Unique adaptation mechanisms to environmental stress combinations in grasses.

Zvi Peleg, The Robert H. Smith Institute of Plant Sciences and Genetics in Agriculture, The Hebrew University of Jerusalem, Rehovot 7610001, Israel.

Abstract

Abiotic stresses such as drought, salinity and high temperatures greatly affect plant growth and productivity worldwide. While plants response to environmental stress have been routinely studied in plants by applying a single stress condition, this type of analysis does not reflect the conditions that occur in the field where crops are subjected to a combination of different stresses. Thus, because the majority of molecular/physiological and genetic studies do not reflect the field conditions, a considerable gap exists between the information gained by these studies and the knowledge needed to develop crops with enhanced tolerance to the stress conditions. The cereal model species, *Brachypodium distachyion*, was characterized under single stress conditions (salinity, drought, and heat) and combinations of these stresses (salt+heat, drought+heat, drought+salt, drought+salt+heat). Morpho-physiological characterization revealed significant differences in plant responses to single stresses *versus* stress combinations in productivity traits and physiological traits. Transcriptome and metabolomics profiling showed that the different treatments elicited both common and unique expression patterns. Using a complementary physiological and functional genomics methodologies we were able to identify novel genes and metabolic pathways associated with plant adaptations to abiotic stress combinations. Our results shed light on the genetic networks and mechanisms employed by plants in response to environmental stress combinations at the reproductive stage and will play fundamental roles in developing cereal crops with improved tolerance and enhance yields under field conditions.