INHERITANCE OF YIELD AND ITS COMPONENTS IN SOME BARLEY CROSSES

By

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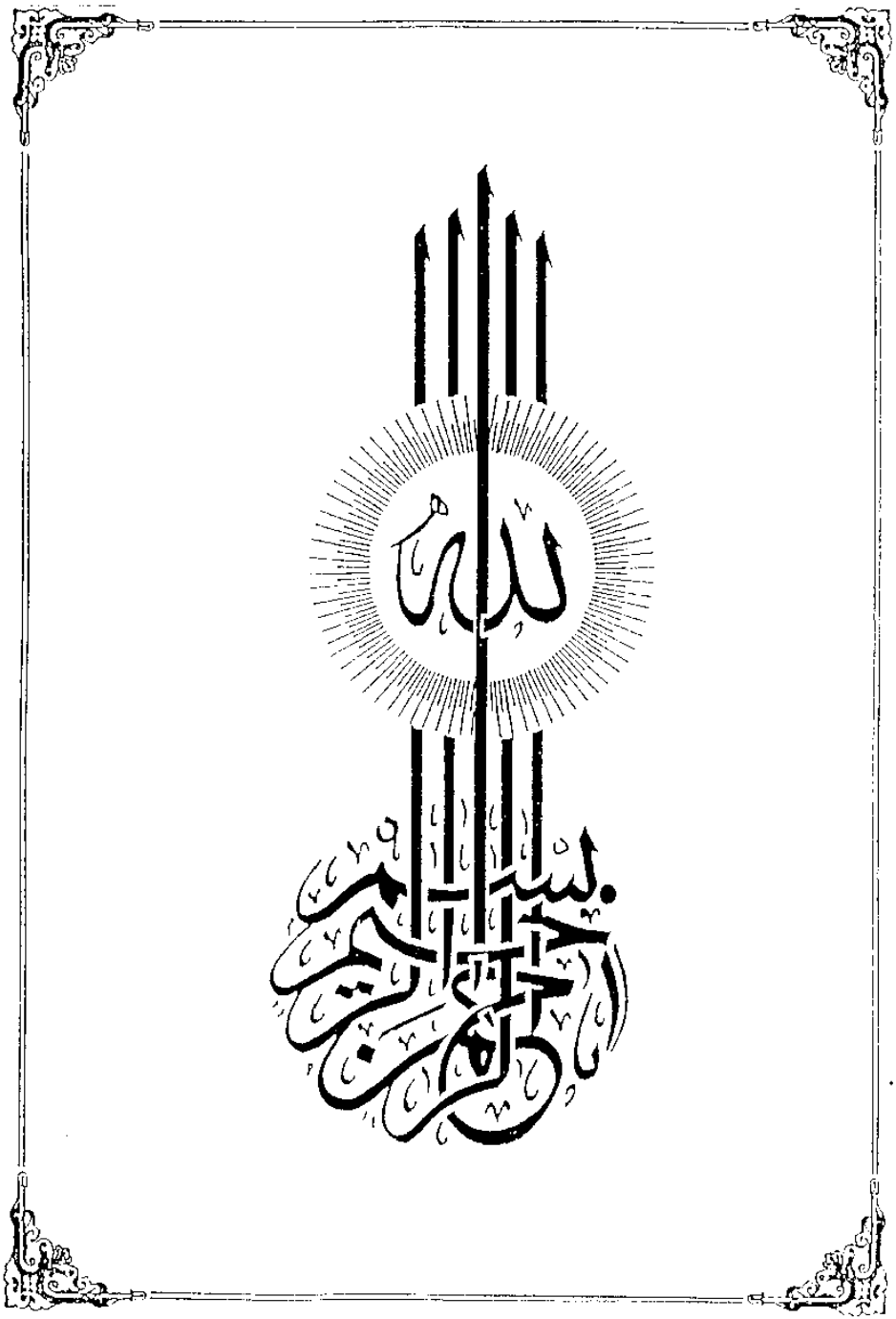

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ABSTRACT

This investigation aimed at evaluating effect of heterosis, combining abilities, type of gene action and interrelationships among yield and other plant characters in barley (*Hordeum vulgare* L.). Six parental varieties of six-rowed barley and their 15 F_1's, produced using diallel fashion in 1986/87 season, were evaluated for days to heading, plant height, flag leaf area, spike length, spikes/plant, 1000-kernel weight, kernels/spike, spike yield, grain protein content and grain yield/plant in 1987/88 season.

The results indicated that heterosis was generally pronounced for spike length, 1000-kernel weight, spike yield and grain yield/plant, whereas little or no heterotic effects were observed for the other studied traits. Parental average could be a good indicator of expected performance of a hybrid for days to heading, plant height, spike length, 1000-kernel weight and kernels/spike, whereas this relationship was not verified for the rest of studied characters.

General combining ability variances were significant for all traits except for grain yield/plant.Specific combining ability were significant for spike length, 1000-kernel weight, kernels/spike, spike yield, grain protein content and grain yield/plant. Estimation of genetic components of variation revealed that additive type of gene action was generally predominant for all studied traits except spikes/plant and grain yield/plant, where dominance effects were more important.

Screening parental lines for general combining ability could be based on *per se* performance for days to heading, plant height, spike length, 1000-kernel weight and kernels/spike, while it may be unfruitful for the other traits studied. High specific combining ability effects were usually associated with high performance for all characters except for days to heading, plant height, kernels/spike and spike yield.

The results indicated partial dominance for days to heading and plant height, complete dominance for spike length and 1000-kernel weight and overdominance for the rest of studied traits. Dominance was unidirectional taword increasing days to heading, plant height, 1000-kernel weight and grain yield/plant, whereas ambidirectional dominance was found for the rest of traits.

High estimates of narrow sense heritability were obtained for days to heading, plant height, spike length, kernels/spike and 1000-kernel weight, while intermediate values were observed for spike yield and flag leaf area. Low heritability was expressed by spikes/plant and grain yield/plant.

At both phenotypic and genotypic levels, grain yield/plant was positively correlated with spikes/plant, kernels/spike and spike yield, while negatively correlated with grain protein content. Among yield components, kernels/spike was highly and positively correlated with spike yield. Path coefficient analysis indicated that, at both phenotypic and genotypic levels, spike yield and spikes/plant had the greatest positive direct effects on plant yield, and that kernels/spike and kernel weight were the most contributing factors to spike yield..

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INTRODUCTION

Barley is the fourth cereal crop of the world in area sown. Barley has been grown under rainfed conditions and mainly on impoverished soils, although there are some areas where it is cropped under irrigation and moderately high fertilization. In Egypt, barley is considered one of the important winter cereal crops. About 118.000 feddan* of barley are grown under irrigation in the Nile Valley and Delta where it is used primarily for animal feed. In Sinai and the Northern West Coast Zone (estimated barley area is about 200.000 feddan), barley is the main cereal crop for human and animal consumption, and it is the the most important cereal adapted for production in these low rainfall areas (about 150 to 200 mm. annually).

Commercial hybrid barley production depends upon the degree of heterosis, frequencies of cross pollination, and availability of a practical system for inducing male sterility and (or) restoring fertility. Renewed interest in hybrid barley has recently developed because of a cytoplasmic male-sterile source found in *Hordeum spontaneum* (Ahokas, 1978). Moreover, fertility restoration of the *H.*

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* Source: Records of Statistics Section, Dep. of Ag. Econ., M.O.A., 1989.

spontaneum source of cytoplasmic male sterility has been reported (Ahokas, 1979). Male sterility has also been successfully induced by gametocide treatments (Foster, 1984). Breeding efforts to enhance cross-pollination in barley have been undertaken, and promising results have been reported (Foster and Fothergill, 1981). However, additional research is needed on methods for evaluating male steriles and fertility restorers, and on seed production potential and heterosis. Identification of parental lines with good general combining ability and high specific combinations which expressed high heterotic effects would be of great importance to hybrid production.

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 also useful for varietal improvement; including such lines in crossing programmes would give rise to desirable segregants. The development of a varietal improvement strategy should be also based upon the genetic information of heritability and type of gene action controlling yield and its components. 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

dominance 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.

Knowledge of nature and magnitude of interrelationships among yield and related attributes helps to improve the efficiency of selection by making possible the use of suitable selection criteria for improving yielding ability.

Therefore, the present investigation was undertaken to study effect of heterosis in F_1 hybrids, general and specific comining abilities, and type of gene action controlling grain yield, yield components and some other yield-related characters in a six-parental diallel cross of barley. Furthermore, interrelationships among yield and other plant characters were investigated through correlation and path coefficient analyses.

REVIEW OF LITERATURE

The review of literature of the study will be presented under the following headings:

I. Effect of heterosis.

II. Combining ability, gene action and heritability.

III. Interrelationships among yield and other plant characters.

I. Effect of heterosis:

The extent to which heterotic effect do occur in yield and its components in barley has been extensively investigated. Many reports have been published establishing the fact that heterosis in barley does occur with proper combination of cultivars, but there is also contradication among the workers with regard to the effect of heterosis in grain yield.

Pawlisch and Van Dijk (1965) observed heterosis for grain yield in four F_1 hybrids of barley with the hybrids yielding 37, 25, 8, and 25% more grain than their respective better parent. Two of the increases over better parent were statistically significant. One of these hybrids also significantly exceeded the highest yielding cultivar. The results also indicated that the particular components contributing to the increased yield were peculiar to the hybrid.

hybrid.

Upadhyaya and Rasmusson (1967) used eight parental varieties and their 28 possible F_1 hybrids to evaluate the expression of heterosis for yield and its components in barley. The average heterosis values based on mid-parent means for yield, kernel weight, kernels per head, heads per plant, and height were 21.5, 5.9, 7.1, 7.6, and 3.2%, respectively, being significant for all traits. Compared to better parent, the comparable estimates were 9.1, 1.4, -0.4, -3.1, and -2.4, respectively, being significant for yield, kernel weight and height. The yield of the best hybrid exceeded that of the highest two yielding cultivars, Liberty and Traill, by 22 and 38%, respectively. The results also indicated that performance per se can be used as basis for initial screening in evaluating potential parental varieties for use in a hybrid breeding program. The data indicated that heterosis for yield may or may not due to the interaction of yield components.

Carleton and Foote (1968) studied heterosis for yield and its components in twelve crosses of barley and reported that the average amount of heterosis, based on mid-parent values, for grain yield, heads per plant, kernels per head, kernel weight, and total leaf area were 1.o, 8.3, -30.5, 28.1, and -6.4%, respectively. None of the hybrids produced significantly more yield or kernels per head than better

parent. Only one and two hybrids produced significantly larger leaf area and more heads per plant than better parent, respectively. For kernel weight 10 out of 12 hybrids showed significant heterosis over better parent. The results also indicated the failure of component interaction to produce heterotic effects for grain yield. The negative correlation between kernels per head and kernel weight and the lack of additivity for kernels per head were determined as possible reasons for that failure.

Gebrekidan and Rasmusson (1970) found that 20 out of 27 hybrids of barley evaluated for heterosis exceeded their respective higher parents in yield, and 16 of them exceeded the highest yielding cultivar. Heterosis, on the better parent basis, ranged from -26 to 47%, with a mean of 11%. Four hybrids had a mean yield 17% higher than the highest yielding cultivar. High yielding cultivars produced a larger proportion of high yielding hybrids than did low yielding cultivars, whereas maximum heterosis occurred in crosses among low yielding cultivars. Heterosis, on the better parent basis, was negligible for heads per plant, kernels per head, kernel weight, plant height, and days to heading.

Yap and Harvey (1971) studied the expression of heterosis for yield and its components in barley under densely seeded and space planted conditions, and found that significant heterosis relative to better parent for yield and its components. was generally observed under densely seeded but