PHYSIOLOGICAL GENETIC STUDIES ON SOME MAIZE INBREDS AND THEIR HYBRIDS

By

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بسم الله الرحمن الرحيم

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Abstract

This investigation was carried out to study the effect of drought treatment on eight morphological characters and some biochemical genetic markers of six maize (*Zea mays* L.) inbreds lines and their hybrids. Drought tolerance experiment showed that the best inbred was G.504-B which showed drought tolerance for all studied characters. The F_1 hybrids were classified into three categories according to the number of drought tolerant characters they posses. On the other hand, the two inbreds G.507-A and G.241-A were found to be good combiner under drought condition, while the three inbreds G.4, G.444 and G.504-B were good combiner under control condition, but the inbred G.102 was poor combiner under both control and drought conditions. Electrophoretic analysis for SDS-protein, esterase and peroxidase isozymes revealed that esterase isozyme system was correlated with drought tolerance than the other two systems.

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INTRODUCTION

Maize, (*Zea mays* L.) is considered as a major cereal crop in Egypt. The annual area cultivated by maize is estimated to be about 1.8 million feddans (feddan = 4200 m^2). The average production of grain yield per feddan is about 16.50 ardabs (one ardab = 150 kgs.). Maize is used primarily as a feed grain for human and livestock, but it is also the source of an increasing number of important industrial products. The local open pollinated cultivars occupy most of the maize area which are not high yielding cultivars. One of the outstanding approaches to increase the grain yield is the development of good high yielding hybrids, so the choice of parental lines in a hybrid corn programme is very important.

Evaluating plants for drought tolerance can be achieved by selecting plants possessing some desirable characteristics such as high yield components under water stress conditions. Moreover, the electrophoretic analysis can also be used for the discrimenation of the drought tolerant genotypes as it was used before cultivar and species identification (Bassiri, 1976; Bassiri and Rouhani, 1977; Abdel-Tawab and Rashed, 1985; Abdel-Tawab *et al.*, 1987 and Abouel-Khier, 1990).

The objectives of this study were:

1. To study the effect of drought on yield components and some morphological traits in different maize inbreds and their hybrids.

2. To estimate general and specific combining abilities of the inbred and their hybrids under water stress.

3. To obtain some biochemical genetic markers such as protein electrophoresis and some isozymes associated with the drought tolerant hybrids.

REVIEW OF LITERATURE

1. Drought tolerance:

Oleinikova *et al.* (1978) placed 136 evaluated lines of maize in four groups with respect to drought tolerance. Highly tolerant material included YuR612, VIR 38zm, VIR-116TUV, 7-116, 05, W59E, W537-7, W374, W153R, VIR11, YuR545, W153, W39 and A392.

Ordas (1978) identified 23 maize lines with some degree of tolerance to summer drought in two years. He selfed some varietal populations known to possess tolerance and crossed plants of the S2 with some of the tolerant lines. The resulting F_1 hybrids were compared in trials with experimental drought-tolerant hybrids from the USA and with some commercial hybrids commonly chosen for cultivation in dry environments. He also, showed that out of the five which gave the highest yields, three had one of the drought-tolerant S_2 lines as one parents. He found no relationships between the type of hybrids (single, double or three ways) and drought tolerance, or between grain protein content and drought tolerance.

Pinter *et al.* (1978) found that total soluble protein and free amino acid contents were correlated with strong drought tolerance in eight hybrids of maize. Moreover, free asparagine and proline contents were positively correlated with tolerance observed in the field.

Filippov and Vishnevsku (1979) studied varieties differing in drought tolerance in maize and found that the midseason Dnepr 320 AMV had the greatest water requirement. The closet in this respect to the standard variety, VIR 42 MV, were K rasnodar.436 M, Dnepr PG.27 and VIR.329. Under drought conditions, the highest yields were given by Krasnodar 436 M and VIR 42 MV.

Daynard and Baron (1980) confirmed that European maize (French) hybrids of the F_2 x F_7 (flint) type were, on average, superior in tolerance to high plant density and water stress than the Canadian varieties. They reported that moisture loss from grain and whole-plant forage occurred more slowly in European than Canadian hybrids, but some variation existed in the rate of grain drying among European hybrids.

Il'in (1980) studied the breeding of early maize hybrids in Siberia, some of the promising material produced including Omsk 22 and Kollektivnyl 220 (collective 220) were mentioned. He found useful breeding lines tolerant to lodging and drought, such as Om12, Om29, Om16, Om210 and Om212.

Kotova and Pyabtseva (1980) found that maize lines; VIR44, T13, T22, TS_2 and WH were drought tolerant throughout the growth period, but some lines were tolerant only at particular stages of growth. Some midearly lines formed two ears per plant even under soil moisture stress, notably VIR44, T13, T22, T70, S16, 15h, D-Ve19, KLS1, KS2 and KS6.

Milenin and Tarasov (1980) confirmed that maize hybrid Stavropol IMV showed high tolerance to drought, moderately tolerant to lodging and had good tolerance to low temperatures druing early developmental stages.

Fourie and Kuhn (1981) suggested that the Mexican cultivar Latente, although poorly adapted, was a promising source of drought tolerance using selection for drought survival under arid field conditions at Oudtshoorn among four groups of breeding maize materials. Adapted Oudtshoorn composite, subjected to mass selection for drought tolerance in 1977-79, exhibited good performance well. It was noted that root development option was poor in both GSS6 and Latente.

Seruguruka *et al.* (1981) cultivated 19 inbred lines and eleven hybrids of maize in the field at three irrigation levels. The use of an electrical conductivity test for leaf tissues showed significant differences among plant types in response to heat and water stress. They noted that a drought-heat tolerant line will not necessarily yield more under conditions of adequate moisture supply.

Tsalov (1981) studied four maize hybrids of different growth period under different densities and NPK regimes with and without irrigation. He found that irrigation increased yield by 30% in KWS713, 37% in Anjou 360, 48% in BC 66-25 and 51% in Knezha 2L611. Optimum stand density with irrigation was 8-10 x 10^3 plants/daa for early and midearly hybrids and 4000-6000 for midlate and late hybrids. Without irrigation the corresponding figures were 6000-7000 and 5000-6000, respectively. Choice of optimum stand density increased yield by 38% in KWS713, 31% in Anjou 360, 29% in BC 66-25 and 38% in Knezha 2L611.

Ali and Naidu (1982) found significant positive correlations between yield under water stress and plant height, leaf number, leaf area, ear number, ear length and girth, and 100 grain weight, for maize inbred lines, open-pollinated varieties, synthetics, composites and hybrids for 15 days at the flowering stage.

Fischer *et al.* (1982) described the drought tolerance of one lowland tropical maize population in a full-sib recurrent selection programe. They reported that after three cycles of recurrent selection the crop showed a significant increase in yield (= 8% per cycle) under severe drought conditions.

Hall *et al.* (1982) studied the effects of water stress (water was withheld until wilting) at the start of anthesis on the availability of pollen during the exposure of receptive silks in six maize cultivars. They showed considerable varibility between cultivars in the number of pollen grains produced per tassel, and water stress decreased the quantity of pollen grains produced.

Ackerson (1983) compared between the maize hybrids X.L62 AA, a drought tolerant commercial hybrid, and LH, an experimental hybrid derived from a cross of two latente parents in the responses of several physiological processes to water stress imposed at three stages of growth. He confirmed that LH had higher rates of photosynthesis than X.L62 AA at high leaf-water potentials, maintained higher contents of soluble sugars and starches in most cases, and accumulated ABA more rapidly to a greater extent. Differences in internal water relations between the hybrids were observed only during tassel emergence, LH exhibiting the higher turgor pressures. It was concluded that LH might represent an important source of germplasm for developing drought-tolerant hybrids.

Fischer *et al.* (1983) outlined current breeding strategies and screening techniques for drought tolerance in maize. Three cycles of recurrent selection in the lowland population Tuxpeno 1 have produced a significant increase in