GENOTYPIC AND ENVIRONMENTAL EFFECTS ON PARTITIONING AT THE WHOLE PLANT, BOLL AND SEED LEVEL FOR PREDICTING YIELD AND STRESS

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Abstract

Cotton (*Gossypium hirsutum L.)* yields in Arkansas increased steadily throughout the 1980's, but leveled off and even decreased in the 1990's. Of more concern, however, is the increased year-to-year variability. A clear understanding of why yields have leveled off the past decade and why increased variability from year to year has occurred is urgently needed. It is speculated that the reason for this decrease in yield is a combination of adverse environmental conditions coupled with changes in breeding objectives over the past few decades. The main objective of this study is to investigate dry matter, carbohydrate and energy partitioning at the whole plant, boll and seed level in relation to genotype and environment. An extensive investigation of these partitioning factors should help in the development of an "early warning" signal for detecting low boll weight development and potential yield problems in the field during the season. The second objective is to investigate methods for ameliorating this potentially low crop boll weight using foliar feeding and plant growth regulators that enhance translocation of carbohydrates.

Two field studies were designed to test the impact that environmental and genotypic differences had on partitioning in cotton. For the genotype study, eight cultivars (four modern and four obsolete) were selected with the combined help of cotton breeders across the U.S. and planted into randomized irrigated field plots to evaluate changes in partitioning in relation to genotypes from contrasting decades. For the environmental study, we selected an obsolete genotype (ST 213) and a modern genotype (ST474) from the previous study and planted each under well-watered and water-deficit conditions to determine if differences in partitioning exist between contrasting genotypes in different environments. These treatments were then further subdivided into fruit removal versus no fruit removal for each genotype in both well-watered and water-deficit plots. Fruit removal consisted of removing half of the fruit load on 10-day intervals throughout the effective flowering period. Fruit removal was performed to establish two separate carbohydrate pools for further study of partitioning within the boll and seed levels.

Results from the genotype study indicated that the modern cultivars had higher yields than the obsolete cultivars. This was due to changes in partitioning of dry matter from vegetative to reproductive structures. The modern cultivars also had more bolls per meter and more seeds per boll than obsolete cultivars. From the environment study it was observed that for both new and old genotypes alike, yield was significantly increased under well-watered conditions. However, there was no significant difference in yield between old and new genotypes under either water level. In terms of fruit removal, yield was significantly decreased where fruit was removed in well-watered plots for both old and new genotypes, however in water-deficit plots there were no significant differences in lint yields following removal of half the fruit load. This suggests that compensation occurred following fruit removal under limited carbohydrate supply. These results help to summarize how partitioning impacted yield at the whole plant level in relation to genotype and environment. Current research is presently evaluating partitioning at the boll and seed level to gain insight into underlying principles of boll development as related to changes in genetics and the environment. If this research is successful it will permit producers to be able to make management decisions either to attempt to enhance boll development or reduce production inputs to save costs.

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