Identifying cold tolerance alleles from a Mexican highland variety for modern Maize improvement

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Climate change poses a significant threat to crop sustainability, with rising temperatures and environmental fluctuations reducing agricultural productivity. Planting maize earlier in the season could improve nitrogen uptake, increase yield, and reduce greenhouse gas emissions, but this approach increases exposure to colder temperatures, which limits maize growth and yield (**1**). One approach to do this is to leverage genetic diversity, including introgressions from maize's wild ancestor *Zea mays ssp. mexicana*, which has shown promise in enhancing cold tolerance and adaptation to environmental extremes. The laboratory of Dr. Rubén Rellán Álvarez and collaborators at Penn State University, Dr. Ruairidh Sawers and Sergio Pérez-Limón, have recently developed 229 recombinant inbred lines (RILs) from the well-characterized temperate inbred line of maize, B73, and a Mexican highland variety, Palomero Toluqueño (PT) (**2**). These RILs provide a valuable genetic framework to investigate the genetic basis of maize adaptation to low temperatures. I hypothesize that *mexicana* introgressions in PT contain critical genetic variants that can enhance cold stress tolerance in modern commercial maize. To investigate this, I will grow all 150 RILs under both control and cold stress conditions. Through phenotyping and expression analysis I will identify regulatory genes that play a role in cold stress response. Then I will validate these genes by introducing a variant from the introgressed regions of PT that enhances cold tolerance into a B73 individual. This research will advance our understanding of the genetic basis of cold stress tolerance in maize and provide valuable insights for the development of more resilient commercial varieties through existing genetic diversity.