THE EFFECT OF CONSTITUTIVELY OVER-EXPRESSING THE GENE FOR TOMATO FRUCTOKINASE *(LeFRK1)* ON COTTON YIELD IN GREENHOUSE AND FIELD TRIALS

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Abstract

Cotton yield depends on cellulose synthesis during fiber wall development. Sucrose synthase (SuSy) cleaves sucrose to provide UDP-Glucose for cellulose synthesis. The other product, fructose, inhibits SuSy and can be removed by fructokinase (FRK). Since fructokinases positively regulate cell wall development in tomato, our hypothesis was that constitutively over-expressing the tomato gene (*LeFRK1)* in cotton would reduce SuSy inhibition and enhance cotton yield under optimum and, possibly, drought conditions. Two to three transgenic lines with moderate to high expression of *LeFRK1* in leaves and fibers, were subjected to well-watered and water-deficit stress treatments in greenhouse and full irrigation in the field. Transgenic plants with *LeFRK1* over-expression and increased fiber FRK activity yielded 30-90% more seed-cotton mass/boll and seed number/boll with significantly more bolls/plant under all watering regimes in the greenhouse, than the non-expressing null controls. Thus, seed cotton mass and fiber mass per plant were greater than for the nulls. Field-grown transgenic plants yielded 10-30% more seed-cotton mass/boll than the nulls under full-irrigation. However, there was little effect of *LeFRK1* over-expression on fiber length or strength. Although only one transgenic line had higher rates of CO_2 assimilation in the greenhouse and field, the greater individual leaf area and node number/plant suggested that total carbon assimilation was greater for the transgenic plants as compared to the null controls. Thus, we conclude that, constitutive over-expression of the *LeFRK1* in cotton, leads to improved seed-cotton yield via an improvement in total carbohydrate synthesis that improves seed number/boll and boll number/plant.