Tatum Davis, Environmental Science

University: Haskell Indian Nations University
Year in School: Junior
Hometown: Kayenta, Arizona
Faculty Mentor: Dr. Michael D. McMullen, Plant Sciences

Funding Source: U.S. Department of Agriculture-Agriculture Research Service Internship

Genetic consequences of artificial selection on amino acid synthesis: Cysteine synthase and chorismate mutase

Tatum V. Davis, Katherine Houchins, Sherry A. Flint-Garcia, and Michael D. McMullen

Genetic diversity is crucial for progress in plant breeding as well as for adaptation to future environmental challenges. Maize is the most genetically diverse crop species. Maize was domesticated from teosinte about 7,500 years ago. Both domestication and crop improvement involved selection of specific alleles at genes controlling key morphological and agronomic traits, resulting in reduced genetic diversity relative to unselected genes. The McMullen Laboratory is interested in the genetic consequences of selection on genes of agronomic importance. Prior research by the Laboratory has identified a series of selected genes, including two key genes for the synthesis of amino acids, cysteine synthase and chorismate mutase. One approach to define the importance of a gene is to isolate a mutation and examine the resulting phenotype. A Mutator insertion was isolated in the cysteine synthase gene. An F2 population segregating for an albino phenotype and the Mutator insertion was genotyped by PCR to determine if the insertion was casual for the phenotype. The albino phenotype was found to be closely linked, but distinct from the insertion site leading to the conclusion that the albino phenotype is caused by a second linked mutation. The chorismate mutase gene in maize shows strong evidence of selection, with high diversity in teosinte accessions and essentially no diversity among inbred lines. Did the selection that reduced the diversity in this gene occur at domestication or during subsequent plant breeding? To answer this question, three segments of the chorismate mutase gene were sequenced in a panel of 14 landraces, the historical intermediate between teosinte and inbreds. Four landraces contained numerous polymorphism not found in inbreds, indicating that much of the selection occurred during recent crop improvement. This result is significant as it indicates genetic diversity can be reintroduced into selected amino acid genes by crosses with landraces.