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SHORT RESEARCH ARTICLE

Genetic analysis for yield and ginning out turn in F_1 and F_2 populations of upland cotton

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Abstract

Gene action and combining ability for seed cotton yield (SCY) and ginning outturn (GOT) were investigated in F_1 and F_2 populations of 4 x 3 line tester in cotton (*Gossypium hirsutum* L.). The rate of general and specific combining ability variances showed non-additive gene action in controlling SCY (F_2) and GOT (F_1). Carmen cultivar determined as the best general combiner for SCY and GOT. Carmen x Carisma was the most promising combination to be used as an F_2 hybrid and a base population for filial generations. The individual plants with desired traits should be selected in later generations.

Keywords: GCA, Ginning outturn, Line x tester, SCA, Seed cotton yield.

Cotton breeders should concentrate on the improvement of productive cotton genotypes by crossing good general combining genotypes for seed cotton yield (SCY) and ginning outturn (GOT) and selecting promising combinations from resulting hybrids (Akbar et al. 2009). Most of the early progress of cotton breeding was accomplished by indirect selection for yield. The line × tester is one of the suitable quantitative analysis methods for evaluation the combining ability effects of parents and crosses and gene actions of selection criteria's in pedigree breeding. The ratio of GCA/SCA was used for the estimate of gene action in line x tester analysis. Both non-additive type of gene action (Roy et al. 2018) and additive gene actions (Prakash et al. 2018) for SCY and GOTwas reported. Numerous studies about gene action and combining ability in any mating design have been evaluated the F_1 population and parents, but the little investigation has been focused on the F_1 and F_2 populations. The present investigation is to determine the gene action and combining abilities for SCY and GOT in F_1 and F_2 populations of line x tester mating design in cotton (*Gossypium hirsutum* L.)

The genetic material included 4 lines *viz*., Gloria, Claudia, Carmen and Julia and 3 testers viz., Stoneville 468, Carisma and Flash were crossed to generate 12 hybrid combinations in line x tester mating design. The seven parents, 12 F_1 and 12 F_2 populations were planted in the randomized complete block design with 3 replications in 2014-15.Each entry was sown in single-row plots of 12 m length. The sowing norms were 0.7 m and 0.2 m. SCY per plant (g) and GOT (%) were recorded on 20 random plants of each entry. Collected data were subjected to Line x Tester analysis suggested by Singh and Chaudhary (1979) and combining ability effects were computed for SCY and GOT. The mean of genotypes was separately compared by using the LSD test at a 5% probability level.

Line x Tester analysis

The significant mean squares of the line for SCY (F_1) and GOT(F_1 and F_2); tester for GOT (F_1 and F_2) and line x tester for GOT (F_2) indicated significant differences between F_1 and F_2 in this study (untabulated data). The ratio of σ^2_{GCA} / σ^2_{SCA} above 1 for SCY (F_1) and GOT (F_2) indicated higher additive gene action than non-additive gene action in the inheritance of traits. Whereas, ginning outturn in F_2 exhibited non-additivity. The difference of gene action for SCY and GOT between F_1 and F_2 clearly showed that it is complicated to decide when to select a single plant in filial generations. Also,

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the higher proportion line × tester than lines and testers was a sign of non-additivity. Although Prakash et al. (2018) found the preponderance of additive genes in the inheritance of SCY and GOT, whereas, non-additive gene effect was reported by Roy et al. (2018) and Makhdoom et al. (2019).

The GCA effect of Carmen was significant and positive for both F_1 and F_2 while Carisma had positive GCA effects for both generations. Significantly negative GCA effects were recorded in Claudia and Flash. In case of F_1 and F_2 SCA effects for SCY (Fig. 1), Carmen x Carisma exhibited significant and positive SCA effects in both generations. Carmen and Carisma were found as the best general combiner by having a leading position for SCY in both populations. Also, the Carmen x Carisma was the best promising combination for both generations. The parent with the best GCA had capable of producing superior hybrid for high yield (Khan et al. 2009).The F_2 hybrid of Carmen x Carisma surpassed its parents despite inbreeding depression.Claudia, Carisma and ST-468 expressed positive and significant GCA effects while SCA effects of Claudia x Carisma were positive and significant in both generations (Fig. 2). The performances of Claudia x Carisma and Gloria x ST-468 indicated that the utilization as

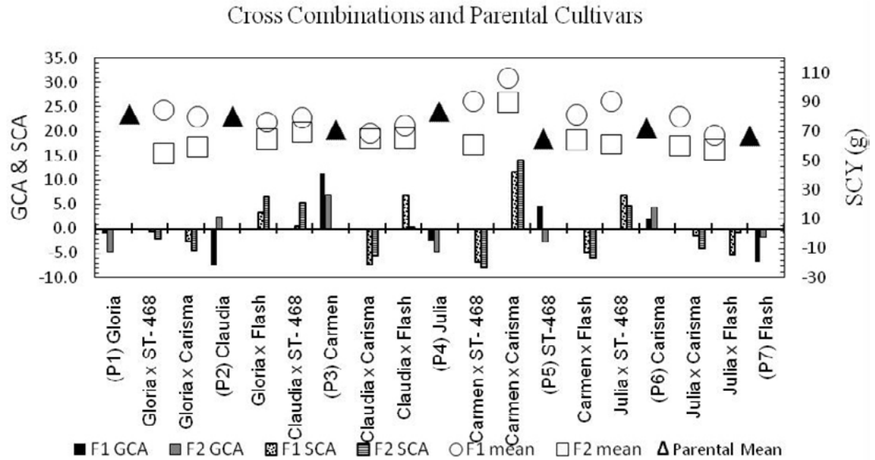

Fig. 1. Mean performance and combining ability effects of F_1 and F_2 combinations and parents for SCY

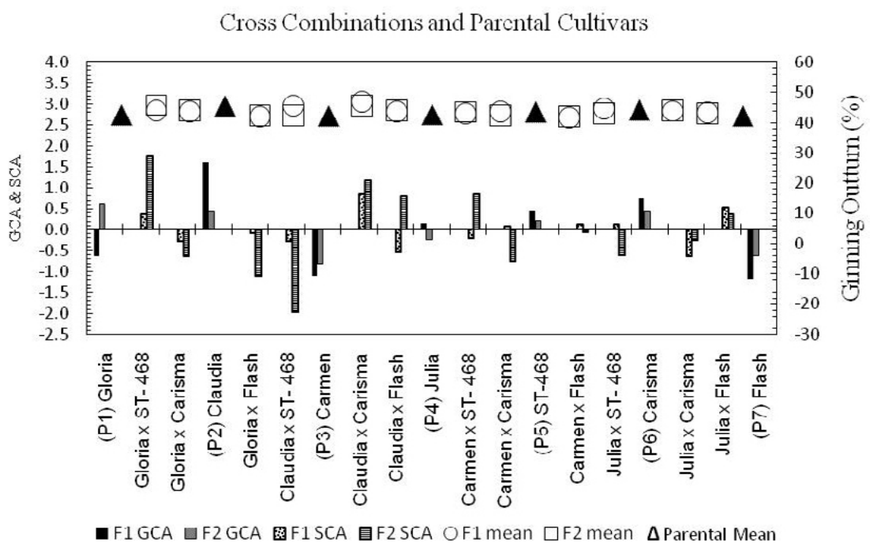

Fig. 2. Mean performance and combining ability effects of F_1 and F_2 combinations and parents for GOT

one of a parent having the best GCA in a breeding program can produce promising hybrids.

Both additive and non-additive gene action for SCY and GOTwere important for inheritance. Therefore, superior plants should be selected in later generations to optimize SCY and GOT. Carmen was determined as the best general combiner for SCY. Carmen x Carisma combination having combined performance could be used as a promising population for F_1 and F_2 hybrid production and a base population for further selection in high yielding and GOT cotton breeding. Also, it could be speculated that high (Carmen) x low (Carisma) parents performed well in SCA determination and mean performances of Carmen x Carisma for SCY and GOTin both generations.

Authors' contribution

Conceptualization of research (SB, AU); Designing of the experiments (SB, AU); Contribution of experimental materials (SB); Execution of field/lab experiments and data collection (SB); Analysis of data and interpretation (VMC, AU); Preparation of the manuscript (SB, VMC, AU).

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