Breeding studies on sunflower (Helianthus annuus, L.)

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SUMMARYThis study investigated the extent of heterosis, combining abilityand their interactions with three nitrogen levels (as three differentenvironmental conditions) and genetic components in sunflower(Helianthus annuus, L.) for flowering date, plant height, number ofleaves/ plant, head diameter, 100- seed size, number of seeds/ head,1000- seed weight, husk percentage, seed yield per plant and oilpercentage. Path coefficient analysis for seed yield, were also calculated.The seven inbred lines in this study were derived from Giza- 1 (PI),Introduced 30 (P2), Peredovic (P3), Raistra 70 (P4), CR2 (P5), nno (P6)and CHO (P7) after ten selfed generations. These parents were chosen torepresent a wide range of variability in most of the studied traits (oilpercentage, yield and certain other agronomic characters). In 1993season, these inbred lines were sown and crossed in all possiblecombinations without reciprocals to obtain seeds of 21 crosses. In 1994season, three adjacent experiments were fertilized by 20,30 and 40 kg N/fed., respectively. Each experiment, the parental inbred lines and their 21Fl hybrids and three hybrids of sunflower (Hysun 354, G 101 and Vidoc)were grown in a randomized complete block design with threereplications. Each plot consisted of two ridges without separationbetween plots, 4 meters long and 60 em apart. Seeds were sown in hillsof25 em within ridge.Data were recorded on seven to ten individual guarded plantschosen at random from each plot in each fertilization experiment, exceptflowering date, oil and husk percentages which were determined on themean plot basis. The analysis of variance was performed for the studiedtraits in each experiment and then a combined analysis was carried outwhenever, homogeneity of error variance was realized. Heterosis wascomputed as the percentage deviations of F1 mean performance from midand! or better parent also, from the yield of the three hybrids forindividual crosses. The data were genetically analyzed by the proceduresdeveloped by Griffing (1956), Hayman (1954 a, b) and Jinks (I 954).The results obtained can be summarized as follows:1- Nitrogen levels mean squares were significant for all the studiedtraits.2- Significant genotype mean squares were detected for all the studiedtraits in the separate nitrogen levels and their combined analysis.Insignificant genotype x nitrogen level interaction mean squareswere obtained for all traits.3- Mean squares for parents vs crosses were of appreciable magnitudesin separate experiments as well as the combined data for all casesexcept flowering date, plant height, number of leaves per plant andseed yield per plant traits. ~ itsignificant interaction betweenparent vs crosses andnitrogen levels meansq~ was detected forall the studied traits. The cross (PI x P4) in the combined analysisshowed high significant heterotic effects relative to better parent forseed yield per plant. Also the crosses (PI x p2), (PI x P4) and (PIx P7) had significant heterotic effects relative to the better parent foroil percentage in the combined data. Also, these crosses were themost evident for heterosis estimates in this study for most traits. Thecross (pI 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 (PI x P2) and (PI x P7)significantly out-yielded the check hybrids Hysun by 37.72 and35.90 %, G 101 by 14.28 and 12.77 % and Vidoc by 24.13 and22.49 %, respectively, in the combined analysis.4- The mean squares associated with general and specific combiningabilities were significant for all traits except number of leaves/ plantat the 40 kg N/ fed. which showed an insignificant S.C.A. It isevident that additive and additive by additive types of gene actionwere the more important part of the total genetic variability for

thisexceptional case. For other cases, both additive and non additivegenetic effects were involved in determining the performance ofsingle cross progeny. Also, the results revealed that all other casesexhibited high GCA/ SCA ratios which exceeded the unityindicating the predominance of additive and additive by additivegene action in the inheritance of such cases. The same conclusionwas detected by genetic component analysis.5- The mean squares of the interaction between nitrogen levels and bothtypes of combining ability were non significant for all traits,revealing that additive and non additive effects were not influencedby the environmental conditions. (nitrogen levels).6- The parental inbred lines No. P6, P5, PI, PI, P2, PI, P2, P5, PI andP4 appeared to be the best general combiners for number of days toflowering, plant height, number of leaves per plant, head diameter,1OO~seed size, number of seeds per head, IOOO~seed weight, huskpercentage, seed yield per plant and oil percentage, respectively.7- The two crosses (pI x P4) and (pI x P7) produced the highestdesirable S.C.A effects for seed yield! plant. Also, the cross (PI xP7) had the highest S.C.A. effects for oil percentage followed byboth crosses (PI x P6) and (PI x P2).8- Studies on degree of dominance revealed the existence ofoverdominance for flowering date, number of leaves per plant,number of seeds per head and seed yield! plant in the three nitrogenlevels. Meanwhile, the complete dominance was present for headdiameter, and oil percentage in the three nitrogen levels and huskpercentage in the first and third nitrogen levels. The partialdominance was detected for other cases.9- High to moderate values for heritability in broad sense were obtainedin all traits, i.e. for number of days to flowering, number of leavesper plant, head diameter and number of seeds per plant in the threenitrogen levels, and 100- seed size in the first level of nitrogen,values of heritability of narrow sense were much lower than those ofbroad ones. For other cases, high heritability values in broad sensealong with moderate ones in narrow sense were detected.10- The parental inbred lines (P6) and (P7) for flowering date and plantheight in the three nitrogen levels, (PI) for number of leaves perplant in the three nitrogen levels and 100- seed size in the secondnitrogen level, (P7) for husk and oil percentages in the three levelsof nitrogen, (P5) for seed yield in the three nitrogen levels seemed tobe carry most of dominant genes that responsible for these traits.However, (P5) for flowering date, number of leaves per plant; huskpercentage, and head diameter in the three nitrogen levels andmunber of seeds/ head in the second and third nitrogen levels, (PI)for oil percentage and (P2) and (P4) for seed yield! plant in the threenitrogen levels possessed more recessive genes for the previoustraits.11- Significant positive correlation values were obtained between seedyield per plant and each of plant height, number of leaves per plant,head diameter, IOO-seed size, 1000- seed weight and number ofseeds per head in the three separate levels of nitrogen. Based onpath coefficient analysis, the most important sources of variation inplant yield were the direct effect of 1000- seed weight and number ofseeds per head at the three nitrogen levels.