

Interspecific Chromosome Substitution Lines as Genetic Resources for Improvement, Trait Analysis and Genomic Inference

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The genetic base that cotton breeders commonly use to improve Upland cultivars is very narrow. The AD-genome species *Gossypium barbadense*, *G. tomentosum*, and *G. mustelinum* are part of the primary germplasm pool, too, and constitute genetic reservoirs of genes for resistance to abiotic stress, pests, and pathogens, as well as agronomic and fiber traits. Conventional methods of interspecific introgression into cotton typically entail inbreeding immediately after hybridization or after a few backcrosses. Traditional plant breeding approaches of interspecific crosses have been hindered by many challenges including complex antagonistic relationships between the important traits, genetic drag effect of poor agronomic qualities from alien species, loss of alien genetic materials in early generations, sterility and distorted segregation. An alternative approach to conventional introgression of alien genes for improved traits into an Upland background is via chromosome substitution (CS). Contrary to conventional backcross methods, CS entails the use of hemizygoty to preclude recombination during introgression, so that all genes within a given alien chromosome or chromosome segment are transferred into Upland cotton. We have backcross-substituted (BC₅) 20 different chromosomes and chromosome arms of *G. barbadense* into quasi-isogenic Upland cotton (CS-B) lines. Analyses of CS-B lines based on an additive-dominance genetic model have revealed intriguing effects, including inter-chromosomal epistasis. Plans are to use the CS lines for high-resolution definition and mapping of QTLs associated with important fiber and agronomic traits. Collectively, the CS lines offer an effective and complementary means of germplasm introgression, and the product CS lines are structured well enough to allow for insightful genetic analyses. We expect that CS lines for *G. tomentosum* and *G. mustelinum*, CS-T and CS-M lines will be similarly useful.