Genetic determinant function in plant salinity and drought stress tolerance

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Today, an estimated 70% of water required by humans is used for agriculture, which contributes substantially to declining worldwide fresh water resources. Even with implementation of effective water saving policies, the growing world population will require agricultural intensification to ensure world food security in the next decades, which will further tax already insufficient fresh water resources. Water scarcity has required that, in many areas of the world, crops are grown on saline soils or are irrigated with saline water. This practice is unsustainable with the germplasm of present day agricultural crops for which farmers are able to obtain about 20% of the genetic yield potential because of drought and salinity stress effects that reduce biomass production and yield, and even survival. A goal for agriculturalists and plant biologists has been and continues to be identification of salt and drought stress tolerance genetic determinants and characterization of how these function. These determinants must enable crops to not only adapt or acclimate to low and saline water availability but also to maintain adequate harvest indices. To that end, research on model plants such as *Arabidopsis thaliana* has led to identification of genes that are mechanistically involved in physiological processes that alleviate or allow plants to cope with salt and drought stress. For example, critical determinants involved in intracellular and *in planta* Na^+ homeostasis have been identified and functionally characterized. These determinants are ion transport proteins such as HKT1, a uniporter that controls Na^+ loading into the root xylem and accumulation in leaves. Interestingly, in both rice and wheat, *HKT1s* have been identified in quantitative trait loci (QTL) as the genes responsible for enhanced salt tolerance in breeding materials. This presentation will summarize current understanding of salt and drought tolerance determinants, and describe near-term prospects and approaches for enhancing crop production under conditions of low and saline water conditions.