ABI5 Is a Regulator of Seed Maturation and Longevity in Legumes

The preservation of our genetic resources and production of high-quality seeds depends on their ability to remain viable and vigorous during storage. In a quantitative trait locus analysis on seed longevity in Medicago truncatula, we identified the bZIP transcription factor ABSCISIC ACID INSENSITIVE5 (ABI5). Characterization of Mt-abi5 insertion mutant seeds revealed that both the acquisition of longevity and dormancy were severely impaired. Using transcriptomes of developing Mt-abi5 seeds, we created a gene coexpression network and revealed ABI5 as a regulator of gene modules with functions related to raffinose family oligosaccharide (RFO) metabolism, late embryogenesis abundant (LEA) proteins, and photosynthesis-associated nuclear genes (PhANGs). Lower RFO contents in Mt-abi5 seeds were linked to the regulation of SEED IMBIBITION PROTEIN1. Proteomic analysis confirmed that a set of LEA polypeptides was reduced in mature Mt-abi5 seeds, whereas the absence of repression of PhANG in mature Mt-abi5 seeds was accompanied by chlorophyll and carotenoid retention. This resulted in a stress response in Mt-abi5 seeds, evident from an increase in α-tocopherol and upregulation of genes related to programmed cell death and protein folding. Characterization of abi5 mutants in a second legume species, pea (Pisum sativum), confirmed a role for ABI5 in the regulation of longevity, seed degreening, and RFO accumulation, identifying ABI5 as a prominent regulator of late seed maturation in legumes.