

SUMMARY

The aim of this investigation was to determine the extent of heterosis and combining ability estimates and their interactions with four nitrogen levels (four environmental conditions) for heading date, number of grains per spike, 1000 kernel weight, number of spikes per plant, grain yield per plant, plant height, straw yield per plant, biological yield per plant and leaf rust reaction, and susceptibility index for low nitrogen levels four grain, straw and biological yields. Also, path coefficient analysis was calculated for yield and some of its components on seven barley genotypes and their 21- hybrid.

Seven parental lines and/or varieties of barley (*Hordeum vulgare* L.), representing wide range of variability in most of the studied traits, were utilized. These lines and varieties were local pure line (P₁), Giza 123 (P₂), Giza 125 (P₃), Giza 121 (P₄), lines (P₅, P₆ and P₇) introduced from ICARDA. Crossing among the parental material by means of diallel system was initiated at 1994/95 season. In 1995/96 season, half diallel set of crosses involving seven parents and 21 F₁ hybrids were evaluated under four nitrogen levels as 0.0,30,45and 60 kg N/fed. respectively (N₁,N₂,N₃ and N₄) as urea 46.5% at four separate experiment. Each experiment included the seven parents and their twenty-one F₁ hybrids were sown on 18/12/1995 in the first season and 25/12/1996 in the second one. In 1996/97 season the same four experiments in the previous season was repeated. In both seasons each experiments was designed in randomized complete block design with three replications in the experimental farm at Sakha Agric.Res.Stn, Kafr El-Sheikh Governorate. In both seasons of evaluation i.e. 1995/96 and 96/97, each plot consisted of two rows, each row was 1.5-m long and 30-cm width plants within row were 15 cm apart. The dry method of planting was used in this concern. Field plots were

fertilized by 15 kg P_2O_5 / fed added before sowing. Nitrogen fertilization added in three times, the first was with sowing (25 % of total nitrogen), the second with first irrigation (37.5 % of total N) and the third with second irrigation (37.5 % of total N).

All other agricultural practices were carried out as usual in the conventional barley fields. Data were recorded on ten individual plants chosen at random from each plot except heading date and leaf rust reaction were determined on the main plot basis.

The results obtained can be summarized as follows: -

A- Yield and its components.

- 1-Nitrogen levels mean squares were significant for all the studied traits .In both seasons all traits, increased significantly with increasing nitrogen levels up to 60 kg /fed. Also, increased nitrogen fertilizer significantly increased susceptibility to leaf rust.
- 2-Significant genotypes mean squares were detected for all the studied traits in the separate nitrogen levels and their combined analysis except number of spikes per plant at N_1 , N_2 and N_4 as well as the combined analysis in the first season. Significant genotype x nitrogen level interaction mean squares were obtained for all traits.
- 3-The parental variety G 125 (P_3) gave the highest mean values for number of grains per spike, 1000 kernel weight, number of spikes per plant, grain yield per plant, plant height, straw yield and biological yield also, it was moderate for earliness and leaf rust resistance. The two parental lines (P_6 and P_7) behaved as the earliest and resistant for leaf rust.
- 4-The two crosses between P_3 (G. 125) and each of P_1 and P_5 had the highest grain yield per plant in each separate nitrogen levels as well as the combined analysis over them in both seasons.

- 5-Mean squares for parent vs. crosses as an indication to average heterosis overall crosses was of appreciable magnitude in the four fertilizer levels as well as their combined in separate season for all investigated traits except heading date at N_1 , N_2 and N_3 in the second season, number of grains per spike at N_4 in the first season and four N fertilizer levels as well as the combined analysis in the second season, 1000- kernel weight at N_1 and N_2 in the second season, number of spikes per plant and grain yield at N_1 in the second season, plant height at N_1 , N_2 , N_3 , N_4 as well as the combined analysis in the first season and N_3 in the second season, straw yield at N_2 , N_3 , N_4 and combined analysis in the second season, and biological yield at N_1 and N_3 in the second season.
- 6-Significant mean squares due to interaction between parents vs. crosses and nitrogen fertilizer were detected for all traits except heading date and number of grains per spike in second season and plant height in the first season.
- 7-The crosses ($P_1 \times P_2$), ($P_2 \times P_5$) and ($P_3 \times P_5$) gave the highest values of heterotic effects for grain yield per plant in the first season. Also, the cross ($P_2 \times P_3$) gave the highest negative heterotic effects relative to better parent followed by cross ($P_2 \times P_6$) for leaf rust reaction.
- 8-The mean squares associated with general and specific combining ability were significant for most cases. Also, the results showed that all traits expressed high GCA/SCA ratios, which exceeded the unity indicating the predominance of additive and additive by additive gene action in the inheritance of these traits.
- 9-The mean squares of interaction between nitrogen levels and both types of combining ability were significant for all traits except plant height in the first season which showed insignificant interaction between SCA and nitrogen fertilizer levels.

10-The parental varieties G.125 (P_3) seemed to be good combiner for number of kernels per spike, 1000- kernel weight, grain yield / plant, straw and biological yields for all nitrogen levels in both season. Also, it gave significant negative (g_i) effects for leaf rust reaction at N_2 , N_3 , N_4 and combined analysis in the second season.

11-The cross ($P_3 \times P_5$) had the highest positive (\hat{s}_{ij}) effects for grain yield at different nitrogen levels and the combined analysis in both seasons followed by cross ($P_2 \times P_5$). Also, the five crosses ($P_1 \times P_5$), ($P_1 \times P_7$), ($P_2 \times P_3$), ($P_2 \times P_6$) and ($P_5 \times P_6$) gave significant negative (\hat{s}_{ij}) effects for all nitrogen levels and the combined analysis for leaf rust disease .

B-Susceptibility index :-

1-Season mean squares were insignificant for the three studied (grain, straw and biological yields).

2-Mean squares of genotypes and its components, parents and hybrids and interaction between genotypes and season for fertilizer SI (FSI) were significant for the three traits.

3-The parental variety P_3 (G. 125) gave the desirable (FSI) for grain, straw and biological yields. Also, the best cross was ($P_1 \times P_3$) followed by cross ($P_3 \times P_5$) and then by cross ($P_2 \times P_3$) for (FSI) of biological yield per plant . While the crosses ($P_1 \times P_3$), ($P_3 \times P_5$), and ($P_2 \times P_3$) for (FSI) of grain and straw yields gave low (FSI).

4-The three Crosses ($P_1 \times P_5$), ($P_2 \times P_5$) and ($P_2 \times P_7$) exhibited significant negative heterotic effects relative to better parent for (FSI) of straw and biological yield, Also, the four crosses ($P_1 \times P_5$), ($P_1 \times P_6$), ($P_2 \times P_6$) and ($P_5 \times P_6$) exhibited significant negative heterotic effects relative to better parent in the first season for (FSI) of grain yield.

5-The variance associated with general and specific combining ability were significant for (FSI) in the three traits. High GCA/ SCA ratios than unity were obtained for the three traits. Also, the mean squares of interaction between season and specific combining ability were significant for (FSI) of the three traits.

6-The parental variety (P3) G. 125 seemed to be the best combiner for (FSI) in the three characters studied. While, the crosses ($P_1 \times P_6$), ($P_2 \times P_3$), ($P_2 \times P_4$), and ($P_5 \times P_6$) in the first season, gave significant negative (\hat{S}_{ij}) effects for (FSI) of grain yield.

C-Association studied

1-Significant positive phenotypic correlation values were detected between grain yield per plant and each of heading date, number of grains per spike, 1000- kernel weight, number of spikes per plant, plant height, straw and biological yields at four N- levels as well as the combined analysis, except for correlation values between grain yield and heading date at N_2 in the second season and leaf rust at four nitrogen levels and the combined in the second season.

2-Based on path coefficient analysis, the most important sources of variation in plant yield were: 1) indirect effect of number of spikes through 1000-kernel weight at the four nitrogen levels in both season ,2) direct effect of 1000- kernel weight at the four nitrogen levels in both seasons except at 60 kg N/ fed. in the first season,3) The direct effect of number of grains per spike in most cases and 4) The direct effect of number of spikes per plant at N_1 (zero N- level) in both seasons and N_2 in the second season.