Identification and manipulation of Tiller A ngle Control (TAC1) homologs in upland cotton results in altered branch angle for increased planting densities and improved light interception (2024-023)

Improve cotton productivity by genetically modifying plant architecture—specifically branch and petiole angles—using CRISPR-based genome editing of TAC1 genes.

Market Overview

The global cotton industry spans over 33 million hectares and is a cornerstone of the textile economy, with the U.S. ranking among the top producers and exporters. Current yield improvements are constrained by traditional plant architecture, which limits planting density and mechanization efficiency. This technology—CRISPR-based editing of *TAC1* genes to create columnar cotton varieties—addresses these limitations by enabling high-density planting, improved light interception, and potential yield gains per acre. With increasing global demand for fiber and pressure to optimize land use under climate variability, the adoption of compact, high-yield cotton varieties represents a multi-billion-dollar opportunity. Beyond fiber production, this innovation aligns with sustainability goals by reducing resource inputs and supporting precision agriculture, making it highly attractive to public breeders, seed companies, growers, and the bioenergy sector.

Technical Summary

The study investigates the role of *Tiller Angle Control 1 (TAC1)* homologs in upland cotton (*Gossypium hirsutum*) to optimize plant architecture for high-density planting. Phylogenetic analysis revealed six *TAC1* copies in allotetraploid cotton, a unique duplication compared to other angiosperms. Expression profiling identified A11G109300 and D11G112200 as dominant in stem and reproductive tissues. CRISPR/Cas9-mediated knockout of these homeologs produced a columnar phenotype with a threefold reduction in sympodial branch angle (from ~74° to ~51°) and narrower petiole angles, confirming their functional role in branch orientation. This genetic modification enables improved light interception and resource efficiency, offering a strategy to enhance cotton yield under dense planting conditions.

Application
Agronomic Benefits

Development Stage
TRL 2

Advantages
- Higher planting density without yield penalty.
- Improved canopy light distribution.
- Potential for mechanized harvesting and reduced labor

About the Inventor

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Dr. Chris Saski is a systems geneticist and translational scientist at the forefront of discovery, developing and delivering new methods to understand and harness the crop genome and germplasm collections, thereby advancing crop breeding, productivity, horticultural traits, and resilience to abiotic/biotic stresses. Dr. Saski recently received a highly competitive research award from NASA, CASIS, and Target to conduct cotton research aboard the International Space Station.

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