

Discriminating Fe deficient soybean plants by Fourier Transform Infrared Spectroscopy

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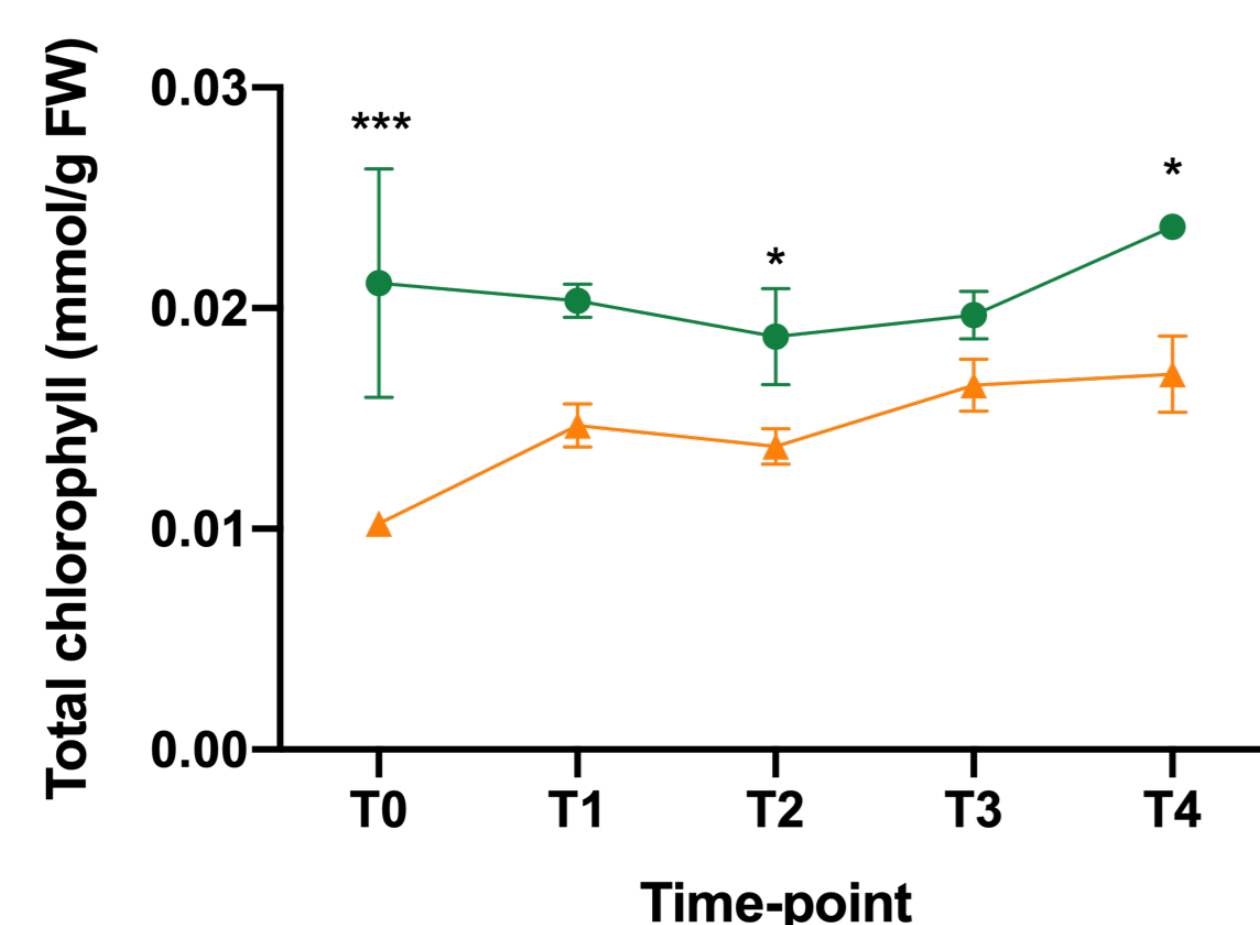
Overview

To foster sustainable agricultural practices, the present work studied the potential of Fourier transform infrared (FTIR) spectroscopy in iron deficiency chlorosis (IDC) diagnosis. Soybean plants grown under Fe sufficiency (Fe+) and Fe deficiency (Fe-) for four weeks, were collected and analysed using different enzymatic and molecular techniques. The obtained data, together with the FTIR spectra, were analysed and modelled, and the results confirmed the potential of FTIR to discriminate between Fe+ and Fe- plant samples.

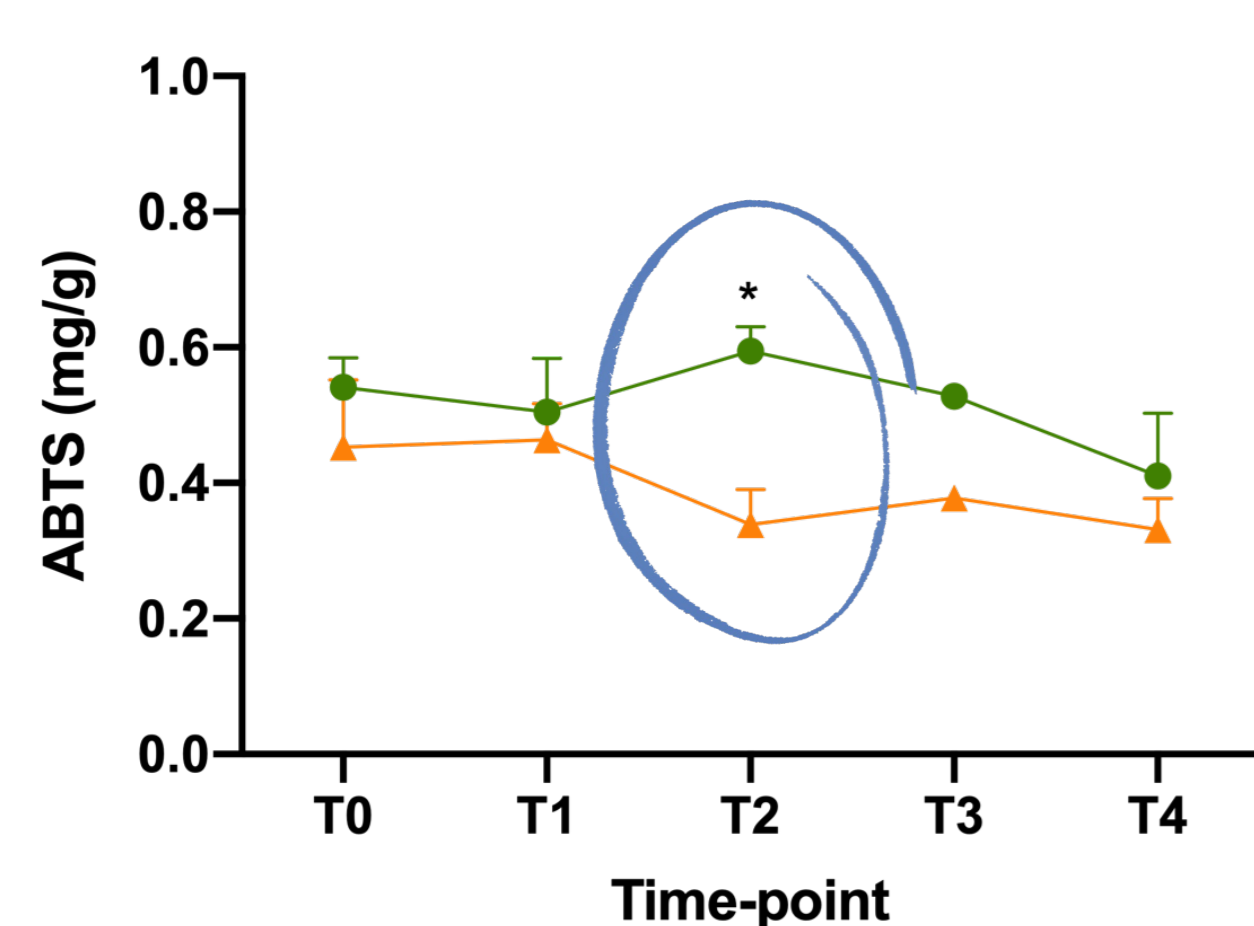
Introduction

Iron deficiency chlorosis (IDC) is a serious environmental problem that affects several crops in the world. Under alkaline soils, Fe bioavailability is limited and plants suffer from leaf yellowing, stunted growth and yield losses. Finding **early, non-invasive, detection methods for IDC is of great agronomic importance**, as these may help farmers improve fertilization timings and avoid economic losses. Fourier transform infrared (FTIR) spectroscopy have been explored as an easy use, cheap, and environmentally friendly technique for several proposes as plant species and/or cultivars discrimination. The main goal of this work was to **test the ability of FTIR spectroscopy to discriminate two groups of soybean (*Glycine max*) plants treated under different Fe stress conditions**.

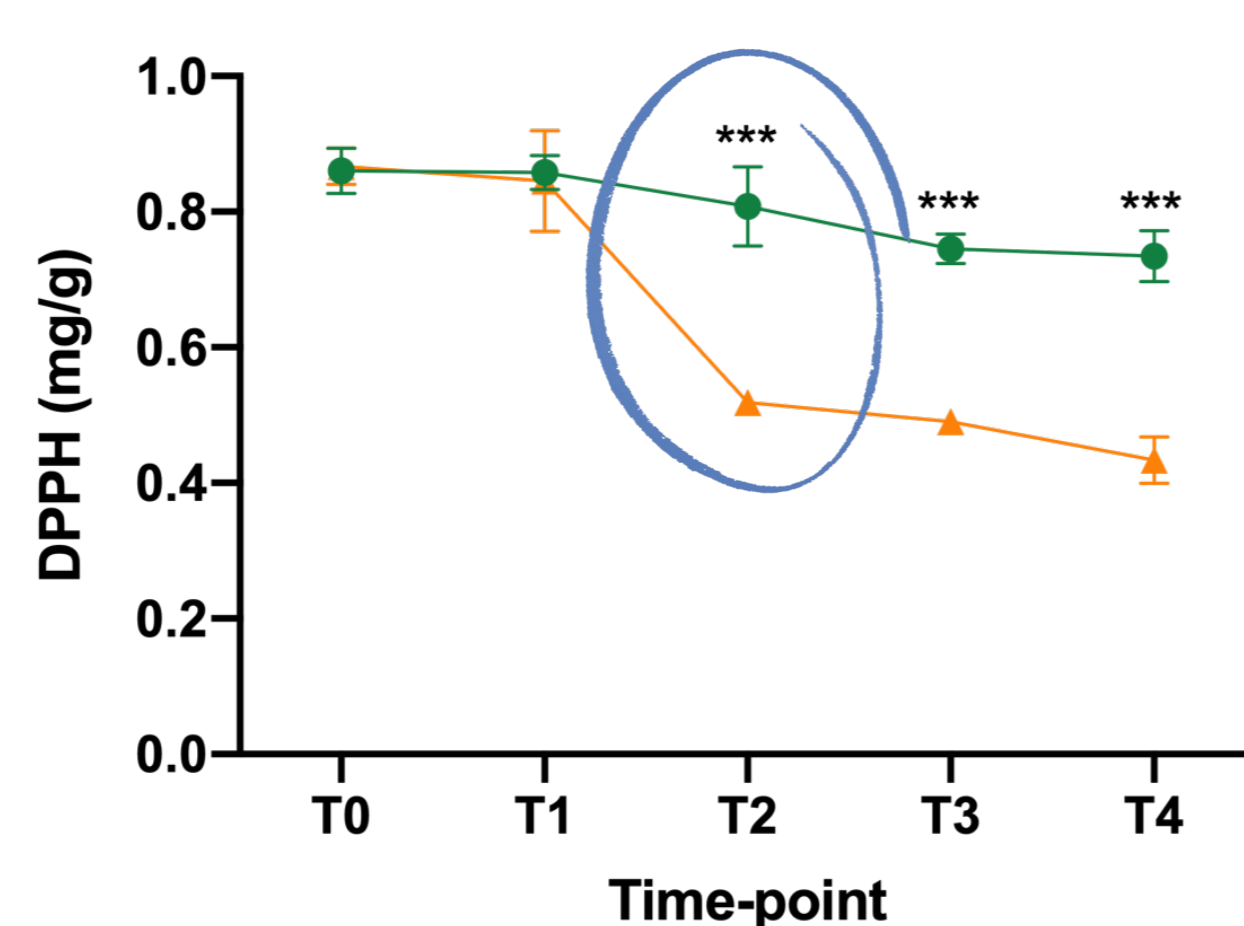
Results & Discussion



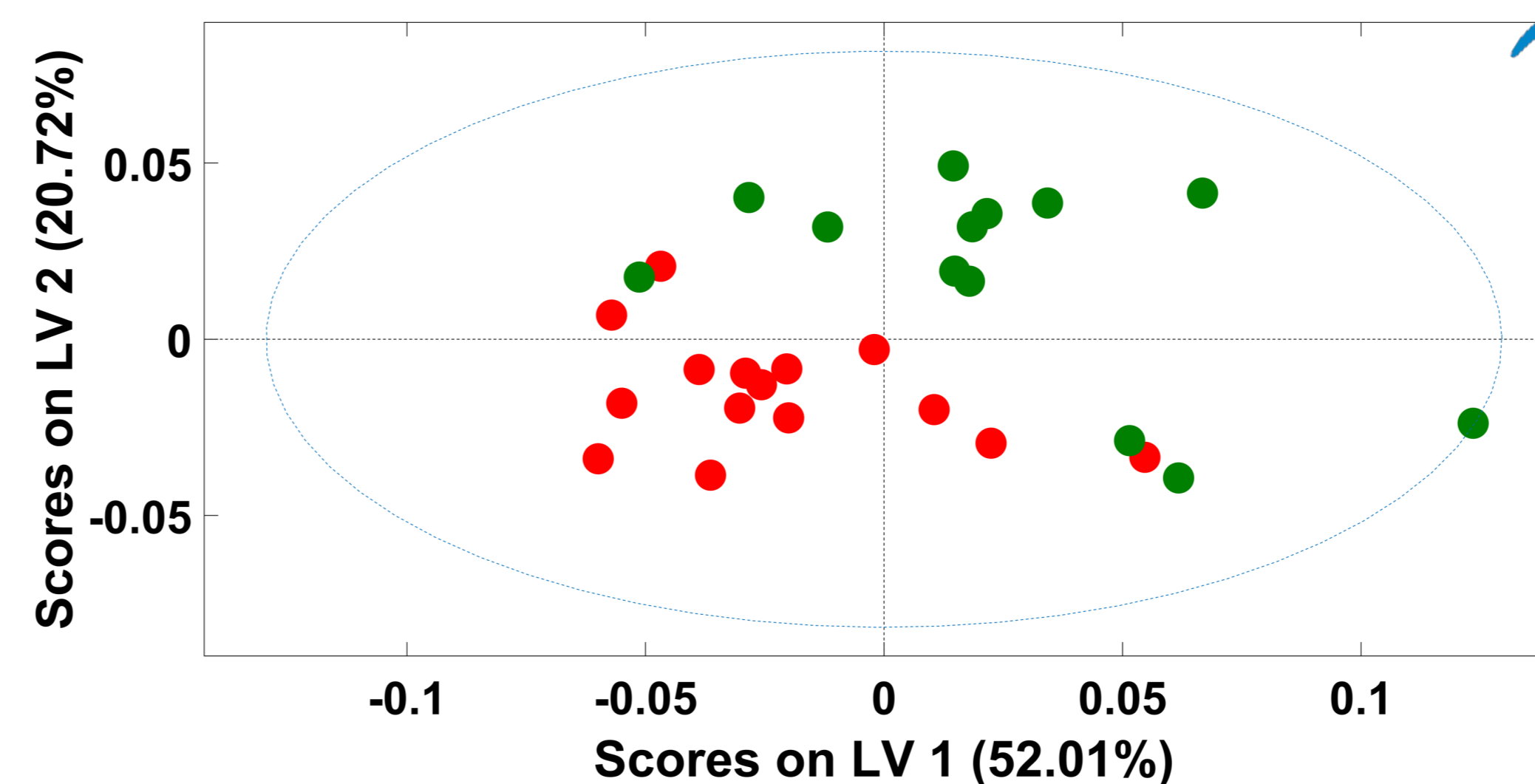
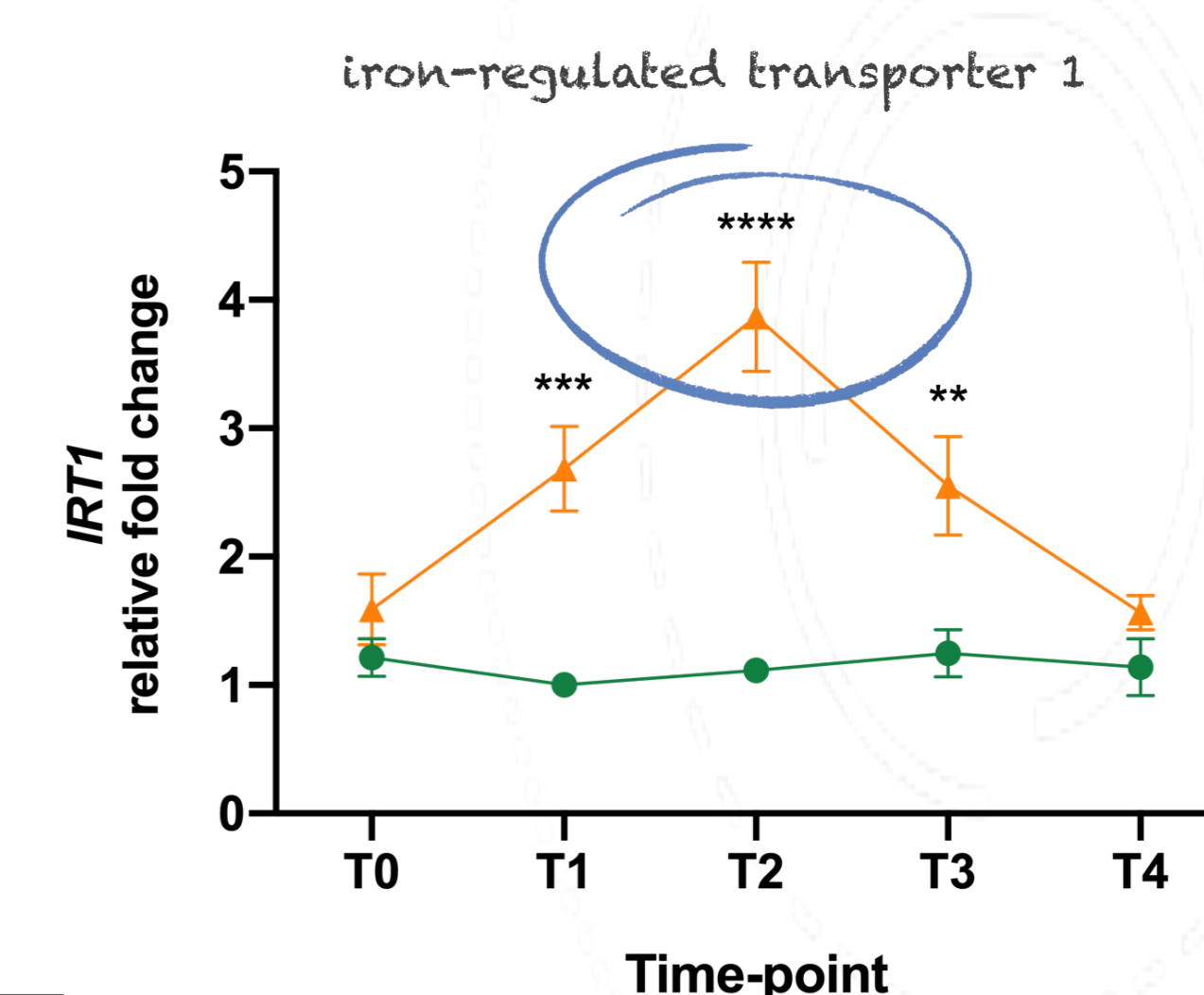
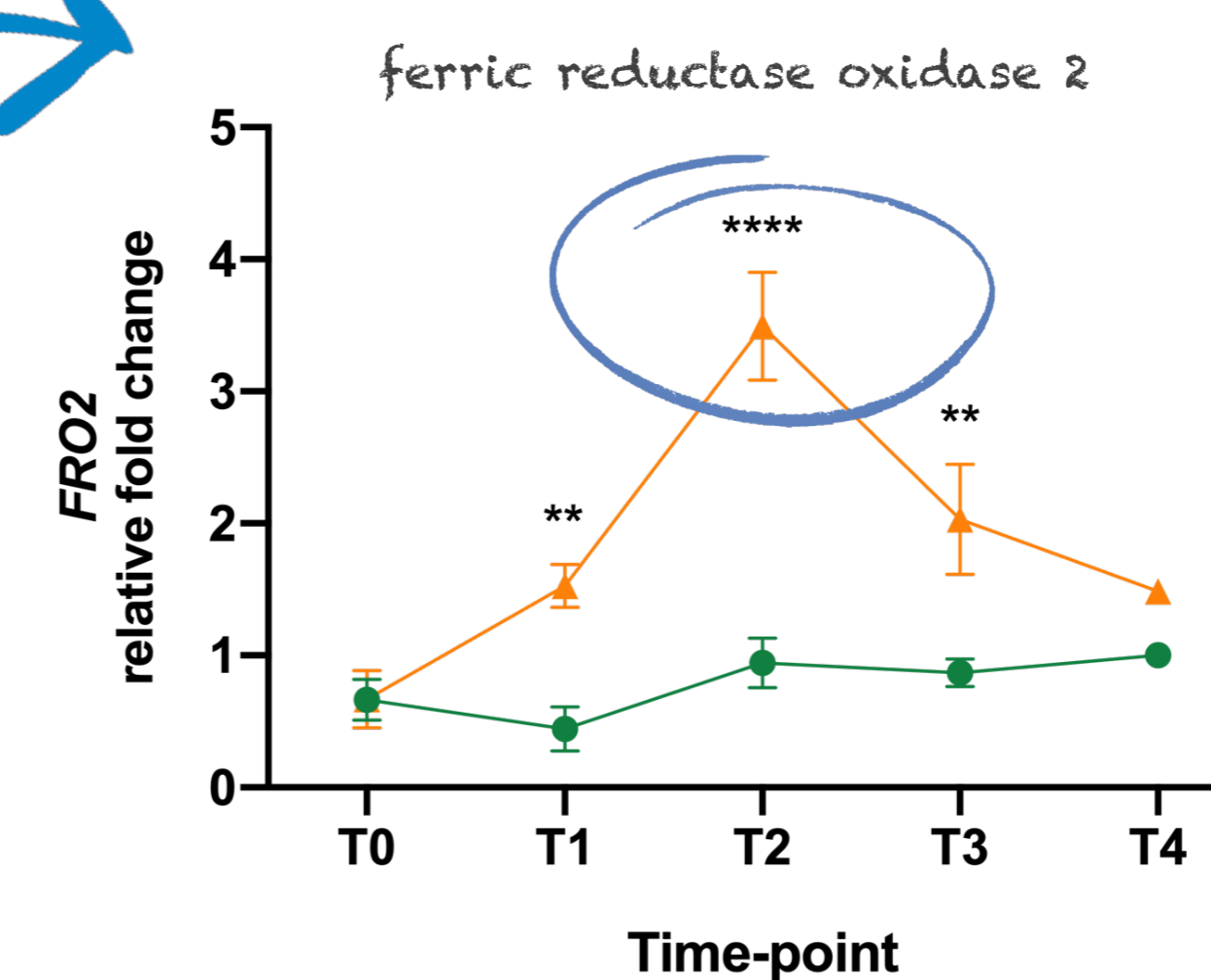
1. Photosynthetic pigments quantification showed that Fe- plants displayed IDC symptoms



2. The antioxidant activity significantly changed at T2 in Fe- plants



3. The gene expression of Fe-deficiency related genes was increased at T2



4. FTIR spectra

The developed model was able to discriminate between Fe+ (green dots) and Fe- (red dots) plants

Conclusions

- Plants without Fe supplementation displayed IDC symptoms, specifically **decrease leaf chlorophyll concentration**;
- Two weeks after imposing Fe stress – **at T2** – plants seem to have **increased oxidative stress** and **Fe-related genes expression** to cope with IDC;
- FTIR spectroscopy can potentially provide a rapid, easy, and non-invasive way to detect IDC.**

Methods

- Fe +
- ▲ Fe -



After two weeks of hydroponic growth under Fe supplemented conditions (20 μ M of Fe (III)-EDDHA), plants were divided into:

- Fe sufficient plants (Fe+), supplemented with 20 μ M of Fe (III)-EDDHA
- Fe deficient plants (Fe-) no Fe supplementation.

On the day of the imposition of the Fe supplementation regimens (T0), and in the following 1, 2, 3 and 4 weeks (T1, T2, T3 and T4), three Fe+ and three Fe- plants were sampled for analysis.

Leaf samples were analysed for:

- photosynthetic pigments concentration
- antioxidant activity (ABTS and DPPH scavenging assays)
- Fe-related genes expression (*FRO2* and *IRT1*)

Acknowledgements

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