SUMMARY

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The aim of this investigation was to determine the heterosis and types of gene action and their interaction with sowing dates (Environments) for some growth and yield characteristics, i.e. flowering date, maturity date, first pod height, plant height, number of branches/plant, number of pods/plant, number of seeds/plant, 100-seed weight and seed yield/plant. To achieve this target F_1 and F_2 of half diallel cross between six parental varieties and/or lines namely P_1 (Clark), P_2 (Giza 83), P_3 (Ware), P_4 (Holladay), P_5 (L86-k-73) and P_6 (H_2L_{12}) representing wide range of variability in most of the studied traits were utilized.

In 1998 season, crossing was made with all possible combinations among the six parental and evaluated in successive season 1999 in a randomized complete block design with three replications. In 2000 season, two experiments were conducted, the first involved the parents and their fifteen possible crosses and the second included parents and F_2 crosses. In each generations (F_1 and F_2) two adjacent experiments (early and late of sowing date) were conducted in a randomized complete block design with three replications.

Data were recorded on 10 and 30 individual guarded plants, chosen at random from each plot for F_1 and F_2, respectively. Analysis of variance was performed for the studied traits in each planting date and then a combined analysis was carried out whenever homogeneity of error variance was realized. Heterosis mean squares and effects for both generations were calculated.

The data were genetically analyzed by the procedures by Griffing (1956), Hayman (1954) and Jinks (1954).

The obtained results can be summarized as follows :

1. Analysis of Variance, Mean and Heterosis :

A. F_1 generation :

1- Planting date mean squares were highly significant for all studied attributes.

2- Genotypes mean squares reached the significance level of probability for all traits in both planting dates as well as the combined analysis. Significant genotypes by planting dates were detected for all the studied traits.

3- Mean squares due to parents were highly significant for all cases except number of branches/plant and seed yield/plant in the late of planting date. Whereas, significant mean squares due to interaction between parental genotypes and planting dates were obtained for all the studied traits except number of branches/plant.

4- Line L86-k-73 and Giza 83 gave the lowest values of number of days to flowering and maturity in the two planting dates and the combined data. However Holladay and H_2L_{12} gave the latest at flowering and maturity in the two planting dates and the combined data. Giza 83 and H_2L_{12} gave the highest values of number of pods/plant, number of seeds and seed yield/plant in both planting dates as well as the combined analysis.

5- Crosses mean squares were highly significant for all the studied traits in the separate planting dates as well as the combined data. While, significant mean squares due to interaction between F_1 hybrids and planting dates for all the studied traits. The cross (P_2xP_4) significant surpassed the other hybrids for grain yield/plant in the late sowing date as well as the combined analysis.

6- Mean squares for parents vs. crosses were of appreciable magnitude in both sowing dates as well as their combined for all investigated traits except maturity date, first pod height and plant height in late sowing date and 100-seed weight in the combined analysis. For maturity date, the crosses (P_1xP_6), (P_1xP_3), (P_2xP_3), (P_2xP_5) and (P_2xP_6) expressed significant negative heterotic effects relative to better parent, whereas these crosses gave significant positive heterotic effect for seed yield/plant.

B. F_2 generation :

1- Highly significant genotypes mean squares were detected for all studied attributes in both planting dates as well as the combined data. Significant genotypes by planting dates were detected for all traits except number of branches and number of seeds/plant. Significant mean squares due to parents for all the studied traits except for first pod height and yield/plant at late planting date and number of branches/plant at early planting date and the combined analysis. Mean squares due to crosses were significant for all the studied traits except for number of branches/plant at early planting date.

2- Mean square for parents vs. crosses as an indication of average remain heterosis of overall crosses was significant for all the studied traits except number of pods and seeds/plant and seed yield/plant in both sowing dates and the combined analysis, maturity date and 100-seed weight in early and late sowing dates, respectively.

2. Combining Ability :

A. F_1 generation :

1- The mean squares associated with general and specific combining ability were highly significant in all cases. High GCA/SCA ratios which largely exceed the unity were obtained in flowering and maturity dates, first pod height and 100-seed weight in both sowing dates as well as the combined data and plant height at late of sowing date and the combined analysis, indicating that the largest part of the total genetic variability associated with those cases under both environments was a result of additive and additive by additive gene action. For the other traits, however non-additive type of gene action seemed to be more prevalent.

2- Highly significant GCA by sowing dates and SCA by sowing dates mean squares were obtained for all the studied traits.

3- The parental variety Clark (P_1) gave significant negative (g_i) effects for maturity and flowering dates and the high of first pod. The parental variety Giza 183 (P_2) ranked the second good combiner after L86-k-73 (P_5) for earliness (flowering and maturity dates) and first of pod height in both planting dates as well as the combined analysis. Also, it gave significant positive (g_i) effects for plant height, number of pods/plant, seeds and seed yield/plant at both sowing dates as well as the combined analysis. The parental variety Ware (P) exhibited significant desirable (g_i) effects for 100-seed weight in both planting dates as well as the combined analysis. The parental variety Holladay (P_4) expressed significant positive (g_i) effects for number of branches, pods, seeds and seed yield/plant and 100-seed weight at both planting dates as well as the

combined analysis. The parental line H_2L_{12} (P_6) expressed significant desirable (g_i) for higher plant only.

4- The crosses (P_2xP_4) and (P_4xP_5) for flowering date and the crosses (P_1xP_5), (P_1xP_6), (P_2xP_5) and (P_2xP_6) for maturity date gave significantly negative (S_{ij}) effects. Also, the crosses (P_1xP_6), (P_2xP_5) and (P_2xP_6) exhibited significantly negative (S_{ij}) effects for first pod height. The parental combinations (P_1xP_6) and (P_2xP_3) expressed significantly positive (S_{ij}) effects for number of pods and seeds/plant and seed yield/plant in both sowing dates and the combined analysis.

B. F_2 generation :

1- The mean squares associated with general combining ability and specific combining ability were significant for all traits except for GCA mean squares in early planting date for number of branches/plant. GCA/SCA ratios were higher in magnitude in F_2 than F_1 generation for most traits.

2- The parental variety Clark (P_1) gave significant desirable (g_i) effects for earliness (flowering and maturity dates) and plant height. While the parental variety Giza 83 (P_2) gave significant desirable (g_i) effects for maturity date, first pod height, plant height, number of pods/plant and number of seeds/plant. The parental variety Ware (P_3) gave significant desirable (g_i) effects for flowering date, first pod height, number of branches/plant, and 100-seed weight. The parental variety Holladay (P_4) showed significant positive (g_i) effects for number of branches/plant, number of pods/plant, 100-seed weight and seed yield/plant. The parental line L86-k-73 (P_5) seemed to be good combiner for earliness. The parental line H_2L_{12} (P_6) gave significant positive (g_i) effects for plant height, number of pods/plant, number of seeds/plant and seed yield/plant.

3- The cross (P_1xP_4) had the best desirable (S_{ij}) effects for flowering date. The crosses (P_1xP_5), (P_1xP_6), (P_2xP_5) and (P_2xP_6) had significant negative (S_{ij}) effects for maturity date in both sowing dates as well as combined analysis. The crosses (P_1xP_4), (P_3xP_5) and (P_3xP_6) were significant positive (S_{ij}) effects for seed yield/plant in early planting date and the combined analysis, and the crosses (P_1xP_6), (P_2xP_4) and (P_3xP_4) in late planting exhibited significant positive (S_{ij}) effects.

3. Genetic Components :

A. F_1 generation :

1- Significant values for the additive component (D) were detected for all the studied traits except for maturity date, first pod height and seed yield/plant in the late sowing date, and number of branches/plant in the early sowing date. While, significant values for dominance component (H_1) were obtained for all the studied traits.

2- The relative size of (D) and (H) estimated as $(H_1/D)^{1/2}$ can be used as a weighted measure of the average of dominance for all traits except 100-seed weight in both sowing dates. While, significant values for dominance component (H_1) were obtained for all the studied traits.

3- The average of dominance at each locus, showed the presence of over-dominance for all traits except 100-seed weight in both sowing dates.

4- The average frequency of negative vs. positive alleles in parental populations was detected by computing the ratio ($H_2/4H_1$). Values largely deviating from one quarter were obtained for all traits except seed yield/plant, number of branches, number of pods and seeds/plant.

5- Significant of dominance and recessive alleles (F) in the parental population were detected in all traits except seed yield, number of branches, pods and seeds/plant.

6- Significant (h^2) values were detected for all traits except maturity date, first pod height and plant height in the late sowing date .

7- Low heritability values in narrow sense were detected for all traits except for flowering date and 100-seed weight in both planting dates and maturity date in early sowing date.

B. F_2 generation :

1- The additive component (D) reached the significant level for all the studied traits except for number of branches/plant in early sowing date. While, significant values for dominance component (H_1) were obtained for all the studied traits.

2- The positive and negative alleles were not equally distributed among the parent for maturity date, number of pods/plant, number of seeds and seed yield/plant in both planting dates, first pod height, plant height and 100-seed weight in early planting date, and flowering date and number of branches/plant in the late of planting date.

3- Significant (h^2) values were detected for all traits except number of pods/plant, number of seeds/plant and seed yield/plant in both planting dates, maturity date in late sowing date and number of branches/plant in early sowing date.

4- Low heritability values in narrow sense were detected for all traits except 100-seed weight in both planting dates and maturity date in the early sowing date which moderate values were detected.

4. Graphical Analysis :

A. F_1 generation :

1- The regression line was found to pass through the origin in case of maturity date in early sowing date, and number of seeds/plant and seed yield/plant in both planting dates, revealing the presence of complete dominance. Meanwhile, it intersects the (Wr) axis below the origin for flowering date, first pod height, plant height, number of branches/plant in both planting dates and maturity date in late sowing date, reflecting over-dominance.

2- The correlation coefficient values between parental mean (Yr) and (Wr+Vr) for each array were significant negative for plant height, number of branches/plant and number of seeds/plant in the early planting date, revealing that increasers genes were dominant over decreasers. High and significant positive correlation coefficient values were detected for 100-seed weight in the early sowing date, indicating that decreasers genes were dominant over increasers.

3- The parental varieties (P_1) Clark and (P_2) Giza 83 in early and late sowing dates contained the most recessive genes. While, the parental line H_2L_{12} (P_6) seemed to carry the most dominant genes in both planting dates.

B. F_2 generation :

1- The regression lines were found to intersect the (Wr) axis below the origin for all the studied traits except 100-seed weight in both planting dates and maturity date in early sowing date, suggesting over-dominance.

2- The correlation coefficient value between parental mean (Yr) and (Wr+Vr) for each array were significant negative for plant height in both planting date, number of seeds and seed yield/plant in late sowing date and first pod height and maturity date in early sowing date, revealing that increasers genes were dominant over decreasers. High and significant positive correlation coefficient values were detected for flowering date and 100-seed weight in late sowing. For other cases insignificant correlation values were detected.

3- The parents possessed the most recessive genes and parents contained the most dominant genes in the F_2 was coincided with that reached before in the F_1 in most traits.