BREEDING FOR PLANT PHYSIOLOGICAL TRAITS RELATED TO HIGH MICRONUTRIENT-MINERAL DENSITY IN GRAINS

Ross M. Welch [1]

[1]Department of Crop and Soil Sciences, Cornell University, Ithaca, NY, USA, Ross.Welch@ars.usda.gov

The accumulation of micronutrient-mineral in grain is controlled by the complex interaction of homeostatic mechanisms that regulate their uptake by roots from soil solution, translocation from roots to shoots and re-translocation to reproductive organs and grain. A myriad of plant genes are involved in these processes. Various edaphic factors, rhizosphere processes and root exudates control the available micronutrient supply at the root-soil interface. Micronutrient uptake into root cells to enter the cellular symplasm occurs via specific membrane transporter proteins. Movement from roots to shoots involves loading of micronutrients into vascular elements including both xylem and phloem tissues via another set of membrane transporters. Movement to grain via the xylem sap is limited because of reduced transpiration in reproductive tissues and to xylem vessel discontinuities in some cereal species. Transfer from shoot to reproductive organs requires the loading of micronutrient-metals into phloem sap where mass flow carriers them to these organs following source-sink relationships mostly driven my sugar synthesis and movement. Transport proteins unload them at sites where they can be loaded into reproductive tissues. Grain loading requires the trafficking of micronutrients into aleurone transfer cells or into developing embryo tissues again controlled by transport proteins. Movement within the tissues of the grain is also dependent on other sets of transport proteins but little is known about these processes. Current knowledge suggests that the most limiting step in moving micronutrient-minerals to developing grain is their loading into and unloading out of the phloem sap. Therefore, focusing on the traits that control these processes may lead to significant increases in grain-loading of micronutrient minerals. This review will primarily focus on Fe movement to grain because most of the research in this area has focused on Fe and very little is known about the movement of the other micronutrient minerals into grain.