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Addressing the diversity of the mechanisms involved in metal hyperaccumulation in plants

Sylvain MERLOT^{1,2}, Celestine BELLOEIL¹, Melina Gallopin¹, Vanesa GARCIA DE LA TORRE¹,
Dubiel ALFONSO GONZALEZ³ and Yohan PILLON⁴

¹*Institute for Integrative Biology of the Cell, CEA, CNRS, Paris-Saclay University, France*

²*Laboratoire de Recherche en Sciences Végétales, Toulouse University Paul Sabatier, CNRS, INP
Toulouse, France*

³*Jardín Botánico Nacional, Universidad de La Habana, Cuba*

⁴*Laboratory of Tropical and Mediterranean Symbiosis, IRD, CIRAD, INRA, Montpellier University,
France*

sylvain.merlot@univ-tlse3.fr

Abstract

The extraordinary ability to accumulate and tolerate tremendous amounts of metals such as nickel, zinc, or manganese in their leaves has been observed in about 700 plant species belonging to more than 50 families. For many years, these metal hyperaccumulator species have attracted the attention of scientists interested in understanding the evolution of this complex and peculiar trait. In the context of the decarbonization of energy, metal hyperaccumulators appear as an opportunity to develop phytotechnologies aimed at limiting the metal pollution associated with the growing demand for metals. However, our knowledge of the molecular mechanisms involved in metal hyperaccumulation, which is key to the development of these technologies, is still very limited.

To extend our knowledge of the diversity of hyperaccumulator species, we participated in a global effort to identify new hyperaccumulator species using the X-ray fluorescence technology focusing on the flora of the neotropical region. Our herbarium and field studies revealed the first example of a zinc hyperaccumulator from the Amazonas region, as well as new nickel hyperaccumulators originating from Cuba.

The identification of nickel hyperaccumulators and closely related non-hyperaccumulator species from different families has opened the possibility to perform comparative cross-species transcriptomic studies to identify orthologous genes whose expression is linked to nickel hyperaccumulation. Among candidate genes, our analyses revealed that the high expression in leaves of metal transporters of the IREG/ferroportin family is a highly conserved mechanism involved in nickel hyperaccumulation across distant plant species.

We are now developing the multi-metal hyperaccumulator *Noccaea caerulescens* of the Brassicaceae family as a genetic model to validate and study the role of candidate genes in metal hyperaccumulation.

KEYWORDS

cross-species transcriptomics, hyperaccumulator, ireg/ferroportin, metal transporter, nickel, noccaea caerulescens