Ionome to Genome: Tales of Gene Discovery

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Understanding how seeds, often the edible portion of the plant, obtain and store nutrients is key to developing crops with higher agronomic and nutritional value. Most of our work has been focused on the essential micronutrients iron, manganese and zinc. Combining genetics, high throughput elemental analysis via ICP-MS and high resolution imaging via synchrotron X-ray fluorescence, we have identified and characterized a number of Arabidopsis mutants that have increased tolerance to iron deficient growth conditions and have increased iron accumulation relative to wild type plants. One of these, Ig14, has a similar metal content to wild type when grown on normal soil, but thrives on alkaline soil, accumulating significantly more iron in its shoot and seeds. A triple mutant of three closely related negative regulators of the iron deficiency response (*bts-1 btsl1 btsl2*) has increased tolerance to iron deficient growth conditions and increased iron accumulation without resulting toxicity. We have also uncovered unique patterns of iron and manganese localization in seeds and have now shown that the vacuolar transporters VIT1 and MTP8 are responsible for setting up these patterns, allowing us to determine whether the patterns are biologically significant and, ultimately, whether they can be altered in support of biofortification of staple crops.

We are also taking similar approaches to determine how arsenic, a non-threshold, Class 1 human carcinogen, accumulates in plants. Rice, a staple food for over half the world's population, represents a significant dietary source of arsenic. It is imperative that strategies to reduce grain arsenic are developed, and identifying the mechanisms that enable arsenic to reach and accumulate within the rice grain is key to this endeavor.