Tissue-specific regulation of gibberellin signaling fine-tunes the iron availability responses

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Iron deficiency is one of the most common micronutrient deficiencies in the world, and World Health Organization estimates that more than 10% of the world population suffers from iron malnutrition. Plant foods are the principal iron source for humans. Hence, improving iron content and bioavailability in plant food products would be an efficient and economical way to fight human iron malnutrition.

Plants have evolved efficient mechanisms to cope with iron-deficiency and various phytohormones have been implicated (Kobayashi and Nishizawa, 2012). Gibberellins (GAs) are a class of plant growth-promoting hormones that play important roles throughout plant development, including seed germination, growth, floral transition, and in many aspects of the adaptation of plant growth in response to environmental variable inputs. GAs control a wide range of processes by opposing the function of the DELLA proteins, a family of nuclear growth repressors (Peng et al., 1997). When GA levels are low, DELLAs accumulate and modulate the activity of key regulatory proteins, including members of the bHLH family of transcription factors (TFs), involved in diverse pathways. (Davière and Achard, 2013).

Our data show that the GA-signaling DELLA repressors contribute substantially in the adaptive responses to iron-deficient conditions. In *Arabidopsis*, *FER-like IRON-DEFICIENCY INDUCED TRANSCRIPTION FACTOR* (*FIT*) encodes a bHLH-TF that activates the expression of iron uptake machinery genes in root epidermis upon iron deficiency (Colangelo and Guerinot, 2004). We demonstrate that DELLAs physically interact with FIT to prevent its binding to target promoters, inhibiting its transcriptional activity. Limited iron availability antagonizes such repression by reducing DELLA abundance in epidermal cells in the root differentiation zone and as a consequence fully activates FIT downstream target gene expression and thus iron uptake. Overall, our data highlight that spatial distribution of DELLAs in roots is essential to fine-tune the adaptive responses to iron availability.

Colangelo EP, Guerinot ML (2004) The essential basic helix-loop-helix protein FIT1 is required for the iron deficiency response. Plant Cell **16**: 3400-3412.
Davière JM, Achard P (2013) Gibberellin signaling in plants. Development **80**: 462-474.
Kobayashi T, Nishizawa NK (2012) Iron uptake, translocation, and regulation in higher plants. Annu. Rev. Plant Biol. **63**: 131-152.
Peng, J., Carol, P., Richards, D.E., King, K.E., Cowling, R.J., et al. (1997). The *Arabidopsis GAI* gene defines a signaling pathway that negatively regulates gibberellin responses. Genes Dev. **11**: 3194-3205.