Phenotyping for iron deficiency chlorosis at a morphological, biochemical and multispectral level

Carla S. Santos[1], David Araújo[2], Susana M.P. Carvalho[12], Mohammad-Reza Hajirezaei[3], Ricardo Gieh3[4], Nicolaus von Wirén[3], Marta W. Vasconcelos[1]

[1]CBQF – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa, Porto, Portugal
[2]GreenUP/CITAB-UP & DGAOT, Faculty of Sciences, University of Porto, Vairão, Portugal
[3]Molecular Plant Nutrition, Department of Physiology & Cell Biology, Leibniz-Institute of Plant Genetics and Crop Plant Research, Gatersleben, Germany

Introduction

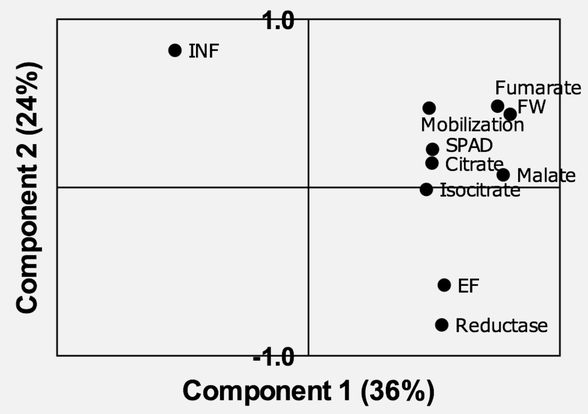
Iron (Fe) is an essential mineral nutrient for plant growth. Albeit present in the soil in high concentrations, it is often deficient for uptake in calcareous conditions, because it is mostly present in an oxidized state. Like most crops, **soybean** (Glycine max. L) is prone to developing **Iron Deficiency Chlorosis (IDC)**, a condition that severely affects plant growth. **Phenotyping** plants at a whole-plant, organ and cellular level is essential to understand the mechanisms underlying Fe uptake, trafficking and homeostasis and this integrated view is essential in order to prevent IDC. The main objective of this work was to characterize the response of different soybean lines to IDC and test a new, **non-invasive**, methodology for **early detection** of mineral deficiencies to be applied in field conditions.

Methods

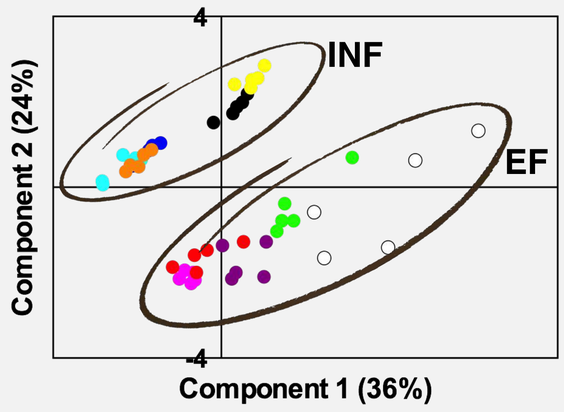
- 10 soybean lines were grown under Fe limitation and Fe sufficiency, and their root exudates were collected, concentrated and subjected to analysis for organic acids and Fe mobilization capacity;
- The best overall performing line was grown under Fe limitation and Fe sufficiency for 15 days in a time-course trial and total fresh weight, total chlorophyll concentration and root reductase activity were measured.
- Reflectances at wavelengths between 450-950 nm were measured and correlations with the physiological measurements were established

Results / Discussion

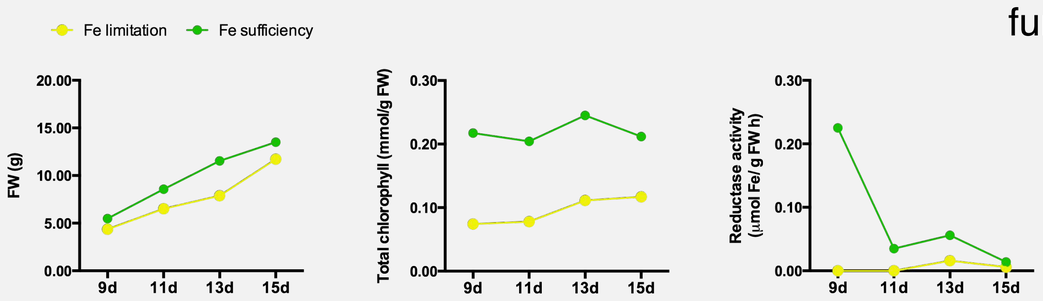
Fe chlorosis is characterized by the yellowing of the leaves and yield losses

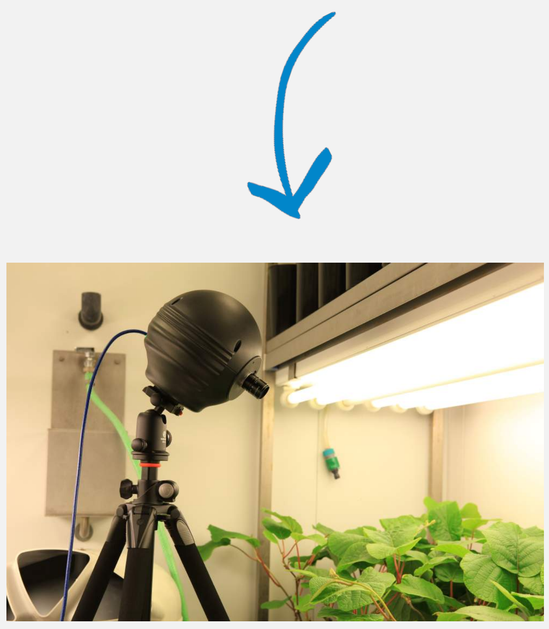


According to these factors, soybean lines were separated in inefficient (INF) or efficient (EF)

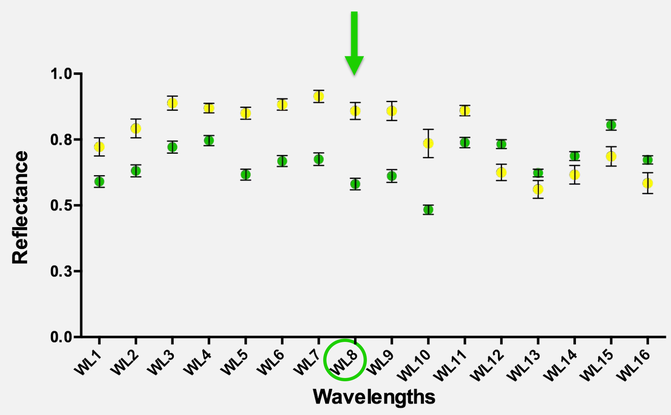


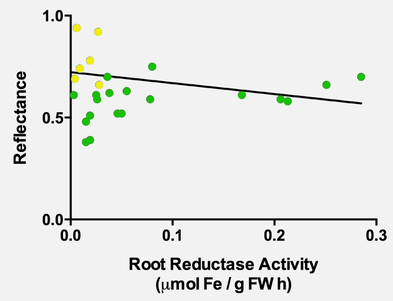
The best performing line was selected for further analysis



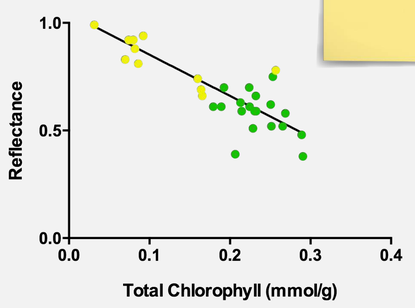


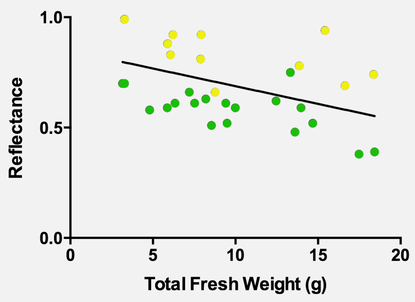
The most significant!





Total chlorophyll concentration was highly correlated to the reflectance (r^2 = 0.724)





Multispectral Analysis was performed with a XpeCAM X01

Conclusions

- ✧ The efficiency trait was highly correlated to ferric reductase activity;
- ✧ We were able to identify the most significant wavelength that could be a good Fe chlorosis indicator;
- ✧ This technology could be applied to field conditions as an early detector of Fe and other nutrients deficiencies.

Acknowledgements

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