Minia University
Faculty of Agriculture
Agronomy Department

ESTIMATION OF COMBINING ABILITY FOR SOME COTTON CROSSES (*G. barbadense* L.) BY USING LINE × TESTER ANALYSIS

BY

Taher Mohamed Elsayed Salem

B.Sc. Agricultural (Agronomy), Faculty of Agriculture, Fayoum University (2009)
M.Sc. Agricultural (Agronomy), Faculty of Agriculture, Minia University (2016)

THESIS
Submitted in Partial Fulfillment of the
Requirements for the Degree
of
DOCTOR OF PHILOSOPHY
in
AGRICULTURAL SCIENCES
(Agronomy - Crop Breeding)

Under supervision of

Prof. Dr. Shokry A. Mokadem
Professor of Agronomy, Faculty of Agriculture, Minia University.

Prof. Dr. Mansour A. Salem
Professor of Agronomy, Faculty of Agriculture, Minia University.

Prof. Dr. Hussein S. Khalifa
Chief Researcher, Cotton Research Institute, Agricultural Research Center.

2020

CONTENTS

LIST OF TABLES

SUMMARY

The present investigation used eight divergent cotton genotypes as parents. These genotypes were Giza 90, [(G.83 × G.80) × G.89] × Australy, (G.91 × G.90) × G.80, [(G.83 × G.80) × G.89] × (G.83 × Daltabain 703), Giza 95, TNB I (Sea Island), BBB (big black boll) and 10229. The first five genotypes were used as lines while the late three genotypes were used as testers and all genotypes belong to (*G. barbadense*, L.). These genotypes (eight parents, their 15 F_1 hybrids and 15 F_2 populations) were involved in a series of hybridization according to line × tester mating design **Kempthorne** (**1957**) and detailed by S**ingh and Chaudhary (1985)**.

The experiments were conducted during 2017, 2018 and 2019 seasons at Sids Agricultural Research Experiment Station, Beni-Suef Governorate, Agricultural Research Center, Egypt. The experiment was set in a randomized complete blocks design with three replications.

The main objectives of the present investigation were to determine heterosis, general and specific combining abilities, heritability in broad and narrow senses and inbreeding depression for earliness traits, yield and yield components and fiber quality traits and its properties.

The results of the present investigation could be summarized as follows:

1 - Analysis of variance:

Analysis of variance revealed that the mean squares due to genotypes (parents, their F_1 hybrids and F_2 populations) were highly significant for all earliness traits, revealing a large amount of variability among each of them. Moreover, mean squares due to parents, crosses and parents versus crosses were highly significant for all earliness traits in both F_1 hybrids and F_2 populations. The results clarified that, the mean squares among lines, testers and lines × testers in both F_1 hybrids and F_2 populations were highly significant for all earliness traits.

Results indicated that the mean squares due to genotypes (parents, their F_1 hybrids and F_2 populations) were highly significant for all yield and yield components, revealing a large amount of variability among them. In addition, mean squares due to parents, crosses and parents versus

crosses were highly significant for all yield and yield components in both F_1 hybrids and F_2 populations. The results concluded that, the mean squares among lines were highly significant for all yield and yield components except (L.%) in F_1 hybrids and (L.I.) in both F_1 hybrids and F_2 populations. Concerning mean squares among testers for all yield and yield components in both F_1 hybrids and F_2 populations were highly significant except (L.I.) was non-significant in F_1 hybrids but was only significant in F_2 populations. Regarding to lines × testers, mean squares of these interactions were highly significant for all yield and yield components in both F_1 hybrids and F_2 populations.

Mean squares due to genotypes (parents, their F_1 hybrids and F_2 populations) were highly significant for all fiber quality traits and its properties in both F_1 hybrids and F_2 populations. Mean squares due to parents, crosses and parents versus crosses were highly significant for all fiber quality traits and its properties in both F_1 hybrids and F_2 populations. The results clarified that the mean squares among lines in F_1 hybrids were highly significant for all fiber quality traits and its properties except (F.S.) was only significant while in F_2 populations were highly significant for (F.F.) and (F.S.) and were only significant for (F.L.) and (U.I.). Concerning mean squares among testers and lines × testers for all fiber quality traits and its properties in both F_1 hybrids and F_2 populations were highly significant.

2 - Mean performance of genotypes:

Results manifested that the mean performance of the line (L_2) was the earliest in comparison with the other lines for all earliness traits. The tester (T_2) was the best tester for all earliness traits. Results clarified that the mean performance of the cross No. 5 in F_1 hybrids was the earliest in comparison with the other crosses for all earliness traits. Results detected that the mean performance of cross No. 4 in F_2 populations was the earliest cross for all earliness traits.

Results showed that the highest mean performance was found for the line (L_1) for (B.W.) and (S.I.). The highest mean performance was found for the line (L_2) for (No.O.B. / P.), (S.C.Y. / P.) and (L.Y. / P.). The highest mean performance was found for the line (L_3) for (L. %). The highest mean performance was found for the line (L_5) for (L.I.). Results

claimed that the highest mean performance was found for the tester (T_1) for (No.O.B. / P.), (S.C.Y. / P.) and (L.Y. / P.). The highest mean performance was found for the tester (T_3) for (B.W.), (S.I.), (L. %) and (L.I.). As for crosses, the cross No. 1 in F_1 hybrids was the highest mean performance for (No.O.B. / P.). The cross No. 3 was the highest mean performance in F_1 hybrids for (B.W.) and (S.I.). The highest mean performance was found for the cross No. 13 in F_1 hybrids for (L.Y. / P.) and (L. %). As for F_1 hybrids, the highest mean performance was found for the cross No. 15 for (S.C.Y. / P.) and (L.I.). As for F_2 populations, the highest mean performance was found for the cross No. 1 for (S.I.). The best mean performance was found for the cross No. 2 in F_2 populations for (No.O.B. / P.). The highest mean performance was found for the cross No. 5 for (L.Y. / P.) in F_2 populations. The highest mean performance was found for the cross No. 6 in F_2 populations for (B.W.). As for F_2 populations, the highest mean performance was found for the cross No. 10 for (L. %) and (L.I.). The highest mean performance was found for the cross No. 14 in F_2 populations for (S.C.Y. / P.).

Results indicated that the mean performance of the line (L_1) was the best in comparison with the other lines for (F.L.) and the line (L_2) was the best in comparison with the other lines for (F.F.), (F.S.) and (U.I.). The tester (T_2) was the best tester for (F.L.) and the tester (T_3) was the best tester for (F.F.), (F.S.) and (U.I.). As for crosses, the cross No. 2 was the highest mean performance in F_1 hybrids for (F.L.) and (U.I.). The cross No. 3 was the highest mean performance in F_1 hybrids for (F.S.). The cross No. 11 in F_1 hybrids was the best mean performance for (F.F.). As for F_2 populations, the best mean performance was found for the cross No. 5 for (F.L.) and (U.I.). The highest mean performance was found for the cross No. 11 in F_2 populations for (F.F.). The highest mean performance was found for the cross No. 12 for (F.S) in F_2 populations.

3 - Heterosis estimates:

Results displayed that the cross No. 3 had recorded the best heterosis values (desirable) relative to mid parents and better parents for (D.F.O.B.). The crosses No. 5, 7 and 9 had recorded the best heterosis values (desirable) relative to mid parents and better parents for (F.F.N.).

The cross No. 12 had recorded the best heterosis values (desirable) relative to mid parents and better parents for (D.F.F.).

Results indicated that the cross No. 1 had displayed the best heterosis (desirable) relative to mid parents and better parents for (L. %). While, the cross No. 4 had showed the best heterosis (desirable) relative to mid parents and better parents for (S.I.) and (L.I.). In addition, the cross No. 9 had recorded the best heterosis (desirable) relative to mid parents and better parents for (No.O.B. / P.), (B.W.), (S.C.Y. / P.), (L.Y. / P.) and (L. %). The cross No. 13 had recorded the best heterosis (desirable) relative to mid parents and better parents for (No.O.B. / P.), (B.W.), (S.C.Y. / P.), (L.Y. / P.), (L. %), (S.I.) and (L.I.).

Results manifested that the percentage of heterosis relative to mid parents and better parents of the crosses No. 2 and 11 had recorded the best heterosis (desirable) relative to mid parents and better parents for (F.F.). The cross No. 2 had recorded the best heterosis (desirable) relative to mid parents and better parents for (F.S.), (F.L.) and (U.I.).

4 - General and specific combining abilities:

a- General combining ability effects:

Results reported that the estimates of G.C.A. effects for (F.F.N.), (D.F.F.) and (D.F.O.B.) were negative and highly significant in line (L_2) in both F_1 hybrids and F_2 populations. In addition, the estimates of G.C.A. effects for (F.F.N.), (D.F.F.) and (D.F.O.B.) were negative and highly significant in tester (T_2) in F_1 hybrids. While, the estimates of G.C.A. effects for (F.F.N.), (D.F.F.) and (D.F.O.B.) were negative and highly significant in tester (T_1) in F_2 populations.

Results showed that the estimates of G.C.A. effects for (S.I.) were positive and highly significant in line (L_1) in both F_1 hybrids and F_2 populations. In addition, the estimates of G.C.A. effects for (No.O.B. / P.), (B.W.), (S.C.Y. / P.) and (L.Y. / P.) were positive and highly significant in line (L_5) in both F_1 hybrids and F_2 populations. While, the estimates of (G.C.A.) effects for (L.%) and (L.I.) were positive and highly significant in line (L_5) in F_1 hybrids. Results concluded that the tester (T_1) showed positive and highly significant for (No.O.B. / P.) and (S.C.Y. / P.) in both F_1 hybrids and F_2 populations. In addition, the tester

(T_3) showed positive and highly significant for (B.W.) in both F_1 hybrids and F_2 populations. While, the tester (T_1) showed positive and highly significant for (L.Y. / P.) and (L.%) in F_1 hybrids. the tester (T_2) showed positive and highly significant for (S.I.) and (L.I.) in F_2 populations.

Results noted that the estimates of G.C.A. effects for (F.F.) were negative and highly significant and for (F.L.) were positive and highly significant in line (L_1) in both F_1 hybrids and F_2 populations. In addition, the estimates of G.C.A. effects for (F.S.) and (U.I.) were positive and highly significant in line (L_3) in F_1 hybrids. While, in F_2 populations for (F.S.) were positive and highly significant in line (L_4) and for (U.I.) were positive and highly significant in line (L_5). Moreover, the estimates of G.C.A. effects for (F.F.) were negative and highly significant and for (F.L.) and (U.I.) were positive and highly significant in tester (T_2) in both F_1 hybrids and F_2 populations. In addition, the estimates of G.C.A. effects for (F.S.) were positive and highly significant in tester (T_2) in F_1 hybrids while in F_2 populations were positive and highly significant in tester (T_3).

b- Specific combining ability effects:

Results clarified that the estimates of specific combining ability S.C.A. effects for (F.F.N.) and (D.F.O.B.) the cross No. 5 in F_1 hybrids had recorded the best S.C.A. effects were negative and only significant or highly significant. In addition, the cross No. 7 in F_1 hybrids had showed the best S.C.A. effects for (D.F.F.) were negative and only significant or highly significant. The cross (No. 12) in F_2 hybrids had showed the best S.C.A. effects for (F.F.N.) were negative and only significant. As well as the cross No. 4 had displayed the best (S.C.A.) effects for (D.F.O.B.) in F_2 populations were negative and highly significant. The cross No. 9 had displayed the best S.C.A. effects for (D.F.F.) and (D.F.O.B.) in F_2 populations were negative and only significant or highly significant.

Results indicated that the estimates of S.C.A. effects in both F_1 hybrids and F_2 populations the cross No. 5 had recorded positive and only significant or highly significant for (L.Y. / P.) and (S.I.). While, the cross No. 11 had showed positive and only significant or highly significant for (L. %) and (L.I.) in both F_1 hybrids and F_2 populations. In addition, the cross No. 12 in both F_1 hybrids and F_2 populations had showed positive and highly significant for (No.O.B. / P.), (B.W.) and (S.C.Y. / P.).

Results showed that the estimates of specific combining ability S.C.A. effects in both F_1 hybrids and F_2 populations the cross No. 11 had displayed negative and highly significant for (F.F.). While, the crosses No. 3 and 5 had displayed positive and highly significant for (F.S.) in F_1 hybrids. In addition, the crosses No. 2 and 6 had recorded positive and highly significant for (F.L.) and (U.I.) in F_1 hybrids. As well as the crosses No. 3 and 5 had recorded positive and highly significant for (F.L.) and (U.I.) in F_2 populations. While, the crosses No. 4 and 15 had displayed positive and highly significant for (F.S.) in F_2 populations.

5 - Combining ability variances and genetic components:

The results revealed that the mean square of general combining ability were lower than those of specific combining ability for earliness traits, yield and yield components and fiber quality traits and its properties. The results showed that the ratio of (G. C.A. / S.C.A.) was noticed to be low for all studied traits indicated that specific combining ability was more important than general combining ability. Thus, the non-additive (σ^2D) genetic variance of these traits were larger than those the additive (σ^2A) genetic variance.

6 - Heritability estimates:

Results claimed that the estimates of broad sense hertability in F_1 hybrids and F_2 populations for all earliness traits were moderate to high. Results noticed that the estimates of narrow sense hertability in F_1 hybrids and F_2 populations for all earliness traits were low.

Results clarified that the estimates of broad sense hertability in F_1 hybrids for all yield and yield components were moderate to high. As for F_2 populations, the estimates of broad sense hertability for all yield and yield components were high. Results displayed that the estimates of narrow sense hertability in F_1 hybrids all yield and yield components were low to moderate. As for F_2 populations, the estimates of broad sense hertability for all yield and yield components were low.

Results reported that the estimates of broad sense hertability in F_1 hybrids and F_2 populations for all fiber quality traits and its properties were high. Results manifested that the estimates of narrow sense hertability in F_1 hybrids for all fiber quality traits and its properties were

low to moderate. As for F_2 populations, the estimates of broad sense hertability for all fiber quality traits and its properties were low.

7 - Inbreeding depression:

Results exhibited that the percentage of inbreeding depression of the cross No. 4 had recorded positive and highly significant for (F.F.N.) and (D.F.O.B.).

Results reported that the percentage of inbreeding depression of the cross No. 4 had recorded positive and highly significant for all yield and yield components except (B.W.). In addition, the percentage of inbreeding depression of the crosses No. 8, 9 and 10 had displayed positive and highly significant for (No.O.B. / P.), (B.W.), (S.C.Y. / P.) and (L.Y. / P.).

Results concluded that the percentage of inbreeding depression of the cross No. 15 had recorded positive and highly significant for (F.F.). In addition, the percentage of inbreeding depression of the crosses No. 7 and 13 had displayed positive and highly significant for (F.S.). While, the percentage of inbreeding depression of the crosses No. 2 and 12 had displayed positive and highly significant for (F.L.). The percentage of inbreeding depression of the crosses No. 10 and 12 had displayed positive and highly significant for (U.I.).