CAN COTTON YIELD BE INCREASED BY IMPROVING PHOTOSYNTHETIC CAPACITY?

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Abstract

Genetic improvement in cotton yield has mainly been attributed to increases in harvest index. Studies with Pima cotton indicate that while breeders were selecting for cultivars with higher yield, they were also selecting for higher stomatal conductance and photosynthetic capacity. We recently investigated leaf carbon exchange rate (CER), stomatal conductance, assimilation to intercellular CO_2 response ($A:c_i$), growth, and yield of two cultivars with common ancestry, G&P 74+ (GP74) and TAMCOT HQ95 (HQ95), to determine whether potential yield differences were due to differences in dry matter accumulation, dry matter conversion to yield, or leaf gas exchange. The study was conducted over a two year period at the Texas Agricultural Experiment Station - Temple, TX in a sheltered lysimeter facility. Water stress was imposed after flowering at three levels: 0, 50 or 75, and 100% replacement of depleted soil water. The cultivars did not differ in phenology, i.e., appearance of first flower and fruit appearance rates were similar. Leaf area index (LAI) and rate of leaf area development before stress imposition, and leaf area decline and average LAI afterwards were not different between the two cultivars either year. Total dry matter accumulation of HQ95 was higher for the 0 and 50/75% treatments, but less than GP74 for the 100% treatment both years. Final boll number, lint yield, and harvest index was higher in HQ95 for all treatments both years. Leaf CER, stomatal conductance, and $A:c_i$ response measurements were higher in HQ95 for any level of water stress. $A:c_i$ responses indicate that HQ95 had higher photosynthetic capacity than GP74. As a result, HQ95 had higher boll production efficiency, i.e., more bolls were supported per unit of leaf area. Our results indicate the potential exists to improve cotton yield through increased stomatal conductance and photosynthetic capacity. As the limits to genetic improvement of harvest index are approached, increasing stomatal conductance and photosynthetic capacity will become more important to cotton improvement.

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