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Shedding Light on Metal Uptake, Distribution and Storage in Plants

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Deficiencies of metal micronutrients commonly limit plant growth and crop yields. Furthermore, as most people rely on plants as their dietary source of micronutrients, plants that serve as better sources of essential nutrients would improve human health. We combine genetics, high throughput elemental analysis via inductively coupled plasma mass spectrometry (ICP-MS) and high-resolution imaging via synchrotron X-ray fluorescence (SXRF) to identify and characterize genes involved in metal uptake, distribution and storage. We had previously uncovered unique patterns of iron and manganese localization in seeds of the model plant Arabidopsis and have shown that the transporters VIT1 and MTP8, respectively, are responsible for setting up these patterns, allowing storage of iron and manganese in vacuoles. In addition to showing that storage of iron in the seed vacuole is essential for successful seedling establishment, we now have evidence that suggests iron is also required for successful germination. During germination, endosperm cell walls must weaken to allow the embryonic root to protrude. The endosperm accumulates iron close to the site of radicle protrusion in both Arabidopsis and tomato seeds. Using a combination of physiological experiments on wild type plants and mutants with defects in iron transport, we have confirmed that proper iron localization is indeed required for timely germination. Seed quality traits include fast transition to the seedling stage and enhanced tolerance to stresses including metal deficiencies. Both of these traits require proper iron localization in the seed and are of great importance for achieving higher yields in agriculture.

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