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Selection for Earliness in Two Wheat Populations under Toshka Conditions

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ABSTRACT

Drought is a significant constraint for defecting yield and output potential as growth and productivity of plants are adversely affected by water stress which leads to heavy yield losses. A good drought tolerant wheat line should have the ability to withstand in water deficit conditions or have the ability to escape from it. The present work aimed to study the effect of two cycles of pedigree selection for earliness in two segregating populations of wheat under water stress, during 2015/16 and 2016/17 season at Toshka Station, Desert Research Center, Aswan, Egypt. The water treatments were 100 and 67% of the irrigation requirements of wheat in Toshka as normal and drought condition, respectively. The selected family No. 12 was the earlier family and recorded 55.33 and 48.33 days under normal and drought stress, respectively. Moreover, family No. 10 was the best family that showed high grain yield under both water irrigations in Pop.1. Drought stress led to reduce grain yield/plant (GYPP) by 35.3% in best family. These families could be considered as tolerant to drought stress and could be used in breeding program for drought tolerance and earliness. In Pop.2, family No. 6 was the best selected one in (GYPP, BYPP, GYPS, NGPS and 100-GW) under normal conditions, while the family No. 7 was the best one for days to heading under normal and drought stress conditions. The performance of the selected families under normal and/or drought stress conditions may determine the goals and attitudes of the selection program.

Keywords: *Triticum aestivum* L., Pedigree selection, Genotypic and phenotypic variation, Heritability, Drought.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is main human consumption provides food to 35% of the human population (Bishaw *et al.*, 2011, Nouri *et al.*, 2011 and Travlos, 2012). The growing population of the world is expected to hit around 9 billion by 2050, and the demand for wheat is expected to rise by 40 per cent by 2030 (Dixon *et al.*, 2009). Through intensifying the disputes over water and land, it would aggravate the environmental impacts. Therefore, a congruent attempt to balance consumer needs with environmental protection seems necessary (Koh-Banerjee *et al.*, 2004). The major constraints to food production worldwide are environmental stress. Drought is a significant constraint that affecting yield and output potential as growth and productivity of plants are adversely affected by water stress which leads to heavy yield losses. In addition to water scarcity status, exploring new ways of using water supply efficiently is crucial for food safety and sustainable climate. Although wheat is possibly the only grain crop capable of surviving wide ranges of temperatures, altitudes, and water availability (Reynolds and Rebetzke, 2011), The production fluctuates from year to year and from place to place due to unforeseen climatic conditions. Improving the production of wheat under water deficit has therefore become a primary objective of breeding programs across the globe, especially in arid and semi-arid regions. Food security at today and in the future should depend on increased drought resistance and high productivity of cultivars (Ogbonnaya *et al.*, 2008).

Drought stress is the major problem that affects the production in these new reclaimed soils in addition to heat and salinity. Wheat is one of the most strategic crops in Egypt as the majority of the population depends on it on their daily diets which make a massive gab between its production and consumption. So, the alternative way should be by grown wheat in new reclaimed soils. The second scenario is creating new high yielding varieties to maximize the production from the same area, but the production of these new lines deteriorates because of the inappropriate conditions when grow in the new reclaimed soils.

Breeding programs for abiotic stress tolerance in wheat is a historically particularly difficult task, as it takes a too long time most of this time lost in the screening process for tolerant plants and progress is shown to be relatively slow in most cases.

The good drought tolerant wheat line should have the ability to withstand in water deficit conditions or have the ability to escape from the drought. Therefore, the goal of the present work was to study the effect of two cycles of pedigree selection in two segregating wheat populations under water stress for early heading. The main objective was to estimate components of variability, heritability and expected genetic improvement from selection in crossings F2 and F3 under water stress and non-stress conditions as one case for breeding program under heat and water deficit.

MATERIALS AND METHODS

The present work was carried out at Toshka Station, Desert Research Center, Aswan, Egypt, the experiment

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was conducted over two winter seasons of 2015/2016 and 2016/2017 under sandy soil to study the relative response to selection in two bread wheat populations for two cycles started in F_2 using pedigree selection procedure for improving earliness under water stress. Beside, observe the genotypic and phenotypic variation of wheat crosses through two generations.

Genetic Materials:

two cycles of pedigree selection were achieved for days to heading. The genetic materials were the F_2 and F_3 of two populations of bread wheat (*Triticum asetivum* L.). The first population (Pop.1) stemmed from the cross (ICARDA 2×ICARDA 5) and the second population (Pop.2) stemmed from the cross (ICARDA 1× Gemmeza 7). The pedigree and release of the parental varieties are shown in Table 1. Growing seasons, planting dates, genetic materials and experimental design were as follows:

Season	Date	Generation	Experimental design
2015/2016	5/11/2015	F_2	Non-replicated exp.
2016/2017	2/11/2016	F_3	RCBD with three replications

Table 1. The pedigree of the parental varieties.

No.	Entry name	Pedigree	Origin
1	ICARDA 1	CGSS02Y00144S-099M-099Y-099M-47Y-0B	ICARDA
2	ICARDA 2	ICB98-0771-0AP	ICARDA
3	ICARDA 5	ICB97-1207-0AP	ICARDA
4	Gemmeza 7	CMH74A.630/5x//Seri82/3/Agent CGM4611-2GM-3GM-1GM-OGM	Egypt

Season of 2015/2016; F_2- generation

The two aforementioned populations in the F_2-generation were sown; each population were plant in 7 rows, 4 m long, 30 cm apart and 10 cm between hills within a row. The parents were sown; each in two rows. The recommended cultural practices for wheat production were adopted throughout the two growing seasons. The following characteristic were recorded on 250 guarded plants from each population, and 10 plants from each parent. The recorded characters were days to heading (DH), plant height (PH), number of spikes/plant (NSPP), spike length (SL), grain yield/spike (GYPS), number of grains/spike (NGPS), biological yield/plant (BYPP), grain yield/plant (GYPP) and 100-grain weight (100-GW).

After harvest, ten grains from each of the 250 plants from Pop.1 and Pop.2 were bulked to give an unselected bulk sample for each population. Grains of the early 12 plants from each population were saved.

Season of 2016/2017, F_3- generation

The 12 F_3-families along with the unselected bulk sample and the two parents were sown in two separated experiment under stress and non-stress of water irrigation (100 and 67% water irrigation) in RCBD with three replications for each population separately (Gomez and Gomez 1984). The plot size was two rows as in the previous season. The characters were recorded as in the previous season as an average of ten guarded plants from each family.

Statistical analysis:

1. Estimates of genotypic and phenotypic variances as well as heritability estimates were calculated from EMS components of the selected families as presented in Table 2.

Table 2. The form of analysis of variance and mean squares expectations.

Source of variation	d.f.	M.S.	Expected mean squares variance
Replications	r-1	M_3	$\sigma^2e + g\sigma^2r$
Entries	g-1	M_2	$\sigma^2e + r\sigma^2g$
Error	(r-1)(g-1)	M_1	σ^2e

Where: r and g are number of replications and genotypes, respectively. σ^2e and σ^2g are the error variance and genetic variance components; respectively.

The phenotypic (σ^2p) and genotypic (σ^2g) variances were calculated according to the following formulae:

$$\sigma^2p = \sigma^2g + \sigma^2e/r \qquad \sigma^2g = (M_2 - M_1)/r$$

Two separates analysis of variance were done. The first includes the entries (12 selected families along with the bulk samples and the two parents) to measure the variability and the significance of the observed gain. The second include the selected families only to calculate phenotypic (PCV), genotypic (GCV) coefficients of variability and heritability estimates in broad sense.

2. **Heritability**

The following equation was used to estimate heritability in broad sense.

$$(H) = (\sigma^2g/\sigma^2p) \times 100.$$

3. The phenotypic and genotypic coefficients of variation were estimated using the formula developed by Burton (1952).

a) **The phenotypic coefficient of variability (PCV) = $(\sigma p/\bar{X}) \times 100$.**

b) **The genotypic coefficient of variability (GCV) = $(\sigma g/\bar{X}) \times 100$.**

4. Comparisons between means were calculated using Revised L.S.D, was calculated using the formula developed by AI Rawi and Khalafalla (1980).

RESULTS AND DISCUSSION

Evaluation of the two base populations (F2 Plants)

Data in Tables 3 and 4 showed that performance of characteristics of the individual plants in F_2 plants of the two populations. Pop.1; days to heading ranged between 93.00 and 59.00 days with an average of 70.22 days. While in Pop.2, DH varied from 85.00 to 58.00 days with an average of 65.98 days. This result indicated that the Pop.2 was earlier in heading than Pop.1. The average of DH in Pop.1 (70.22) was late than both parents (64.00 and 67.50 days), while the average of DH in Pop.2 (65.98 days) was earlier than ICARDA1 (66.33 days) and late than Gemmeza 7 (64.67 days). Transgressive segregations were observed in both populations, since the range in the two populations in in heading days in the F2 generation was outside the minimum and maximum of their respective parents, indicate the suitability of this population to the pedigree selection for earliness and reflecting transgressive segregation and/or high level of heterozygosity in both populations.

Judging by the range and coefficients of variation for each trait, it is quite obvious that Pop.2 showed more genetic coefficient variation than Pop.1 in most of studied traits. Since, the coefficient of variation in Pop.1 ranged between 12.04 (DH) and 26.74 % (BYPP), while in Pop.2 it ranged between 7.81 (DH) and 35.26 % (GYPP).

The mean of grain yield/plant for the F_2 plants for the Pop.1 was higher than Pop.2 which was 12.57 and 12.30 g for each population, respectively. This result may due to the higher mean values of the components of the grain yield in Pop.1 than in Pop.2. with exception of number of spikes/plant was lower in Pop.1 than in Pop.2. Although, the F_2 plants of Pop.1 were taller than F_2 plants of Pop.2. These results are in agreement with those reported by El-Morshidy *et al.,* (2010), El Ameen *et al.,* (2013) and Ahmed *et al.,* (2014).

Table 3. Means, maximum and minimum values, phenotypic (σ^2p) and genotypic (σ^2g) variances, variation coefficient (CV%), heritability (H^2_b%) and expected genetic advance (ΔG) of the base Pop.1 (F_2) and its parents for all studied traits (season 2015/2016)

Pop.1	DH	PH	NSPP	SL	GYPS	NGPS	100-GW	BYPP	GYPP
Means ± SE	70.22 ± 0.53	68.69 ± 0.68	6.08 ± 0.09	10.43 ± 0.10	2.46 ± 0.03	57.94 ± 0.55	4.28 ± 0.04	30.13 ± 0.51	12.57 ± 0.21
Max	93.00	96.25	11.78	14.38	3.79	85.42	5.77	55.40	27.20
Min	59.00	43.26	2.41	6.18	1.51	37.39	2.78	12.03	4.88
CV %	12.04	15.70	23.18	15.44	18.04	14.92	16.15	26.74	26.20
σ^2g	71.10	114.81	1.87	2.55	0.19	70.91	0.47	61.01	10.56
σ^2p	71.52	116.34	1.98	2.59	0.20	74.71	0.48	64.93	10.85
H	99.42	98.68	94.12	98.29	95.39	94.91	98.14	93.97	97.27
ΔG	14.71	18.63	2.32	2.77	0.74	14.36	1.19	13.25	5.61
ΔG/Mean (%)	20.95	27.12	38.18	26.56	30.12	24.78	27.73	43.98	44.60
ICARDA 2									
Means ± SE	64.00 ± 0.26	76.47 ± 0.20	6.20 ± 0.11	11.03 ± 0.03	1.75 ± 0.01	42.30 ± 0.47	4.13 ± 0.03	30.70 ± 0.49	10.82 ± 0.16
Max	65.00	77.00	6.50	11.10	1.79	44.40	4.25	32.70	11.45
Min	63.00	75.60	5.70	10.90	1.69	41.06	4.03	28.90	10.20
CV %	1.28	0.81	5.74	0.85	2.46	3.53	2.20	5.07	4.72
σ^2p	0.67	0.38	0.13	0.01	0.002	2.23	0.01	2.43	0.26
ICARDA 5									
Means ± SE	67.50 ± 0.13	72.64 ± 0.52	5.10 ± 0.10	11.70 ± 0.09	2.29 ± 0.04	48.16 ± 0.73	4.75 ± 0.03	30.40 ± 0.74	11.63 ± 0.18
Max	68.00	74.80	5.50	11.90	2.42	50.01	4.88	33.50	12.34
Min	67.00	70.83	4.70	11.30	2.11	44.89	4.65	27.90	10.93
CV %	0.60	2.26	6.40	2.42	5.58	4.81	2.05	7.65	4.95
σ^2p	0.17	2.69	0.11	0.08	0.02	5.37	0.009	5.41	0.33

ΔG = Expected genetic advance from selection 5% superior plants.

Table 4. Means, phenotypic variance (σ^2p), genotypic variance (σ^2g), phenotypic coefficient (CV), heritability in broad sense (H) and expected genetic advance (ΔG) of the base Pop.2 (F_2) and its parents of the studied traits (season 2015/2016)

Pop.2	DH	PH	NSPP	SL	GYPS	NGPS	100-GW	BYPP	GYPP
Means ± SE	65.98 ± 0.33	64.46 ± 0.61	6.25 ± 0.11	10.28 ± 0.10	2.10 ± 0.02	54.43 ± 0.87	4.05 ± 0.06	29.95 ± 0.58	12.30 ± 0.27
Max	85.00	85.25	12.67	13.94	3.40	83.13	5.79	62.33	32.33
Min	58.00	37.54	2.48	6.18	1.40	30.80	2.11	12.57	5.85
CV %	7.81	14.93	26.89	14.75	14.50	25.13	22.57	30.42	35.26
σ^2g	26.37	90.93	2.77	2.23	0.08	179.14	0.82	80.74	18.62
σ^2p	26.59	92.63	2.83	2.30	0.09	187.11	0.84	83.02	18.82
H	99.16	98.16	97.89	97.16	90.26	95.74	98.52	97.25	98.94
ΔG	8.95	16.53	2.88	2.58	0.48	22.92	1.58	15.51	7.51
ΔG/Mean (%)	13.56	25.65	46.06	25.08	22.90	42.11	38.91	51.77	61.05
ICARDA 1									
Means ± SE	66.33 ± 0.15	70.67 ± 0.39	4.85 ± 0.08	11.02 ± 0.07	2.50 ± 0.03	53.52 ± 1.08	4.68 ± 0.04	33.83 ± 0.59	12.10 ± 0.16
Max	67.00	72.00	5.05	11.30	2.61	56.15	4.83	35.60	12.80
Min	66.00	69.00	4.50	10.80	2.35	48.70	4.55	31.23	11.75
CV %	0.71	1.76	5.12	1.90	4.35	6.38	2.48	5.55	4.07
σ^2p	0.22	1.56	0.06	0.04	0.012	11.66	0.01	3.52	0.24
Gemmeza 7									
Means ± SE	64.67 ± 0.15	69.80 ± 0.43	5.38 ± 0.08	10.80 ± 0.09	2.02 ± 0.02	49.05 ± 0.65	4.12 ± 0.03	28.95 ± 0.32	10.85 ± 0.13
Max	65.00	71.00	5.70	11.20	2.13	51.75	4.25	30.35	11.32
Min	64.00	67.90	5.12	10.50	1.94	46.73	3.99	27.95	10.35
CV %	0.73	1.95	4.45	2.73	3.91	4.22	2.58	3.52	3.66
σ2p	0.22	1.85	0.06	0.09	0.01	4.28	0.011	1.04	0.16

ΔG = Expected genetic advance from selection 5% superior plants.

Genetic advance and heritability estimates

Heritability estimates and the genetic advance of the studied traits are shown in Tables 3 and 4. High estimates of the heritability in broad sense were observed in both populations, indicating the genetic variation among the F_2 plants. H estimates varied from 93.97 (BYPP) to

99.42 (DH) in Pop.1, while they varied from 90.26 (GYPS) to 99.16 % (DH) in Pop.2. The genetic advance of the selection criterion (DH) was greater in Pop.1 (14.71) than in Pop.2 (8.95). These results are in general agreement with those reported by Al-Naggar and Shehab-El-Deen (2012), El Ameen *et al.,* (2013), Aktaş (2016), Bennani *et al.,* (2016) and Memon *et al.,* (2018).

Analysis of variance of the selected families (F3 generation)

The mean square, heritability estimates, genotypic and phenotypic coefficient of variation for the investigated traits of the selected families in the F_3 generation under normal and drought stress conditions were shown in Table 5. Highly significant differences among entries were observed for all studied traits in both populations under normal and drought stress conditions. In most cases, the variation among entries was higher in Pop.2 than in Pop.1 under both treatment irrigations except PH and GYPP under drought stress.

High estimates of broad sense heritability (H%) were observed for all investigated traits of the selected families in both populations under both water irrigations, especially Pop1. under normal condition, H% estimates ranged between 91.93 (NGPS) and 99.60 (100-GW) in Pop.1, while it ranged from 82,72 (NGPS) to 98.90 (PH) in Pop.2. Under drought stress, H% estimates varied from 90.91 (NGPS) to 98.59 (GYPP) in Pop.1, while it ranged between 88.97 (NGPS) and 99.16 (SL) in Pop.2. The huge estimates of H% may due to the huge genetic variation among the F_3 families. Since, the quantitative traits such as days to heading, grain yield/ plant and its attributes showed high estimates of GCV and PCV% in both populations under both water treatments, which were close each other.

Table 5. Mean squares, heritability in broad sense (H), genotypic (GCV%) and phenotypic (PCV%) coefficients of variability of the selected families for days to heading (DH) in the F_3 generation in both populations, season 2016/2017 under two irrigation levels.

		S.O.V	df	DH	PH	NSPP	SL	GYPS	NGPS	100-GW	BYPP	GYPP
Normal irrigation	Pop.1	Reps	2	0.74	0.22	0.039	0.024	0.013	5.52	0.008	4.33*	0.08
		Entries	14	36.08**	89.71**	2.565**	1.181**	0.187**	79.11**	0.314**	138.06**	20.63**
		Error	28	0.38	1.27	0.038	0.031	0.007	2.30	0.004	1.23	0.15
		GCV%		4.52	8.01	16.93	6.14	9.61	8.79	8.01	18.58	19.24
		PCV%		4.63	8.17	17.17	6.27	9.96	9.17	8.03	18.80	19.44
		H		95.07	96.00	97.19	95.78	93.24	91.93	99.60	97.64	97.99
	Pop.2	Reps	2	0.56	1.90**	0.409*	0.114	0.035	5.70	0.020*	17.24**	0.18
		Entries	14	44.12**	94.50**	2.696**	1.636**	0.543**	117.41**	0.583**	239.15**	33.64**
		Error	28	0.32	0.35	0.106	0.042	0.017	7.98	0.005	1.34	0.22
		GCV%		5.60	8.93	16.64	7.44	16.44	11.36	10.07	20.92	20.99
		PCV%		5.68	8.98	17.42	7.69	17.15	12.49	10.16	21.05	21.18
		H		97.30	98.90	91.25	93.41	91.96	82.72	98.39	98.74	98.28
Drought stress	Pop.1	Reps	2	0.29	0.48	0.062	0.005	0.007	6.86*	0.001	4.09**	0.11
		Entries	14	29.78**	82.33**	1.352**	1.125**	0.124**	66.40**	0.305**	62.28**	8.56**
		Error	28	0.48	1.10	0.027	0.015	0.003	1.29	0.008	0.69	0.04
		GCV%		4.83	8.55	15.81	6.95	7.77	6.99	9.38	16.37	18.27
		PCV%		4.99	8.71	15.92	7.07	8.11	7.33	9.48	16.62	18.40
		H		93.74	96.23	98.56	96.77	91.66	90.91	97.86	96.93	98.59
	Pop.2	Reps	2	0.46	1.42*	0.040	0.011	0.009	5.63	0.005	1.01	0.06
		Entries	14	30.94**	64.10**	1.469**	1.835**	0.170**	106.49**	0.379**	84.29**	8.28**
		Error	28	0.39	0.31	0.014	0.032	0.004	4.20	0.011	0.86	0.10
		GCV%		5.02	8.53	17.19	8.13	11.40	12.08	9.35	19.60	17.97
		PCV%		5.14	8.57	17.31	8.17	11.91	12.80	9.77	19.78	18.27
		H		95.39	98.95	98.59	99.16	91.63	88.97	91.68	98.10	96.69

***, **, significant at 5% and 1% levels of probability, respectively.**

Furthermore, the combined analysis of variance revealed highly significant differences between both water irrigations (I) and among entries (E) for all studied traits in both populations. In addition, the interaction between entries and irrigations was significant for all studied traits. This result reflected the existence of sufficient variation among entries (Table 6).

Observed direct and correlated responses

Tables 7 and 8 show the means (observed direct) of the best 12 families selected according to the selection criterion ''days to heading'' and correlated responses after carrying two cycles of pedigree selection in F_3 generation in both populations under normal and drought conditions.

Days to heading (DH)

Under both water irrigations, elven families out of twelve were significantly earlier than the earliest parent in each population. The family No.12 was the earliest family and recorded 55.33 and 48.33 days in Pop.1 under normal and drought stress, while the selected family No.7 was the earliest one and recorded 55,33 and 49.33days in Pop.2 under normal and drought stress, respectively. This result reveals that the drought stress led to reduce number of days to heading.

Plant height (PH)

In Pop.1, six and four selected families were significantly shorter than the shortest parent (ICARDA 5) under normal and drought conditions, respectively. The family No. 11 was the shortest family and recorded 64.17 and 58.67 cm under normal and drought stresses, respectively. In Pop.2, eight selected families were significantly shorter than the shortest parent (ICARDA 1) under normal conditions, while the family No. 7 was registered 62.67 cm. In addition, the same number of families (eight selected families) were significantly shorter than the shortest parent (Gemmeza 7) under drought conditions, while the family No. 9 was recorded 51.27 cm.

Number of spikes/plant (NSPP)

In Pop.1, four and five selected families were significantly higher than the better parent (ICARDA 2) and (ICARDA 5) in NSPP under normal and drought conditions, respectively. The family No. 11 was the superior family and recorded 7.33 under normal conditions, while the family No. 10 was the superior family and recorded 5.83 under drought conditions. In Pop.2, seven and six selected families were significantly higher in NSPP than the better parent (ICARDA 1) under normal and drought conditions, respectively. The family No. 9 was the superior family and recorded 7.18 under normal conditions, while the family No. 10 was the superior family and recorded 5.57 under drought conditions.

Spike length (SL)

Under normal conditions, four selected families were significantly taller in spike length than the better parent ICARDA 5 in Pop.1 and Gemmeza 7 in Pop.2. The families No. 1 and No. 5 were the best selected families in SL in Pop. 1 and Pop.2, respectively. Under drought conditions, seven and six selected families were significantly taller in spike length than the better parent ICARDA 5 in Pop.1 and Gemmeza 7 in Pop.2. Since, the family No. 5 was the best selected families in SL in both populations.

Table 6. Mean squares of the selected families for days to heading (DH) in the F_3 generation in both populations over two irrigation levels, season 2016/2017

	S.O.V	df	DH	PH	NSPP	SL	GYPS	NGPS	100-GW	BYPP	GYPP
Pop.1	Irrigation(I)	1	1508.80**	837.84**	26.92**	85.36**	4.23**	140.26**	9.03**	2281.11**	473.94**
	I(Rep)	4	0.51	0.35	0.051	0.014	0.010	6.19	0.005	4.21	0.09
	Entries (E)	14	64.33**	169.01**	3.731**	2.178**	0.290**	138.42**	0.606**	189.43**	27.50**
	I*E	14	1.53**	3.02**	0.186**	0.128**	0.021**	7.08**	0.013*	10.91**	1.69**
	Error	56	0.43	1.18	0.032	0.023	0.005	1.80	0.006	0.96	0.10
Pop.2	Irrigation(I)	1	1091.33**	2809.76**	33.97**	5.65**	9.44**	561.95**	12.96**	4706.54**	838.38**
	I(Rep)	4	0.51	1.66	0.225	0.063	0.022	5.67	0.012	9.13	0.12
	Entries (E)	14	72.98**	153.18**	3.895**	3.400**	0.617**	187.67**	0.908**	294.04**	36.66**
	I*E	14	2.08**	5.42**	0.270**	0.071*	0.096**	36.23**	0.054**	29.40**	5.26**
	Error	56	0.35	0.33	0.060	0.037	0.011	6.09	0.008	1.10	0.16

***, **, significant at 5% and 1% levels of probability, respectively.**

Table 7. Means of the studied traits of the selected families for earliness in the F_3 generation in Pop.1 under normal and drought stress irrigation in season 2016/2017.

	Normal	Drought	Normal	Drought	Normal	Drought	Normal	Drought	Normal	Drought
Pop.1	DH		PH		NSPP		SL		GYPS	
1	60.67	52.33	81.83	75.67	5.96	4.93	12.6	10.37	2.70	2.10
2	58.00	48.67	79.00	73.5	5.53	4.43	11.3	9.77	2.58	2.15
3	57.67	51.33	78.17	72.67	6.09	5.03	11.77	10.17	2.06	1.71
4	61.67	53.33	65.33	59.83	5.57	4.23	10.75	8.93	2.03	1.91
5	63.33	55.33	79.5	74.00	6.28	5.1	12.37	10.57	2.32	1.94
6	61.33	53.67	77.67	72.17	6.89	5.27	11.43	9.57	2.17	1.73
7	58.33	49.33	71.67	66.17	6.55	5.33	10.97	9.03	2.53	2.16
8	60.33	51.33	68.08	62.58	5.11	4.13	10.53	8.43	2.44	1.94
9	65.67	56.67	76.33	70.83	4.59	3.93	11.45	9.27	2.6	2.01
10	60.67	52.67	72.33	66.83	7.17	5.83	11.97	9.63	2.64	2.1
11	59.33	51.33	64.17	58.67	7.33	5.73	10.48	9.13	2.23	1.86
12	55.33	48.33	69.38	63.88	4.07	3.37	10.77	8.77	2.25	1.83
Average	60.19	52.03	73.62	68.07	5.93	4.78	11.37	9.47	2.38	1.95
P1	65.67	56.33	78.33	67.93	6.23	4.77	11.17	8.97	1.87	1.47
P2	68.50	59.33	75.83	67.33	5.33	4.80	11.33	9.03	2.21	1.66
Bulk	61.67	55.33	71.3	65.33	5.30	4.70	11.13	9.17	2.15	1.69
$RLSD_{0.05}$	0.91	0.31	1.68	1.55	0.29	0.24	0.26	0.18	0.12	0.08
Pop.1	NGPS		100-GW		BYPP		GYPP			
1	57.09	51.74	4.73	4.06	40.58	30.47	16.06	10.37		
2	56.47	54.12	4.56	3.98	38.5	27.1	14.24	9.54		
3	47.08	45.25	4.37	3.78	33.27	26.43	12.52	8.61		
4	47.18	49.96	4.31	3.83	30.97	24.47	11.33	8.1		
5	52.76	50.36	4.4	3.86	38.73	27.83	14.58	9.9		
6	55.24	55.01	3.93	3.15	38.7	26.57	14.94	9.13		
7	54.94	54.52	4.61	3.96	42.87	31.5	16.59	11.51		
8	59.32	55.89	4.11	3.48	34.57	24.97	12.44	8.03		
9	65.03	59.17	4	3.39	32.23	23.7	11.92	7.9		
10	52.65	48.76	5.01	4.3	51.5	35.67	18.92	12.24		
11	55.77	54.63	4.01	3.4	45.43	31.33	16.36	10.65		
12	57.02	54.62	3.95	3.36	25.37	18.3	9.16	6.17		
Average	55.05	52.84	4.33	3.71	37.73	27.36	14.09	9.35		
P1	46.37	42.39	4.04	3.47	30.83	20.2	11.67	6.97		
P2	48.87	45.24	4.52	3.66	30.97	22.55	11.76	7.95		
Bulk	51.36	48.03	4.18	3.53	32.17	24.57	11.38	7.96		
$RLSD_{0.05}$	2.25	1.68	0.1	0.14	1.64	1.23	0.57	0.31		

Table 8. Means of the studied traits of the selected families for earliness in the F_3 generation in Pop.2 under normal irrigation and drought stress in season 2016/2017.

	Normal	Drought	Normal	Drought	Normal	Drought	Normal	Drought	Normal	Drought
Pop.2	**DH**		**PH**		**NSPP**		**SL**		**GYPS**	
1	65.67	56.33	78.67	66.60	6.10	4.90	12.13	11.83	3.24	2.44
2	60.67	53.33	66.50	56.77	7.04	5.47	11.33	11.03	2.86	2.08
3	62.33	55.33	68.67	57.25	6.18	5.20	10.83	10.00	2.75	1.96
4	57.67	50.67	64.00	53.85	5.50	4.07	10.27	10.17	2.40	1.99
5	65.33	57.67	80.50	65.23	4.31	3.43	12.31	11.90	3.26	2.39
6	62.67	56.67	74.33	62.90	6.20	4.67	11.35	11.07	3.66	2.44
7	55.33	49.33	62.67	51.90	5.27	4.23	9.73	9.13	2.54	2.02
8	58.33	52.33	76.67	61.83	4.30	3.27	11.65	10.93	2.81	2.02
9	56.67	51.33	62.83	51.27	7.18	4.77	10.17	9.73	2.21	2.13
10	57.67	52.33	69.58	57.70	6.88	5.57	10.34	9.97	2.04	1.57
11	58.67	50.67	65.75	55.77	5.27	4.03	10.65	10.07	2.81	2.15
12	62.33	54.33	67.33	57.30	5.18	3.77	11.73	11.17	2.56	2.04
Average	60.28	53.36	69.79	58.20	5.78	4.45	11.04	10.58	2.76	2.10
P1	67.67	60.00	70.83	62.98	4.93	4.13	10.98	10.17	2.50	1.89
P2	66.33	58.33	71.07	60.30	4.80	3.93	11.07	10.63	2.41	1.78
Bulk	62.33	56.53	66.67	56.80	4.83	4.09	10.83	10.07	2.52	1.96
$RLSD_{0.05}$	0.84	0.93	0.88	0.83	0.50	0.18	0.30	0.27	0.19	0.10
Pop.2	NGPS		100-GW		BYPP		GYPP			
1	63.99	61.65	5.06	3.96	53.81	34.72	19.66	11.97		
2	58.92	54.06	4.86	3.85	54.17	35.60	20.03	11.37		
3	52.66	45.87	5.22	4.27	47.73	27.40	16.99	10.18		
4	54.12	49.20	4.44	4.04	36.00	23.63	13.20	8.09		
5	60.23	52.39	5.42	4.57	37.03	23.38	14.03	8.22		
6	69.50	54.57	5.27	4.48	59.50	33.83	22.69	11.41		
7	60.69	58.16	4.18	3.47	37.33	24.60	13.36	8.53		
8	64.09	55.21	4.38	3.67	32.10	18.43	12.05	6.61		
9	55.67	63.79	3.98	3.34	42.20	31.20	15.84	10.15		
10	44.97	39.96	4.54	3.94	36.67	25.47	14.03	8.75		
11	66.57	57.87	4.22	3.71	39.63	25.83	14.79	8.66		
12	53.49	51.69	4.78	3.96	35.47	23.47	13.25	7.70		
Average	58.74	53.70	4.70	3.94	42.64	27.30	15.83	9.30		
P1	54.09	50.88	4.63	3.71	33.32	21.43	12.32	7.79		
P2	56.49	50.83	4.27	3.50	30.48	20.25	11.58	6.99		
Bulk	57.73	52.11	4.37	3.77	34.95	24.20	12.20	8.03		
$RLSD_{0.05}$	4.37	3.12	0.11	0.16	1.72	1.38	0.70	0.46		

Grain yield/spike (GYPS)

In Pop.1, six and ten selected families were significantly higher in grain yield/spike than the better parent (ICARDA 5) under normal and drought conditions, respectively. Since, the families No. 1 and No. 7 were the best yielding families and recorded 2.70 and 2.16 g under normal and drought conditions, respectively. The same scenario was observed in Pop.2, where seven and ten selected families were significantly superior in grain yield/spike than the better parent (ICARDA 1) under normal and drought conditions, respectively. Since, the families No. 6 and No. 1 were the best yielding families and recorded 3.66 and 2.44 g under normal and drought conditions, respectively.

Number of grains/spike (NGPS)

In Pop.1, ten and elven selected families were significantly higher in number of grains/ spike than the better parent (ICARDA 5) under normal and drought conditions, respectively. Since, the family No. 9 was the best yielding family and recorded 65.03 and 59,17 under normal and drought conditions, respectively. The same scenario was observed in Pop.2, where four and seven selected families were significantly superior in this trait than the better parent (ICARDA 1) and Gemmeza 7 under normal and drought conditions, respectively. Since, the families No. 6 and No. 9 were the best yielding families and recorded 69.50 and 63.79 under normal and drought conditions, respectively.

Biological yield/plant (BYPP)

In Pop.1, nine and ten selected families were significantly heavier in biomass than the better parent (ICARDA 5) under normal and drought conditions, respectively. Since, the family No. 10 was the best yielding family and recorded 51.50 and 35.67 g under normal and drought conditions, respectively. In Pop.2, where elven selected families were significantly superior in this trait than the better parent (ICARDA 1) under both water treatments. Since, the families No. 6 and No. 2 were the best yielding families and recorded 59.50 and 35.60 g under normal and drought conditions, respectively.

Grain yield/plant (GYPP)

In Pop.1, nine and eight selected families were significantly higher in grain yield/plant than the better parent (ICARDA 5) under normal and drought conditions, respectively. Since, the family No. 10 was the best yielding family and recorded 18.92 and 12.24 g under normal and drought conditions, respectively. In Pop.2, elven and eight selected families were significantly superior in this trait than the better parent (ICARDA 1) under normal and drought conditions, respectively. Since, the families No. 6 and No. 1 were the best yielding families and recorded 22.69 and 11.97 g under normal and drought conditions, respectively. These results are agreement with those obtained by Al-Naggar and Shehab-El-Deen (2012) and Patel *et al.*, (2019).

100-grain weight (100-GW)

In Pop.1, two and six selected families were significantly heavier in 100-grain weight than the better parent (ICARDA 5) under normal and drought conditions, respectively. Since, the family No. 10 was the best family in this trait which recorded 5.01 and 4.30 g under normal and drought conditions, respectively. In Pop.2, six and seven selected families were significantly superior in 100-grain weight than the better parent (ICARDA 1) under normal and drought conditions, respectively. Since, the families No. 6 and No. 7 were the best families and recorded 5.42 and 4.57 g under normal and drought conditions, respectively. These findings are in agreement with those obtained by Menshawy (2007), Dejan *et al.,* (2008), Akçura (2011), Farshadfar *et al.,* (2011), Mohammadi et al (2011), and Mursalova *et al.,* (2015).

CONCLUSION

From the previous results, it could be concluded that the selected family No. 10 was the best family out of twelve of Pop.1 that showed high grain yield under both treatments. In the same time, it was early in heading than the earliest parent. But the drought stress led to reduce grain yield/plant from 18.92 g to 12.24 g by reduction percentage 35.3%. This family could be considered as tolerant to drought stress and could be used in breeding program for drought tolerance and earliness. But the scenario was not the same in Pop.2, since different families showed different attitudes under normal and drought stress conditions. However, the family No. 6 was the best selected one in (GYPP, GYPS, NGPS, BYPP and 100-GW) under normal conditions, while the family No. 1 was the best one for GYPS and GYPP under drought stress conditions.

REFERENCES

Ahmed A.A.S., M.A. El –Morshidy, K.A. Kheiralla, R. Uptmoor, M.A. Ali and Naheif E.M. Mohamed (2014). Selection for drought tolerance in wheat population (*Triticum aestivum* L.) by independent culling levels. World J. of Agric. Res., 2 (2), 56-62.

Akçura, M., F. Partigoç and Y. Kaya (2011). Evaluating of drought stress tolerance based on selection indices in Turkish bread wheat landraces. J. of Animal & Plant Sci., 21(4): 700-709.

Aktaş, H. (2016). Drought tolerance indices of selected landraces and bread wheat (*Triticum aestivum* L.) genotypes derived from synthetic wheats. Applied Ecology and Environmental Res., 14(4): 177-189.

Al-Naggar A.M.M. and Shehab- El- Deen, M.T. (2012). Predicted and actual gain from selection for early maturing and high yielding wheat genotypes under water stress conditions. Egypt. J. Plant Breed., 16(3):73-92.

Al-Rawi K.M. and A.M. Khalafalla (1980). Design and Analysis of Agricultural Experiments. Dar Al-Kutub for Printing and Publishing.Mosul Univ., Iraq.

Bennani, S, A. Birouk, N. Nsarellah, M. Jlibene and H. Ouabbou (2016). Efficiency of selection indices in screening bread wheat lines combining drought tolerance and high yield potential. J. of Plant Breed. and Crop Sci., 8(5), 72-86.

Bishaw, Z, P.C. Struik and A.J.G. Van Gastel (2011). Wheat and barley seed system in Syria: farmers, varietal perceptions, seed sources and seed management. Int. J. Plant Prod., 5(4): 323-348.

Burton G.W. (1952). Quantitative inheritance in grasses. Proc. 6th Intercropping. Grassland Cong. 1: Chowdhury, N. H. 1991. Studies on quality of rice in Bangladesh. In: Proceeding of the workshop on chemical aspects of rice grain quality, IRRI, Philippines, pp 23-127.

Dejan, D., Z. Miroslav, K. Desimier, R.K. Stephen and S.M. Gordana (2008). Genotype x environment interaction for wheat yield in different drought stress conditions and agronomic traits suitable for selection. Australian J. of Agric. Res., 59: 536-545.

Dixon, J., H.J. Braun and J.H. Crouch (2009). Overview: transitioning wheat research to serve the future needs of the developing world. In: Dixon J, H.J. Braun P. Kosina and J. Crouch (eds). Wheat facts and futures 2009. Mexico, D.F: CIMMYT.

El Ameen T., A. Hossain and J.A. Teixeira da Silva (2013). Genetic Analysis and Selection for Bread Wheat (Triticum aestivum L.) Yield and Agronomic Traits under Drought Conditions. International J. of Plant Breed., 7 (1), 61-68.

El-Morshidy M.A., K.A.A. Kheiralla, M.A. Ali and A.A. Said (2010). Response to Selection for Earliness and Grain Yield in Wheat (*Triticum aestivum* L.) Under Normal and Water Stress Conditions. Assiut J. of Agric. Sci., 41: 1-23.

Farshadfar E., N. Mahmodi and A. Yaghotipoor (2011). AMMI stability value and simultaneous estimation of yield and yield stability in bread wheat (Triticum aestivum L.). Australian J. of Crop Sci., 5(13): 1837-1844.

Gomez, K.A. and A.A. Gomez (1984). Statistical Procedures for Agriculture Research. John Wiley and Sons. Inc. New York, USA.

Koh-Banerjee, P., M. Franz, L. Sampson, S. Liu, D. Jacobs, D. Spiegelman, W. Willett and E. Rimm (2004). Changes in whole-grain, bran, and cereal fiber consumption in relation to 8-y weight gain among men. American J. of Clinical Nutrition 80: 1237-1245.

Memon S., N. Iqbal, F. Zaman, S. Memon, M.A. Abro, G.H. Jatoi and A.R. Mangi (2018). Heritability estimates in F_2 segregating population in hexaploid wheat (*Triticum aestivum* L.). Pak. J. Biotechnol., 15 (3) 803-810.

Menshawy A.M.M. (2007). Evaluation of some early bread wheat genotypes under different sowing dates: 1. Earliness characters. Egypt. J. Plant Breed., 11(1):25-40.

Mohammadi, M., R. Karimizadeh and M. Abdipour (2011). Evaluation of drought tolerance in bread wheat genotypes under dryland and supplemental irrigation conditions. Australian J. of Crop Sci., 5 (4): 487-493.

Mursalova, J., Z. Akprov, J. Ojaghi, M. Eldarov, S. Belen, N. Gummadov and A. Morgounov (2015). Evaluation of drought tolerance of winter bread wheat genotypes under drip irrigation and rain-fed conditions. Turkish J. Agric., 39: 1407-152.

Nouri, A., A. Etminan, J.A. Teixeira da Silva and R. Mohammadi (2011). Assessment of yield, yield-related traits and drought tolerance of durum wheat genotypes (Triticum turjidum var. durum Desf.). Australian J. Crop Sci. 5(1): 8-16.

Ogbonnaya, F.C., F.C. Imtiaz, H.S. Bariana, M. McLean and M.M. Shankar (2008). Mining synthetic hexaploids for multiple disease resistance to improve bread wheat. Crop and Pasture Science 59: 421-431.

Patel, J.M., A.S. Patel, C.R. Patel, H.M. Mamrutha, Sharma Pradeep and Karen P. Pachchigar (2019). Evaluation of selection indices in screening durum wheat genotypes combining drought tolerance and high yield potential. International J. Current Microbiology and Applied Sci., 8(4): 1165-1178.

Reynolds, M.P. and G. Rebetzke (2011). Application of plant physiology in wheat breeding. In AP Bonjean, W.J., M. Angus and Van Ginkel, eds, The World Wheat Book: A History of Wheat Breeding 2: 877-906.

Travlos, I.S. (2012). Reduced herbicide rates for an effective weed control in competitive wheat cultivars. Int. J. Plant Prod., 6:1-14.

الانتخاب للتبكير في عشيرتين من قمح الخبز تحت ظروف توشكي

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إنتاجية النباتات تتأثر سلبا بالجفاف وكذلك بعض المكونات مثل صفات النمو والمحصول. لذا فإن سلالة القمح المتحملة للجفاف يجب أن تتمتع بالقدرة على الصمود فى ظروف نقص المياه أو الهروب منه خلال المراحل الحرجه من حياتها. أجريت هذه الدراسة بمحطة بحوث توشكى التابعة لمركز بحوث الصحراء، بمحافظة أسوان (مصر) خلال موسمين ٢٠١٦/٢٠١٥ و ٢٠١٧/٢٠١٦، بهدف دراسة تاثير الانتخاب المنسب لصفة التبكير لدورتين انتخابيتين تحت ظروف الاجهاد المائي على عشيرتين من محصول قمح الخبز. وكانت معاملتي الري المستخدم هي ٦٧% و ١٠٠% من احتياجات الري الطبيعية لمحصول القمح بمنطقة توشكى. أشارت النتائج إلي أن العائله المختارة رقم ١٢ كانت أكثر قدرة على الهروب من الجفاف بالتبكير في طرد السنابل حيث سجلت قيم ٥٥،٣٣ و ٤٨،٣٣ يوم تحت ظروف معاملتي الري، علي التوالي، بينما العائلة رقم ١٠ كانت أفضل عائلة فى العشيرة الآولى والتي أعطت أعلى انتاجية فى صفة محصول الحبوب فى الجيل الثالث تحت كلا معاملتي الري. الإجهاد المائي بتقليل كمية المياه إلى ٦٧% أدى إلى نقص فى محصول الحبوب للنبات فى العائلة رقم ١٠ بنسبة ٣٥,٣٪. هذه العائلات المنتخبه تعتبر الافضل فى تحمل الجفاف ويمكن استخدامها فى برامج التربية لتحمل الجفاف والتبكير. أما فى العشيرة الثانية فكانت العائلة رقم ٦ هى الأعلى قيم فى صفات محصول الحبوب والمحصول البيولوجي ومحصول وعدد حبوب السنبلة ووزن المائة حبة تحت ظروف الاجهاد المائي، فى حين كانت العائلة رقم ٧ هى المبكرة تحت كلا معاملتي الري. أداء العائلات المنتخبة تحت ظروف الري الطبيعي اوالجفاف هى التي قد تحدد أهداف برامج الانتخاب.