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SUMMARY

The present study was carried out at Experimental Farm at Sakha Agric. Res. St. Kafer El-sheikh Governorate, Egypt. The genetic materials used in this investigation as parents included four bread wheat genotypes (*Triticum aestivum* L.), were chosen from previous study (M.Sc.). four genotypes were chosen as line 1 (Tolerant), Sakha 93(Tolerant), Sakha 94 (Sensitive) and Gemmiza 9 (Sensitive). Four crosses derived from the above parents have been chosen as follows:

Cross 1 = (Line 1×Sakha 93) Cross 2 = (Line 1×Sakha 94)

Cross 3 = (Sakha 93×Gemmiza 9) Cross 4 = (Sakha 94×Gemmiza 9)

In 2007/2008 season, the F_1 of each of the previous crosses were crossed back to its parents to produce BC_1 (F_1 x P_1) and BC_2 (F_1 x P_2). The F_1 plants were selfed to produce F_2 seeds.

In 2008/2009 season, The six population (P_1, P_2, F_1, F_2, BC_1 and BC_2) were evaluated in two separate irrigation regimes experiments. The first experiment (Normal treatment, N) was irrigated three times after sowing irrigation i.e. four irrigations were given through the whole season. The second experiment (Water stress treatment, S) was given one surface-irrigation 33 days after the seedling i.e. two irrigations were given through the whole season. The two experiments were designed in a randomized complete block design with three replications. Each replicate consisted of 21 rows; P_1, P_2 and F_1 were planted in one row for each, F_2 in 10 rows, BC_1 and BC_2 in 3 rows for each as

well as two border, rows 4 m long and 30 cm apart with 20 cm between plants. Twenty grains were manually drilled in the rows on, 6 December 2008. Each experiment was surrounded by a wide border (20 m) to minimize the underground water permeability. All other cultural practices, except irrigation, were applied as recommended for wheat cultivation. The two outside plants from each row and the two external rows of each replicate (border) were excluded to avoid the border effect.

Studied traits: Data of the following traits were recorded from 10 plants of each P_1, P_2, and F_1, 110 Plants of F_2 and 40 plants of BC_1 and BC_2 for each replicate for the two experiments as following: (1) Earliness component i.e. days to heading (day), days to maturity (day), grain filling period (day) and grain filling rate (g/day/plant). (2) Yield and yield components i.e. plant height (cm), number of spikes/plant, number of grains/ spike, 100-grain weight (g) and grain yield/plant (g) (3) Evidences of water stress tolerance i.e. tolerance index and yield reduction ratio for grain yield.

Statistical and genetically analysis: (1)- T-test was used to test the water effect. (2)- The differences between parents for each cross. (3)-Mean and variance were estimated for all populations. (4)- Evidences of water stress tolerance. (5)-Heterosis and inbreeding depression. (6)-Generation mean analysis **(Jinks and Jones, 1958)**. (7)-Generation variance analysis (**Mather, 1949)**. (8)-Heritability and expected genetic advanced from selection. (9)-Phenotypic and genotypic correlation coefficients **(Johnson *et al.*, 1966)**.

1-Water effects:

The results indicated that there were significant differences between the two water treatments for all earliness and yield and yield component traits as the effects of water stress.

The means of the four crosses significantly decreased under the water stress treatment for all traits as the effect of water stress, except grain filling rate at cross 2 and cross 3, number of spikes/plant at cross 1, cross 4 grain yield/plant at cross 1 which decreased without significant. On the other hand, grain filling rate at cross 1 and 100-grain weight at cross 1 and cross 3 had significantly increased as the effect of water stress.

2- The differences between parents for each cross:

The results indicated that the two parents for each cross were differed significantly for all earliness and yield and yield components traits in the four crosses under normal and water stress treatments, except cross 1 for days to maturity under normal treatment, days to heading and number of spikes/plant under water stress treatment; cross 2 for number of grains/spike under normal treatment, grain filling rate and grain yield/plant under water stress treatment and cross 4 for grain filling period under water stress treatment. Whenever difference did not reach the significant level, the data revealing the divers of genetic background of the parents involved.

3- Mean and variance:

The obtained date showed that Line 1 was the best parent for days to maturity, plant height, 100-grain weight under both water treatments, grain filling rate and grain yield/plant under water stress treatment. However, Sakha 94 was the best parent for grain filling rate under both water treatments, grain filling period and grain yield/plant under normal treatment. So that, cross 2 (Line 1 × Sakha 94) was the highest grain yield/plant under both water treatments.

4- Evidences of water stress tolerance:

Tolerance index and yield redaction ratio obtained that line 1 and Sakha 93 were the best tolerant parents and low sensitivity to water stress. The results indicated that cross 1 (Line 1 × Sakha 93) which these two parents involved in had low values at both tolerance index and yield redaction ratio at most of generations so that cross 1 was favored for water stress treatment.

5-Heterosis and inbreeding depression:

The useful heterosis over the both mid and better parent was showed at cross 1 for 100-grain weight under water stress treatment, cross 2 for days to maturity under normal treatment, cross 3 for grain filling rate, 100-grain weight, grain yield/plant under water stress treatment and cross 4 for grain filling period, 100-grain weight under both water treatments.

The results show that inbreeding depression values were positive and significant for days to maturity at cross 3 under water stress treatment; for grain filling period at cross 1 under normal treatment, cross 2 and cross 3 under both water treatments. While, inbreeding depression values were negative and significant for grain filling rate at cross 1, cross 2 under water stress treatment and cross 4 under both water treatments; for number of spikes/plant at cross 1, cross 4 under water stress treatment, cross 2 and cross 3 under both water treatments; for number of grains/spike at cross 4 under water stress treatment; for 100-grain weight at cross 3 under water stress treatment; for grain yield/plant at cross 1, cross 2 under water stress treatment and cross 4 under both water treatments.

6-Generation means analysis:

The F ratio of significance for the genetic variance among F_2 plants in the four crosses indicated that the F_2 plants were genetically different for all earliness and yield and yield components traits. These results assured the presence of enough variability in the material under study.

The scale test for all traits were shown that most values of A, B and D were significant or highly significant for all earliness and yield and yield components traits in the four crosses under normal and water stress treatments, except days to maturity for cross 2, grain filling period for cross 4 under water stress treatment, plant height at cross 3, cross 4 under water stress treatment and 100-grain weight at cross 2 under water stress treatment.

Additive genetic effect components played a great role in the inheritance of days to heading, days to maturity, grain filling period and plant height at most cases under both water treatments.

Additive and dominance genetic effect components played together a great role in the inheritance of grain filling rate, number of spikes/plant, number of grains/spike, 100-grain weight and grain yield/plant at most cases under both water treatments. But the dominance genetic effect component was more important than additive genetic effect in this respect.

The three types of epistatic effects as Additive × additive, Additive × dominance and dominance × dominance were important in inheritance of most earliness, yield components and grain yield traits at most cases under normal and water stress treatments.

7-Components of variance:

The results indicated that additive variance was played the greatest role and the important in the inheritance for all earliness traits, plant height, number of spikes/plant and grain yield/plant at most cases under both water treatments. Also, Partial dominance was found at most cases which can be calculated under both water treatments to these traits. Indicating that selection for these traits might be more effective in early generations for improving such traits in the four studied crosses, however, it would be better if it was delayed to later generations.On the other hand, dominance genetic variance was the greatest and the important in the inheritance for number of grains/spike and 100-grain weight at most cases under both water treatments. Also, Partial over dominance was found at most cases which can be calculated under both water treatments to these traits. Indicating that selection for these traits might be more effective in later generations for improving such traits in the four studied crosses.

8-Heritability and genetic advance:

Heritability in broad sense ($h_{.b.s}$) had high values for all earliness traits. While, it had medium to high values for yield and yield component at most cases under normal and water stress treatments. Heritability estimate in narrow sense ($h_{.n.s}$) had moderate to high values for earliness and yield and yield components traits at most cases under both water treatments except number of grains/spike which had low values at most cases under both water treatments.

Genetic advance estimates under selection show the possible gain from selection as percent increase in the F_3 over the F_2 mean when the most desirable 5% of the F_2 plants as selected. Genetic advance under selection (Δg%) was found to be low for days to heading, days to maturity, grain filling period and plant height at most cases under both water treatments. While, it was high for grain filling rate, number of spikes/plant and grain yield/plant at most cases under both water treatments. Also, it was founded to be low to high for plant height, number of grains/spike and 100-grain weight at most cases under both water treatments.

9-Phenotypic and genotypic correlation coefficient:

The phenotypic and genotypic correlation coefficient indicated that both of days to heading and maturity were negative significantly with grain yield/plant at most cases. While, grain filling rate, plant height, number of spikes/plant, number of grains/spike and 100-grain weight were positive significantly with grain yield/plant at most cases. The highest positive significantly phenotypic and genotypic correlation were found between grain filling rate and number of spikes/plant with grain yield/plant at most cases under both water treatments.

Conclusion

Finally, the results indicated that:

1-The obtained date showed that Line 1 and Sakha 94 were the best parents for grain yield under both water treatments .So that, cross 2 (Line 1× Sakha 94) was the highest grain yield/plant under both water treatments.

2-Tolerance index and yield redaction ratio obtained that line 1 and Sakha 93 were the best tolerant parents and low sensitivity to water stress. The results indicated that cross 1 (Line1×Sakha 93) had low values at both tolerance index and yield redaction ratio at most of generations so that cross 1 was favored for water stress treatment.

3-Selection for most traits might be more effective in early generations for improving such traits in the four studied crosses, however, it would be better if it was delayed to later generations

4-Genetic advance under selection show high possible gain from selection for grain filling rate, number of spikes/plant and grain yield/plant. While, grain filling rate and number of spikes/plant had strong link with grain yield/plant so that it could be recommended to selection for these traits.