Improving Food and Nutritional Security for the Global South: The Genetic Improvement of Maize and Cassava with Smallholder Farmers

Abstract: Nutritional deficiencies are a major public health challenge facing a burgeoning human population. Maize is an important food staple, particularly in sub-Saharan African countries where it can account for more than half of daily calories. With considerable natural variation in grain carotenoid (provitamin A) levels, maize could have far-reaching impact in the global South where vitamin A deficiency is prevalent. Our joint linkage-genome wide association study of maize grain carotenoid levels in the 5000-line US nested association mapping (US-NAM) population revealed that the majority of identified quantitative trait loci (QTL) were underpinned by causal genes with a priori roles in carotenoid synthesis and degradation. More than half of the identified a priori genes were expression QTL (eQTL), showing strong correlations between gene expression levels and QTL allelic effect estimates. Most of these eQTL also had high correlation of QTL allelic effect estimates across traits, suggesting that pleiotropy within this pathway is largely regulated at the expression level. Taken together, these findings have been used to develop a pathway-level breeding approach for orange, provitamin A-biofortified maize grain with tandem consideration of the influence of combined heat and drought stress on the grain nutritional profile within a key target environment. The lessons learned from this work in maize are now being collaboratively leveraged for the development of provitamin A-biofortified cassava for Nigeria and Uganda. Additionally, mobile apps for field-based high-throughput phenotyping are being developed to improve the efficiency of selection for farmer-preferred traits in cassava breeding programs.

For more information, please see http://www.stat.purdue.edu/~minzhang/598_Spring2017/schedule.htm.