

Correlation Analysis of Quantitative Traits and Its Significance for Selection in Cotton (*Gossypium hirsutum* L.)

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Abstract

Correlation analysis of quantitative traits is an important approach for understanding the relationships among agronomic and fiber characteristics and for improving the efficiency of selection in cotton breeding. The present study was aimed at evaluating the relationships among economically important quantitative traits in *Gossypium hirsutum* L. genotypes and determining their potential significance for selection. The main traits considered included plant height, number of fruiting branches, number of bolls per plant, boll weight, seed cotton yield, fiber percentage, and fiber length. The relationships among these characteristics were assessed to identify traits that are closely associated with productivity and fiber quality. The analysis indicated that quantitative traits are interconnected to different degrees, reflecting the complex genetic architecture of cotton productivity. Strong positive associations between yield and its component traits may provide useful indirect selection criteria, whereas weak or negative relationships between productivity and fiber characteristics may indicate the need to balance these traits during selection. The results demonstrate that correlation analysis can complement genetic variability and heritability assessments and contribute to the identification of promising traits and genotypes for cotton improvement.

Keywords: *Gossypium hirsutum* L.; cotton; quantitative traits; correlation; seed cotton yield; fiber quality; selection; breeding.

Introduction

Cotton productivity is determined by a complex system of quantitative traits that interact with each other and are influenced by both genetic and environmental factors. Plant height, fruiting branch number, boll number, boll weight, seed cotton yield, fiber percentage, and fiber length are among the major characteristics considered in cotton breeding programs. Because these traits do not function independently, improvement of one characteristic may influence the expression of another.

Correlation analysis provides an opportunity to determine the direction and strength of relationships among quantitative traits. Positive associations between yield and its component traits can be particularly useful for indirect selection, especially when a component trait is more stable or easier to evaluate than final yield. At the same time, negative associations between yield and fiber quality characteristics may create challenges for simultaneous improvement of productivity and technological fiber properties.

Understanding the relationships among quantitative traits is therefore important for developing an effective selection strategy. The identification of traits positively associated with seed cotton yield can help breeders use these characteristics as additional selection criteria, while knowledge of unfavorable associations can help avoid undesirable changes in genetically improved populations.

The objective of this study was to assess the relationships among major quantitative traits of *Gossypium hirsutum* L. genotypes and to determine the potential significance of these relationships for improving the efficiency of selection in cotton breeding programs.

Materials and Methods

A collection of *Gossypium hirsutum* L. genotypes representing different genetic backgrounds was evaluated under field conditions. Morphological, yield-related, and fiber characteristics were recorded during the growing period. The evaluated traits included plant height, number of fruiting branches, number of bolls per plant, boll weight, seed cotton yield, fiber percentage, and fiber length. Measurements were obtained from representative plants of each genotype using standardized field and laboratory procedures.

The relationships among the studied quantitative characteristics were evaluated using correlation analysis. Particular attention was given to associations involving seed cotton yield, as yield represents one of the principal objectives of cotton breeding. The observed relationships were interpreted from the perspective of direct and indirect selection and the possibility of simultaneous improvement of productivity and fiber quality.

Results and Discussion

The analysis of quantitative characteristics demonstrated that the studied traits were associated with each other to different degrees. This variation in the strength and direction of relationships indicates that cotton productivity is determined by a combination of interrelated morphological and reproductive characteristics.

Seed cotton yield is generally influenced by the number of fruiting sites, boll formation, and boll weight. Therefore, positive relationships between yield and these components have important practical significance. Genotypes characterized by a greater number of productive bolls and favorable boll weight may have a higher potential for seed cotton production. Such traits can consequently be considered useful secondary selection criteria when evaluating breeding material.

The number of fruiting branches is also an important component of plant productivity. A favorable association between fruiting branch number and boll formation suggests that the development of productive branches may contribute to increased reproductive potential. However, excessive vegetative development should be avoided because a high plant stature or excessive vegetative growth does not necessarily result in higher yield.

The relationship between fiber characteristics and seed cotton yield is particularly important from a breeding perspective. Cotton improvement requires not only high productivity but also acceptable fiber quality. If productivity traits and fiber quality characteristics show favorable associations, simultaneous improvement becomes comparatively easier. In cases where unfavorable associations occur, breeders need to use a balanced selection strategy to prevent improvement of one characteristic from causing deterioration of another.

The relationships among boll weight, boll number, and seed cotton yield also provide useful information for identifying superior genotypes. A genotype producing a large number of bolls with favorable boll weight may possess a desirable combination of yield components. Nevertheless, selection based on a single component may not always result in maximum yield because yield is a complex trait controlled by multiple interacting factors.

From a practical breeding perspective, correlation analysis should be interpreted together with genetic variability and heritability estimates. A strong association between two traits does not necessarily indicate that the relationship is entirely genetic. Environmental effects and developmental interactions may also contribute to the observed phenotypic association. Therefore, traits showing both substantial genetic variability and favorable relationships with yield are particularly valuable for selection.

The combined assessment of quantitative variability, heritability, and correlations can improve the identification of promising genotypes. Such an integrated approach makes it possible to select genotypes with a favorable combination of productivity components and fiber characteristics and can support

the development of new cotton varieties adapted to specific agroecological conditions.

Conclusion

Correlation analysis demonstrated the importance of considering relationships among quantitative traits when developing selection strategies in *Gossypium hirsutum* L. The relationships between seed cotton yield and its component traits provide useful information for identifying secondary selection criteria, while associations between yield and fiber characteristics are important for achieving a balance between productivity and fiber quality.

The most useful selection strategy should therefore combine information on trait associations with estimates of genetic variability and heritability. Such an integrated approach can increase the reliability of genotype evaluation, facilitate the identification of promising breeding material, and contribute to the development of cotton varieties combining high productivity with desirable fiber properties.

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