

SUMMARY

This study investigated the extent of heterosis, combining ability and their interactions with three nitrogen levels (as three different environmental conditions) and genetic components in sunflower (*Helianthus annuus*, L.) for flowering date, plant height, number of leaves/ plant, head diameter, 100- seed size, number of seeds/ head, 1000- seed weight, husk percentage, seed yield per plant and oil percentage. Path coefficient analysis for seed yield, were also calculated. The seven inbred lines in this study were derived from Giza- 1 (P1), Introduced 30 (P2), Peredovic (P3), Raistra 70 (P4), CR2 (P5), IH10 (P6) and CHO (P7) after ten selfed generations. These parents were chosen to represent a wide range of variability in most of the studied traits (oil percentage, yield and certain other agronomic characters). In 1993 season, these inbred lines were sown and crossed in all possible combinations without reciprocals to obtain seeds of 21 crosses. In 1994 season, three adjacent experiments were fertilized by 20, 30 and 40 kg N/ fed., respectively. Each experiment, the parental inbred lines and their 21 F₁ hybrids and three hybrids of sunflower (Hysun 354, G 101 and Vidoc) were grown in a randomized complete block design with three replications. Each plot consisted of two ridges without separation between plots, 4 meters long and 60 cm apart. Seeds were sown in hills of 25 cm within ridge.

Data were recorded on seven to ten individual guarded plants chosen at random from each plot in each fertilization experiment, except flowering date, oil and husk percentages which were determined on the

mean plot basis. The analysis of variance was performed for the studied traits in each experiment and then a combined analysis was carried out whenever, homogeneity of error variance was realized. Heterosis was computed as the percentage deviations of F_1 mean performance from mid and/ or better parent also, from the yield of the three hybrids for individual crosses. The data were genetically analyzed by the procedures developed by Griffing (1956), Hayman (1954 a, b) and Jinks (1954).

The results obtained can be summarized as follows:

- 1- Nitrogen levels mean squares were significant for all the studied traits.
- 2- Significant genotype mean squares were detected for all the studied traits in the separate nitrogen levels and their combined analysis. Insignificant genotype x nitrogen level interaction mean squares were obtained for all traits.
- 3- Mean squares for parents vs crosses were of appreciable magnitudes in separate experiments as well as the combined data for all cases except flowering date, plant height, number of leaves per plant and seed yield per plant traits. An insignificant interaction between parent vs crosses and nitrogen levels mean squares was detected for all the studied traits. The cross ($P_1 \times P_4$) in the combined analysis showed high significant heterotic effects relative to better parent for seed yield per plant. Also the crosses ($P_1 \times p_2$), ($P_1 \times P_4$) and ($P_1 \times P_7$) had significant heterotic effects relative to the better parent for oil percentage in the combined data. Also, these crosses were the

most evident for heterosis estimates in this study for most traits. The cross (P1 x P4) significantly out-yielded by 57.03, 30.3 and 41.54 % when compared with the three hybrids Hysun, G 101 and Vidoc, respectively. Also, the two crosses (P1 x P2) and (P1 x P7) significantly out-yielded the check hybrids Hysun by 37.72 and 35.90 %, G 101 by 14.28 and 12.77 % and Vidoc by 24.13 and 22.49 %, respectively, in the combined analysis.

- 4- The mean squares associated with general and specific combining abilities were significant for all traits except number of leaves/ plant at the 40 kg N/ fed. which showed an insignificant S.C.A. It is evident that additive and additive by additive types of gene action were the more important part of the total genetic variability for this exceptional case. For other cases, both additive and non additive genetic effects were involved in determining the performance of single cross progeny. Also, the results revealed that all other cases exhibited high GCA/ SCA ratios which exceeded the unity indicating the predominance of additive and additive by additive gene action in the inheritance of such cases. The same conclusion was detected by genetic component analysis.
- 5- The mean squares of the interaction between nitrogen levels and both types of combining ability were non significant for all traits, revealing that additive and non additive effects were not influenced by the environmental conditions. (nitrogen levels).
- 6- The parental inbred lines No. P6, P5, P1, P1, P2, P1, P2, P5, P1 and P4 appeared to be the best general combiners for number of days to

- flowering, plant height, number of leaves per plant, head diameter, 100- seed size, number of seeds per head, 1000- seed weight, husk percentage, seed yield per plant and oil percentage, respectively.
- 7- The two crosses (P1 x P4) and (P1 x P7) produced the highest desirable S.C.A effects for seed yield/ plant. Also, the cross (P1 x P7) had the highest S.C.A. effects for oil percentage followed by both crosses (P1 x P6) and (P1 x P2).
 - 8- Studies on degree of dominance revealed the existence of overdominance for flowering date, number of leaves per plant, number of seeds per head and seed yield/ plant in the three nitrogen levels. Meanwhile, the complete dominance was present for head diameter, and oil percentage in the three nitrogen levels and husk percentage in the first and third nitrogen levels. The partial dominance was detected for other cases.
 - 9- High to moderate values for heritability in broad sense were obtained in all traits, i.e. for number of days to flowering, number of leaves per plant, head diameter and number of seeds per plant in the three nitrogen levels, and 100- seed size in the first level of nitrogen, values of heritability of narrow sense were much lower than those of broad ones. For other cases, high heritability values in broad sense along with moderate ones in narrow sense were detected.
 - 10- The parental inbred lines (P6) and (P7) for flowering date and plant height in the three nitrogen levels, (P1) for number of leaves per plant in the three nitrogen levels and 100- seed size in the second nitrogen level, (P7) for husk and oil percentages in the three levels of nitrogen, (P5) for seed yield in the three nitrogen levels seemed to

be carry most of dominant genes that responsible for these traits. However, (P5) for flowering date, number of leaves per plant, husk percentage, and head diameter in the three nitrogen levels and number of seeds/ head in the second and third nitrogen levels, (P1) for oil percentage and (P2) and (P4) for seed yield/ plant in the three nitrogen levels possessed more recessive genes for the previous traits.

- 11- Significant positive correlation values were obtained between seed yield per plant and each of plant height, number of leaves per plant, head diameter, 100-seed size, 1000- seed weight and number of seeds per head in the three separate levels of nitrogen. Based on path coefficient analysis, the most important sources of variation in plant yield were the direct effect of 1000- seed weight and number of seeds per head at the three nitrogen levels.