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Leaf elementomics in chlorophyll-deficient wheat mutants

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The availability of specific metal ions in the soil is a prerequisite for sufficient chlorophyll synthesis and proper assembly of photosynthetic complexes in plants. It is not known whether a partially impaired chlorophyll synthesis due to genetic mutations could result in an imbalanced elemental composition of leaves. To investigate the potential relationship between chlorophyll accumulation and geochemical composition of leaves, a minipanel of six bread and durum wheat lines with reduced chlorophyll content in leaves was analysed in comparison with the corresponding wild-type cultivars. Such wheat lines are well characterized with respect to their photosynthetic functionality, and some strong endpoints were identified to assess the phenotype severity [1]. The eight wheat lines were cultivated in the same soil at the Botanical Garden of Ferrara (Italy), and leaves were analysed for their elemental composition after the tillering stage. The major element composition of the soil was characterized by X-ray Fluorescence (XRF); high-throughput inductively-coupled triple-quadrupole plasma-mass spectrometry (QQQ-ICP-MS) was used to determine the element concentrations down to the ultratrace in leaves and soil. The elemental profiles were compared to the phenotype severity series ascertained by fast chlorophyll a fluorescence emission [2]. The mutations were not followed by notable changes in the elements more directly involved in the pigment or photosynthetic membrane synthesis (Fe, Mg, Cu, Mn). The most interesting finding regarded the specific enrichment in Rare Earth Elements (REE) in the mutants, which was consistent with the phenotype severity. The results indicate that elementomics can contribute significantly to the phenotypic characterization of chlorophyll-deficient mutants and opens up a new application of REE chemometrics in plant biology.

[1] Colpo, Demaria, Baldisserotto, Pancaldi, Brestič, Živčak & Ferroni (2023), *Plants* 12, 822.

[2] Ferroni, Živčak, Kovar, Colpo, Pancaldi, Allakhverdiev & Brestič (2022), *Journal of Photochemistry and Photobiology B: Biology* 234, 112549.