف لصفة التبكير مما يشير الى أن الجزء الرئيسى من التباين الوراثى يرجع الى تأثير الجينات غير المضافة لهذه الصفة وأن نسبة GCA/SCA كانت منخفضة لصفة التزهيرمما يدل على أن القدرة الخاصة على التآلف أكثر أهمية من القدرة العامة على التآلف لهذه الصفة.

وأظهرت النتائج أن القدرة العامة والخاصة على التآلف كانت منخفضة لأرتفاع النبات، ماعدا القدرة الخاصة على التآلف كانت عالية بالنسبة لأرتفاع النبات تحت ظروف الرى العادى.

وكانت نسبة القدرة العامة والخاصة على التآلف ١.٠٨ و ٠.٨٠ فى الجيل الأول تحت ظروف الرى العادى والجفاف على التوالى. وكانت أفضل التراكيب الوراثية فى طول النبات تحت كلا البيئتين هى Entry 21 و Entry 20.

بينما كانت نسبة GCA/SCA منخفضة لصفة طول السنبلة مما يدل على أن القدرة الخاصة على التآلف أكثر أهمية من القدرة العامة على التآلف لهذه الصفة مما يشير الى أن الجزء الرئيسى من التباين الوراثى يرجع الى تأثير الجينات غير المضافة لهذه الصفة.

أظهرت النتائج أن نسبة GCA/SCA بالنسبة لعدد الحبوب / السنبلة كانت ٠.٣١ و ٠.٢٠ فى الجيل الأول تحت نظام الرى العادى والجفاف مما يشير أن الفعل الغير أضافى للجينات أكثر تأثيرا من الفعل الأضافى لصفة عدد الحبوب / السنبلة وكلاهما كان عالى المعنوية.

وكانت نسبة GCA/SCA أقل من الواحد الصحيح بالنسبة لمحصول حبوب النبات الفردى تحت ظروف البيئتين مما يشير الى أن الفعل غير الأضافى كان له أثر كبير فى توريث هذه الصفة.

وكانت نسبة GCA/SCA هى ٠.١٤ و ٠.٤٨ لوزن ال ١٠٠ حبة فى الجيل الأول تحت ظروف الرى العادى والجفاف على التوالى مما يشير الى تأثير الجينات غير المضافة فى توريث هذه الصفة.