Study contributes to research addressing malnutrition and iron deficiency

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Dartmouth biologists are leading a research team that has learned where and how some plant seeds store iron, a valuable discovery for scientists working to improve the iron content of plants. This research helps address the worldwide issue of iron deficiency and malnutrition. Their findings were published online on Nov. 2 at *Science Express*, the advance publication site for the journal *Science*.

The team found that iron is stored in the developing vascular system of the seed of Arabidopsis, a model plant used in research; in particular, iron is stored in the vacuole, a plant cell's central storage site. The researchers also learned that this localization is dependent on a protein called VIT1, shown to transport iron into the vacuole.

Dartmouth Professor of Biological Sciences Mary Lou Guerinot, the principal investigator on the study, says, "Iron deficiency is the most common human nutritional disorder in the world today, afflicting more than three billion people worldwide. Most of these people rely on plants for their dietary iron. However, plants are not high in iron, and the limited availability of iron in the soil can limit plant growth. Our study certainly suggests that iron storage in the vacuole is a promising and, before now, largely unexplored target for increasing the iron content of seeds. Such nutrient-rich seed would benefit both human health and agricultural productivity."

The researchers combined traditional mutant analysis (turning on and off the VIT1 protein) with a powerful X-ray imaging technique to create a

map of where iron is localized in the seed. Guerinot was surprised by the finding because most studies on iron storage focus on the protein ferritin. This paper reveals how important it is to look beyond ferritin to understand how iron is stored by plants. The researchers say that their study suggests that the stored iron in the vacuole is an important source of iron for developing seedlings. Seedlings that do not express the VIT1 protein grow poorly when iron is limited.

"We have demonstrated the usefulness of synchrotron X-ray fluorescence microtomography to look inside a seed," says Guerinot. "This technique is noninvasive and requires no sample preparation. We think our work will open the way for many more biologists to use this technique to examine the spatial distribution of metals in samples of interest." The imaging was carried out at the Department of Energy's National Synchrotron Light Source at Brookhaven National Laboratory.

Source: Dartmouth College