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SUMMARY AND CONCLUSION

The present investigation was carried out at El-Mattana Agric. Res. Station, Agric. Res. Center, Egypt, during, 2004/05 and 2005/06 seasons to study :(i) the relative importance of heterosis and heat tolerance for some agronomic traits in bread wheat under different planting dates. (ii) the relative importance of general and specific combining ability for morphophysiological, characters, yield and its components under recommended and late planting dates. (iii) the nature of genetic system and heritabilites for morphophysiological traits, yield and its components in bread wheat under recommended and late planting dates.

The materials used for this investigation were eight bread wheat varieties varied in origin and are widely different in agronomic characters.

In 2004/2005 season these genotypes were crossed in all possible combinations excluding reciprocals. The eight parents and their 28 F_1 hybrids are sown in season 2005/2006 in two experiments under two planting dates. The first was sown on 25th of November (recommended date), while the second was sown on 25th of December (late planting). A randomized complete blocks design with three replications was used. The experimental plot consisted of one row, 3m along and 30cm apart between rows with 15 cm between plants within row.

The studied characters included days to heading, maturity date, plant height, grain filling period, number of spikes/plant, spike length, number of kernels/spike, grain production rate, 1000-kernel weight, and grain yield/plant.

The results obtained from the present study are summarized in the following:

A- Performance of wheat genotypes:-

Analysis of variance revealed highly significant differences among genotypes, parents and F_1 crosses for all traits under both planting dates.

Parents vs. crosses mean squares as an indication to average heterosis over all crosses were found to be highly significant for heading date, maturity date, plant height, grain filling period, number of kernels/spike, 1000-kernel weight, and grain yield/plant under both planting dates, while it was highly significant under late planting date only for grain production rate.

Combined analysis for the two planting dates revealed highly significant differences among genotypes for all traits under study. Moreover, mean square due to parents as well as F_1crosses exhibited highly significant differences for all traits. Considerable and significant heterotic effects were detected for all traits except number of spikes/plant and grain yield/plant. The variance due to interaction between genotypes and dates was significant for all traits under study, except plant height and 1000-kernels weight. Parents x dates interaction variance was highly significant for all traits under study, except number of kernels/spike. The variance due to interaction between crosses x dates was highly significant for all studied traits, except plant height, spike length and 1000-kernels weight while, the variance due to interaction between heterosis x dates was highly significant for maturity date, grain filling period, grain production rate and grain yield/plant.

The best parents for the two planting dates were (P_3) and (P_8) for heading, maturity and plant height, (P_4) for grain filling period, (P_1) and (P_2) for number of spikes/plant, (P_6) and (P_8) for spike length, (P_7) and (P_8) for number of kernels/spike, (P_2) for grain production rate, (P_5) for 1000-kernel weight and (P_2) for grain yield/plant.

The promising crosses in mean performance under the two planting dates were (P_2 x P_8) and (P_5 x P_8) for heading dates, (P_1 x P_8) and (P_5 x P_8) for maturity date, (P_3 x P_7) and (P_3 x P_4) for plant height, (P_2 x P_4) for grain filling period, (P_1 x P_2) for number of spikes/plant, (P_3 x P_8) and (P_4 x P_8) for spike length and (P_6 x P_8) and (P_5 x P_8) for number of kernels/spike.

Results showed that means of all studied traits were significantly high in the recommended planting date when compared to the late planting. Late planting reduced days to heading, maturity date, plant height, grain filling period, number of spikes/plant, spike length, number of kernels/spike, grain production rate, 1000-kernel weight and grain yield/plant by 4.32, 13.26, 6.68, 25.12, 52.75, 2.48, 5.31, 21.43, 3.49 and 40.06 %, respectively compared with the recommended planting date.

B: - Heterosis:-

1- Number of spikes/plant:-

It ranged from -68.65 for cross (P_5×P_8) to 5.58 % for cross (P_3×P_4) and from -42.33 for crosses (P_2×P_4) and (P_2×P_8) to 40.00 % for cross (P_3×P_8) under recommended and late planting dates, respectively. Positive and significant or highly significant heterosis was found for (P_3 x P_8) and (P_5 x P_7) hybrids under late planting date. The simple correlation coefficients between significant SCA values and heterosis accounted for 0.753^{**} and 0.800^{**} under recommended and late planting dates, respectively.

2- Spike length:-

Crosses (P_2 x P_3), (P_3 x P_4) and (P_3 x P_5) showed positive and significant better parent heterosis values under recommended date. Meanwhile, the cross (P_3 x P_6) showed positive and significant heterotic effect under late planting date. The simple correlation coefficients between significant SCA values and heterosis accounted for 0.731^{**} and 0.792^{**} under recommended and late planting dates, respectively.

3- 1000-kernel weight:-

Eleven and six crosses expressed significant and positive heterotic effect relative to better parent under recommended and late planting dates, respectively. The highest positive heterosis values was recorded for the hybrids (P_1×P_8), (P_2×P_3), (P_3×P_4) and (P_4×P_8) under the recommended planting date.

Meanwhile, it was recorded for (P_1×P_3), (P_1×P_8), (P_2×P_3) and (P_3×P_4) under late planting date.

4-Grain yield /plant:-

Positive and significant heterosis was found for (P_1 x P_3), (P_4 x P_7) and (P_5 x P_7) hybrids under recommended date. While, was found for (P_3 x P_8) hybrid which exhibited sizeable and positive significant heterosis under both planting dates. Simple correlation coefficients between significant SCA values and heterosis accounted for 0.827^{**} and 0.796^{**} under recommended and late planting dates, respectively.

C: - Heat Susceptibility index: -

The calculated heat susceptibility index (HSI) for 1000-kernel weight revealed that (P_3), (P_6), and (P_8) were relatively heat tolerant. The crosses (P_1×P_3) and (P_3×P_8) which gave the heaviest kernels weight under both planting dates showed heat susceptibility index less than one could be considered promising hybrids, and selection for heat tolerance could be feasible in its segregating generations. On the other hand results showed that 15 crosses were relatively stress heat tolerant. For grain yield/plant the results showed that (P8) was the most tolerant parent since it has the least values of (HSI). However, (P_1), (P_2), (P_3), (P_4), (P_5), (P_6) and (P_7) were moderately tolerant to heat stress. The crosses (P_3×P_6) and (P_6×P_8) which gave the high yield under the two planting dates, showed heat susceptibility index (HSI) less than one.

D: - Combining ability:

General and specific combining ability variances were highly significant for all studied traits under both planting dates. Wide range of GCA/SCA ratios was found for most studied traits, indicating that additive genetic effects were predominant and played a major role in the inheritance of nearly all studied traits. The interaction between dates and both types of combining ability were significant for all traits, except GCA x dates interaction for plant height, number of kernels/spike and 1000-kernel weight.

1- Heading date: -

The parents (P_3), (P_7) and (P_8) showed the highest significant and negative values of general combining ability under recommended date, while (P_3) and (P_8) exhibited negative and highly significant g.c.a. under late planting date. The crosses (P_1 x P_3), (P_1 x P_7), (P_2 x P_3), (P_2 x P_7), (P_3 x P_4), (P_4 x P_6), (P_5 x P_7), (P_2 x P_8) and (P_6 x P_8) showed the highest negative values of specific combining ability effect under both planting dates.

2- Maturity date:-

The highest significant and negative values of general combining ability were recorded by (P_3) and (P_8) under both planting dates. The crosses, (P_1 x P_7), (P_5 x P_7) and (P_5 x P_8) showed the highest negative values of specific combining ability effect under both planting dates.

3- Plant height:-

The highest significant and negative values of general combining ability were recorded by (P_3), (P_4), (P_7) and (P_8) under both planting dates. The crosses, (P_1x P_2), (P_1 x P_5), (P_2 x P_5), (P_3 x P_4) and (P_6 x P_7) showed the highest negative values of specific combining ability effect under both planting dates.

4- Grain filling period:-

The parents (P_4), (P_5) and (P_6) under recommended date, while (P_4) and (P_6) under late planting date exhibited negative and highly significant values of general combining ability effect. The crosses, (P_4x P_5), (P_5 x P_8) and (P_6 x P_7) showed negative and significant specific combining ability effect under both planting dates.

5- Number of spikes/plant:-

The parents (P_1) (P_2) (P_5) and (P_7), showed positive and significant values of general combining ability effect under recommended date, while (P_1) and (P_5) under late planting date. The crosses, (P_1 x P_3) and (P_5 x P_7) showed positive and significant specific combining ability effects under both planting dates.

6- Spike length: -

The parents (P_6), (P_7) and (P_8) showed positive and significant values of general combining ability effect under both planting date. The crosses, (P_1 x P_5), (P_1 x P_7), (P_2 x P_5), (P_2 x P_8), (P_3 x P_4), (P_3 x P_6), (P_3 x P_7), (P_3 x P_8) and (P_4 x P_8) showed positive and significant specific combining ability effect under both planting dates.

7-Number of kernels/spike:-

Parents (P_7) and (P_8) gave the highest positive and significant values of general combining ability under both planting dates. The crosses, (P_1 x P_5), (P_1 x P_7), (P_2 x P_5), (P_3 x P_4), (P_5 x P_8) and (P_6 x P_7) displayed the highest positive values of specific combining ability effect under both planting dates.

8- Grain production rate:-

The parents (P_1), (P_2), (P_5) and (P_7) showed positive and significant values of general combining ability effect under both planting dates. The crosses, (P_1 x P_3), (P_2 x P_3), (P_3 x P_6), (P_4 x P_5), (P_5 x P_7) and (P_6 x P_8) showed positive and significant specific combining ability effects under both planting dates.

9- 1000-kernel weight: -

The highest significant and positive values of general combining ability were recorded by (P_1), (P_2), (P_5) and (P_8) under both planting dates. The crosses, (P_1 x P_7), (P_1 x P_8), (P_2 x P_3) and (P_3 x P_4) showed the highest positive values of specific combining ability effect under both planting dates.

10-Grain yield/plant: -

The highest significant and positive values of general combining ability were recorded by (P_1), (P_2), (P_5) and (P_7) under both planting dates. The crosses, (P_1 x P_3), (P_2 x P_3), (P_3 x P_6), (P_5 x P_7) and (P_6 x P_8) showed the highest positive values of specific combining ability effect under both planting dates.

E- Hayman analysis: -

The additive (a) and dominance (b) effects were highly significant for all studied traits under both planting dates. The additive (a) mean squares were high in magnitude than the dominance (b) under both planting dates, except grain production rate under both planting dates and grain yield/plant under late planting date. Dominance deviations of the genes (b_1) was significant or highly significant for all studied traits under both planting dates, except number of spikes/plant, indicating that dominance deviations of the genes were predominantly acting in one direction. Furthermore, the b_2 and b_3 mean squares were highly significant for all the studied traits.

F- Genetic components:-

The differences between arrays for the (Wr+Vr) values were significant or highly significant for all studied traits, except number of spikes /plant under recommended date, indicating the presence of non-allelic gene interaction.

The magnitude of (Wr-Vr) values were significant or highly significant for all studied traits, except number of spikes/plant and grain yield/plant under recommended date, confirming that part of the non-additive effects returns to epistatic effects.

Graphical analysis indicated that the additive-dominance model is adequate in describing the acting of genes for heading date, maturity, spike length and grain production rate under both planting dates while, number of spikes/plant and grain yield/plant under recommended date. Grain filling period and 1000-kernels weight under late planting date.

The results of the genetic and graphic analysis showed the presence of over dominance for maturity date, number of kernels/spike, 1000-kernel weight, and grain yield /plant under both planting dates, while plant height, grain filling period and number of spikes/plant showed that over dominance under late planting date. But grain production rate under recommended date.

The presence of partial dominance was found for heading date and spike length under both planting dates while, plant height and number of spikes /plant showed that partial dominance under recommended date. But grain production rate under late planting date.

Additive genetic component (D) and non-additive (H_1 and H_2) were highly significant for all traits under both planting dates. The additive gene effects were the main influence in the inheritance of all traits except maturity date, number of kernels/spike, 1000-kernel weight and grain yield/ plant under both planting dates, while plant height and number of spikes/plant under late planting date. Meanwhile, the dominance gene effects were playing an important role in the inheritance of maturity date and number of kernels/spike under both planting.

The dominant and recessive genes (UV) were unequally distributed among the parents for all studied traits under both planting dates.

The narrow sense heritability was much smaller than the broad sense heritability, for the all studied traits under both planting dates, indicating that the major component of genetic effects for these traits under both planting dates was the non-additive component.