GENETIC ANALYSIS IN DIALLEL CROSSES OF BREAD WHEAT UNDER HEAT STRESS

By

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B.Sc. Agric. Sc. (Agronomy), Ain Shams University, 2009

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ABSTRACT

Twenty one wheat hybrids and their parental genotypes were evaluated in the Research Farm and Laboratories of the Department of Genetics, Faculty of Agriculture, Ain Shams University, Shoubra El-Khema, Cairo, Egypt, in 2016/17 growing season. The genetic analysis was conducted using Griffing (1956), Method 2, model 1.

Significant differences among genotypes, parents and crosses for all the studied traits (days to 50% heading, days to maturity, flag leaf area, plant height, number of spikes/ plant, spike length, number of spikelets/ spike, number of kernels/ spike, 1000-kernel weight and grain yield/ plant). This indicates that, variability exists among these populations may increase the chance appearance of good new combinations that can be isolated in the succeeding generations. Parents versus crosses mean squares as an indication for average heterosis over all crosses were significant for all the studied traits.

Mean squares of general (GCA) and specific (SCA) combining abilities were significant for all the studied traits, except spike length for SCA was insignificant. GCA/SCA ratios were more than unity for all the studied traits, indicating that the additive type of gene action is of great importance in the inheritance of these traits. Heterosis over better parents showed that, the best hybrids were Gemmiza 9 x Giza 168, Sakha 93 x Giza 168, Sakha 94 x Jawahir-14, Sakha 94 x Bob white, Giza 168 x Acsad 925 and Jawahir-14 x Bob white for grain yield/ plant and some of the other studied traits. The best general combiner parents were Sakha 94, Jawahir-14 and Bob white for grain yield/ plant and some of the other studied traits. The best SCA hybrids were Gemmiza 9 x Sakha 93, Gemmiza 9 x Giza 168, Sakha 93 x Jawahir-14, Sakha 94 x Jawahir-14, Sakha 94 x Acsad 925, Sakha 94 x Bob white, Giza 168 x Jawahir-14, Giza 168 x Acsad 925, Jawahir-14 x Bob white and Acsad 925 x Bob white for grain yield/ plant and some of the other studied traits.

The seven parents and their 21 crosses were subjected to heat stress experiment. Its noticed that the varieties Sakha 94, Sakha 93 and Jawahir-14 expressed the same banding pattern in control and heat stress, while the varieties Acsad 925, Bob white , Giza 168 and Gemmiza 9 showed less banding pattern in heat stress rather than the control. Therefore, the varieties Sakha 94, Sakha 93 and Jawahir-14 can be ranked as a tolerant varieties and the others as sensitive ones.

It is concluded to note from these results that most of the tolerant hybrids which showed no differences in the heat shock protein banding patterns had at least one of the tolerant parents present in their genotypes.

Key words: Wheat, Combining ability, Heterosis, Heat stress, Protein electrophoresis, SDS-PAGE, Heat shock, Thermal tolerance.

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INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the leading cereals and staple food of peoples in many countries of the world including Egypt. It plays a remarkable role in meeting the food requirements of any country **Caporaso *et al*. (2018), García-García *et al*. (2018), Luo *et al*. (2018) Wang *et al*. (2018) Zhong *et al*. (2018).**

In Egypt, wheat is the main winter cereal crop used as a staple food for urban and rural societies and the major source of straw for animal feeding**.** However, total wheat consumption has increased drastically due to over population growth by about 2.5 % per year. Egypt imports about 59.7 % of its wheat requirements, according to the **FAO (2017)**. This reflects the size of the problem and the efforts needed to increase wheat production. Thus, increasing production per unit area appears to be one of the important factors for narrowing the gap between wheat production and consumption.

Information regarding general and specific combining abilities of wheat genotypes is a prerequisite to launch a successful wheat-breeding programs. Diallel mating design has been extensively used to analyze the combining ability effects of wheat genotypes and also to provide information regarding genetic mechanisms controlling grain yield and other traits. Knowledge of general and specific combining abilities, influencing yield and its components has become increasingly important for plant breeders in the choice of suitable parents for developing potential possessing varieties in wheat. Many researchers gives reviews, which revealed that both general and specific combining abilities were involved in the improvement of yield and its contributing traits in wheat **Kumar *et al*. (2017b), Ljubičić *et al*. (2017), Tabassum *et al*. (2017), Yadav *et al*. (2017) and Patel *et al*. (2018).**

The increase or decrease in the productivity and vigor of hybrids compared to those of their parents is generally attributed to heterotic

effects expressed in F_1's and following generations. Heterosis may be useful in identifying the heterotic crosses in wheat. Heterosis in wheat has also estimated [**Mahpara *et al*. (2017a), Murugan and Kannan (2017) and Thomas *et al*. (2017)].**

Heat stress is one of the major environmental challenges in crop production to worldwide today, and recent global climate change has made this situation more serious. Thus, improvement of wheat production for heat tolerance is a major objective in plant breeding programs **Bhanu *et al*. (2018), Hernández-Espinosa *et al*. (2018), Kamrani *et al*. (2018) and Rezaei *et al*. (2018).**

Sodium dodecyl sulfate – polyacrylamide gel electrophoresis (SDS-PAGE) is the most widely used technique in protein studies. It is considered a low-cost, reproducible, and rapid method for quantifying, comparing and characterizing of proteins **Sharma *et al.* (2015), Iqbal *et al.* (2017), Ibba *et al.* (2018) and Victorio *et al.* (2018).**

The aims of this study are to:

1- Evaluate the performances of seven parents of bread wheat and their 21 F_1 crosses for some traits to identify the best performance of wheat genotypes.

2- Estimate heterosis, general combining ability (GCA) and specific combining ability (SCA) for grain yield and its related traits to identify the best combiner parents.

3- Detect the thermal tolerance workers for the seven wheat parents and their 21 F_1 crosses using SDS-protein electrophoresis.