PHYSIOLOGICAL GENETIC STUDIES ON SOME EGYPTIAN WHEAT VARIETIES

BY

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بسم الله الرحمن الرحيم

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ABSTRACT

General, specific combining ability, heterotic values and their relationship with serological analysis were estimated for the wheat varieties : SK8, SK61, SK69 and G157, and their hybrids. moreover, embryo culture technique and electrophoretic analysis were used to evaluate their response for salt stress.

Key words : Combining ability, heterosis, serology, salt stress, embryo culture, electrophoresis, isozymes.

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* **(Photograph)**

I INTRODUCTION

Wheat (*Triticum aestivum* L.) is the world's most important grain crop. In Egypt, the area sown to wheat amounted to about 1,488,000 feddan in 1984 and increased to 1,532,534 feddan in 1989 season via gaining some areas from other winter crops and from the area grown with barley under rain in Sinai and Northern West Coast regions. The total production of this acreage amounted to about 3.2 million tons of grain yield. This quantity constitutes a small proportion of the local yearly consumption of wheat which amounted to eight million tons a year. Thus, production of wheat is considered a problem of major concern today, attributable to the limited area of cultivated land on one hand and the explosive explosion population on the other. Wheat breeding can play a major role in narrowing the gap between production and consumption through utilizing improved varieties.

Choice of parents for crossing is considered an important step in any plant breeding programme aimed at improving yield and related attributes. So, identification of parental lines with good general combining ability could be useful for varietal improvement. Including such lines in crossing programs might give rise to desirable segregants. The diallel analysis is an attempt to partition phenotypic variation into genotypic and environmental components and to further subdivide genotypic variation into its additive and non-additive components. These estimates can then be used to draw inferences about the genetic systems involved for yield and its components, and the best breeding strategy to be used to improve them.

Salinity in soils and irrigation water is a problem that restricts yield on 40,000,000 hectares of irrigated land, which is approximately one-third of the irrigated land on earth, (**Bernstein, 1975**). Development of salt tolerant crop varieties would complement salt management programs to help maximize yields in these area. Breeding for salinity tolerance in wheat, means breeding for yield in environments where this one factor is considered a limiting production factor.

Development of salt-tolerant crops may allow increased production in soils plagued by salt. Although ample sources of genetic diversity exist for most of the major crops, adequate screening methods for isolating salt-tolerant genotypes have not yet been developed (**Kingsbury and Epstein 1984**).

Planting varieties with a decreased dependence on environmental modification would allow land which is currently marginal for cultivation to be brought into production. The gradual build up of salt by irrigation systems is the principal factor affecting their useful life. Therefore application of tissue culture techniques to field crops improvement can help in the production of wheat, sorghum, and rice genotypes which could tolerate the levels of salinity in some areas to avoid this limiting factor (**Nabors, 1983**).

The objectives of this investigation were :

(1) General and specific combining ability and the heterotic effects in F_1 wheat hybrids to study, yield and some other yield-related characters in four-parental diallel cross of Egyptian wheat.

(2) To determine the serological affinities between good and poor combiner to predict for combining ability and heterosis in the studied varieties.

(3) To assess salt tolerance for the wheat varieties (Sakha 8, Sakha 61, Sakha 69, Giza 157) and their hybrids in the screen house to find out the best tolerant variety(s) at different levels of salinity as compared with the control.

(4) To investigate the effect of the different levels of salinity on callus induction by embryo culture in an attempt to reveal the best tolerant variety or hybrid at the callus level.

(5) To develop biochemical genetic markers as SDS-PAGE electrophoresis and some isozymes (Esterase, Peroxidase, Amylase, Glutamic oxaloacetic transaminase) to discriminate between these varieties and their hybrids, and to compare between the control and salinity treatment in order to find the characteristic protein band(s) (SSP)* which is associated with salinity.

* SSP = Stress Shock Protein

II- REVIEW OF LITERATURE

1-Combining ability

Abul-Naas *et al.* (1981a) evaluated combining ability for yield and its components in 5 X 5 diallel crosses of durum wheat, i. e., number of spikelets per spike, spike length, 1000-kernel weight, number of spike/plant and plant height. They obtained significant differences for general combining ability (G.C.A.) and specific combining ability (S.C.A.) for almost all traits. The G.C.A./S.C.A. variance ratio showed that the additive genetic variance was of more importance in the inheritance of most studied characters. **Bitzer *et al.* (1982)** showed significant G.C.A. for number of spikes per plant, number of kernels per spike, 200-kernel weight and grain yield, while, S.C.A variances were insignificant for all characters in winter wheat crosses studied. **Singh *et al.* (1982a)** studied combining ability of grain yield and some other traits involving eight parents diallel cross of bread wheat. Variances of both general as well as specific combining ability were significant for spike length, number of spikelets per spike, plant height, 1000-grain weight and grain yield per plant. But the magnitude of additive gene effect was higher, except for plant height in which non-additive gene action was important.

Combining ability analysis involving nine varieties of durum wheat with their 36 F_1 crosses were carried out to estimate the types of gene action by **Singh *et al.* (1982b)**. Their results showed that G.C.A. values were highly significant for plant height, spike length, number of grains per spike and yield per plant, except for 100-grain weight. Also, S.C.A. values were highly significant, except for number of grains per spike, indicating the presence of additive gene action in the inheritance of these traits.

El-Kadi *et al.* (1983) reported that differences among wheat genotypes and both general and specific combining abilities were highly significant for number of spikes per plant and protein content. Both additive and dominance types of genetic effects with different magnitudes were detected for both traits in F_1 and F_2. Generally, they showed with statistical analysis that the additive-dominance model with independent gene distribution was adequate for each trait. **Nanda *et al.* (1983)** demonstrated that both general and specific combining ability were highly significant for plant height, ear length and spikelets per spike, indicating that additive gene effects were more important than non-additive gene effects in spring wheat. Sonalika variety appeared to be the best general combiner for ear length. **Kumar *et al.* (1983a)** showed that both G.C.A. and S.C.A. variances had important effects on the studied traits in spring wheat. G.C.A. x environment variances were generally higher than S.C.A. x environment variances. They found that crosses involving good x good and good x poor combiners gave the greatest number of productive line. **Shoran *et al.* (1984)** observed a significant correlation (r=0.81) between G.C.A. values for grain weight per spike and grain yield per plant in wheat.

Pochaba *et al.* (1984) exhibited that the winter wheat varieties; Yubileinay 50, MAF 68 and 504 Hol. had the highest general combining ability for number of grains/ear and yield/plant, while for 1000-grain weight, G.C.A. was highest in Primepi, Cana and Rumk. Values for specific combining ability were significant, though not always positive for all the characters considered in most of the hybrid progenies investigated, indicating nonallelic interaction of genes and poor prospects for selection. **Singh *et al.* (1985b)** studied combining ability for grain yield and it's components in a diallel cross involving eight parents of bread wheat. The magnitude of additive genetic variance was comparatively higher than non additive variance for grains per spike, 1000-grain weight and grain yield per plant.

Nass and Jui (1985) found that the general combining ability effects were important for grain yield and harvest index in spring wheat. Correlations of G.C.A. effects in the F_1 and F_2 were significant for both traits, which were controlled by additive gene effects. Grain yield was associated with non grain yield and plant height, but harvest index was not. **Marija (1986)** studied the genetic analysis of a diallel cross involving five cultivars of winter wheat. He showed that variances of general combining ability were significant in F_1 and F_2, while the variances of specific combining ability were significant only in F_1 for productive tillers per plant, indicating that the total genetic variability was due to additive and non-additive gene effects in F_1 and the former being preponderant. In F_2, genetic variability was caused only by additive gene action. **Qari *et al.* (1986b)** reported that both general (predominant G.C.A.) and specific combining ability (S.C.A.) effects contributed to variation in the hybrids of spring wheat for tillers/plant, grains/spike, 1000-grain weight and grain yield/plant. Mexipak 65, Au 49 and Son 63 were good general combiners for yield and some components. High S.C.A. for yield was related to high S.C.A. for tillers/plant and grains/spike. They found four promising cross combinations. **Acharya and Singh (1986)** showed that general and specific combining ability effects were significant for grain yield and five related characters in wheat. The male parent C 306 and the female parent GP 106 were good general combiners for most of the characters and GP 106 X C 306 was the best cross.

Mohammed *et al.* (1986) used a diallel cross among four local hexaploid varieties of wheat (Giza 157, Sakha 61, Sakha 69 and Sakha 8) to estimate general and specific combining ability and to correlate between grain yield/plant and each of leaves/plant , specific leaf weight (SLW), leaf area index (LAI) and net assimilation rate (NAR) at three growth periods (5, 10 and 15 weeks after planting). The nature of gene action for the studied traits was inconsistent from one growth period to another. Concerning general combining ability, Giza 157 was high in leaves / plant, LAI and NAR and Sakha 8 was high in SLW, LAI and NAR. They showed that such traits were mostly correlated in both varieties with grain yield/plant at the different growth periods. This might enable the breeder to predict the performance of these