



Effect of nickel and Iron stress on photosynthesis and metabolite production of *Heterocapsa* cf. *bohaiensis* (dinoflagellate).

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Effect of nickel and iron stress on photosynthesis and metabolite production of *Heterocapsa cf. bohaiensis* (dinoflagellate)

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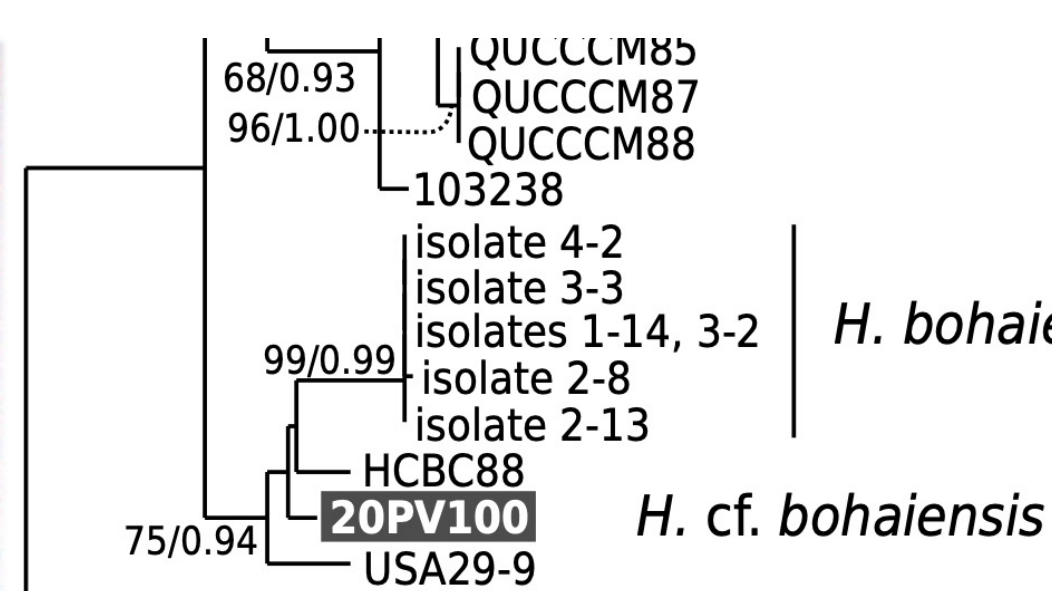
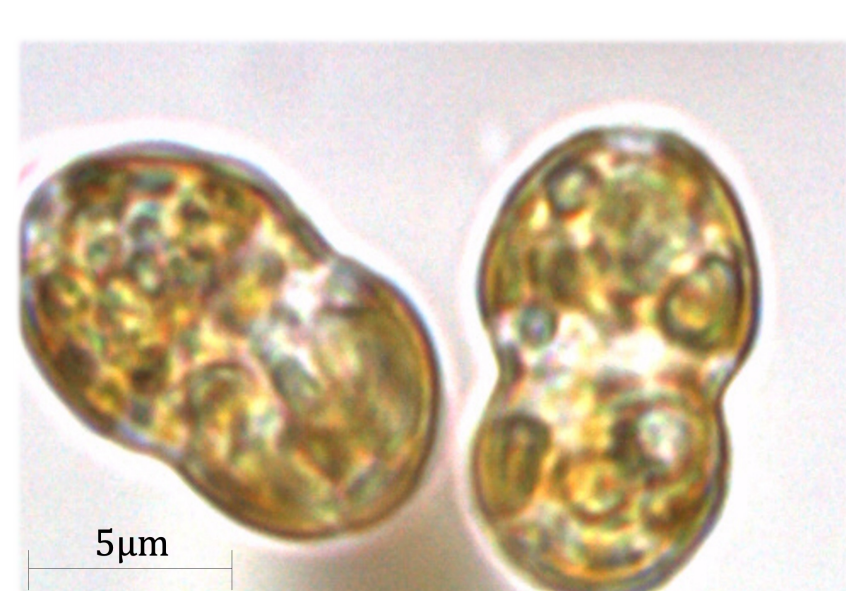
Introduction

- New Caledonian coastal waters are rich in **Trace Metal Elements** owing to the presence of **ultramafic soils** on 1/3 of its land surface. Trace Metal Elements are naturally present on coastal ecosystems as a result of **leaching** and **natural** erosion but their **concentrations** have **increased** due to **anthropic** activity and **climate change**. (Biscéré *et al.* 2017; Merrot *et al.* 2022)
- The **oxidative stress** induced by an **excess** of metallic inputs has therefore a strong capacity to impact the **physiological** response and the **metabolome** of **microalgae**.
- ***Heterocapsa cf. bohaiensis***, is a dinoflagellate with **haemolytic activity** associated to crab and shrimp **mortalities** and has been isolated in New Caledonia (Xiao *et al.* 2018; Zhang *et al.* 2019).
- Moreover, **dinoflagellates** are known to produce **metabolites of interest** (e.g. carotenoids, mycosporine amino acids, biotoxins...) with interesting bioactivity.

What are the nickel and iron impacts on *H. cf. bohaiensis* photosystems and metabolite production ?

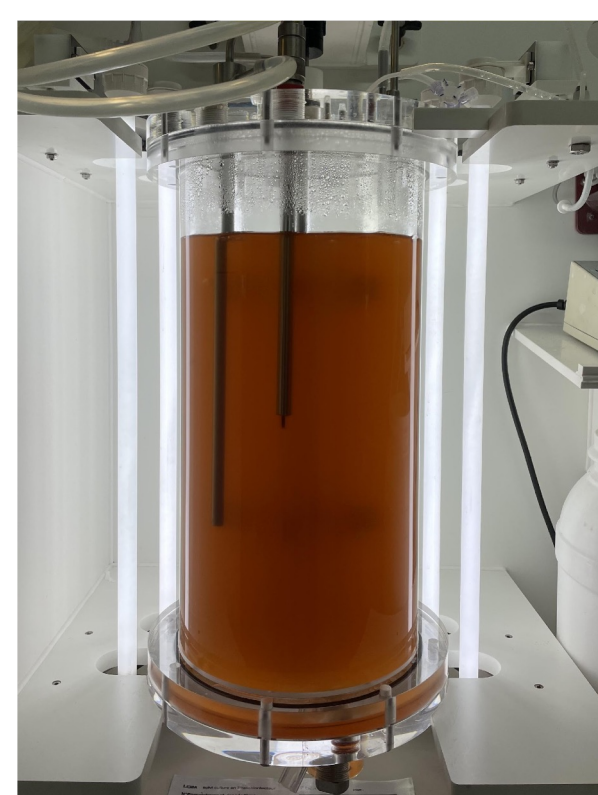
Methods

Identification



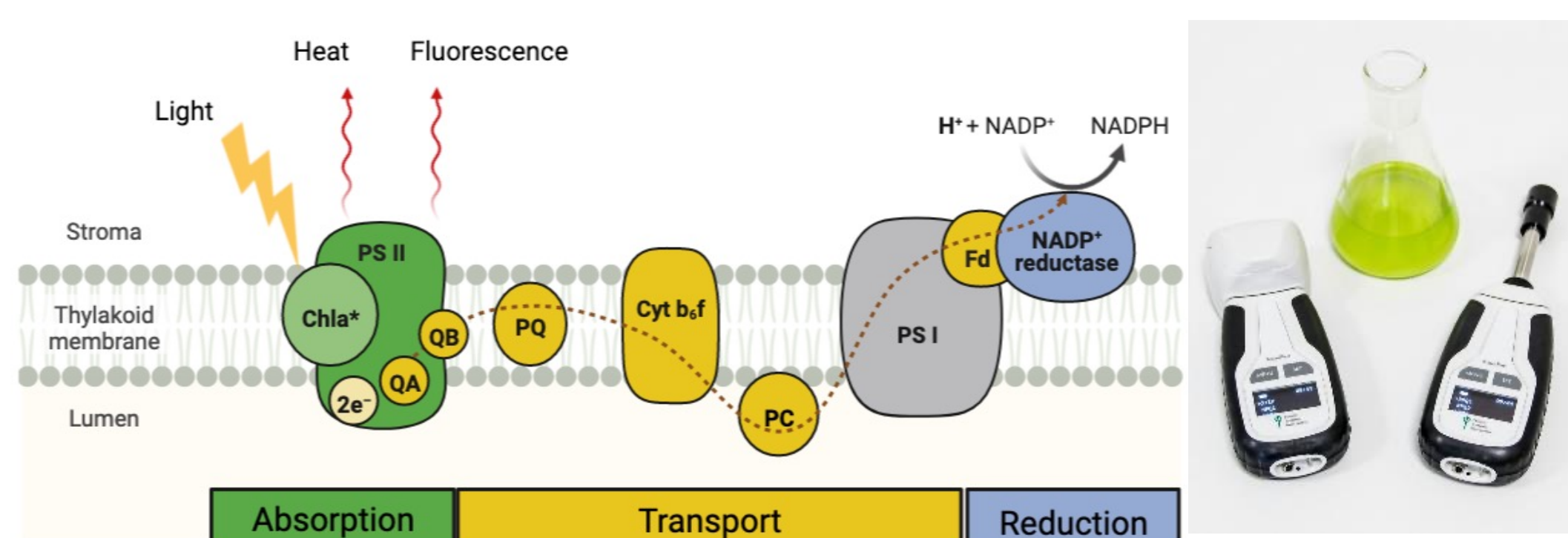
Heterocapsa cf. bohaiensis

Cultivation with metals



Conditions:
Ni, Fe or Ni-Fe [10^{-3} M]

Photosynthetic measurements

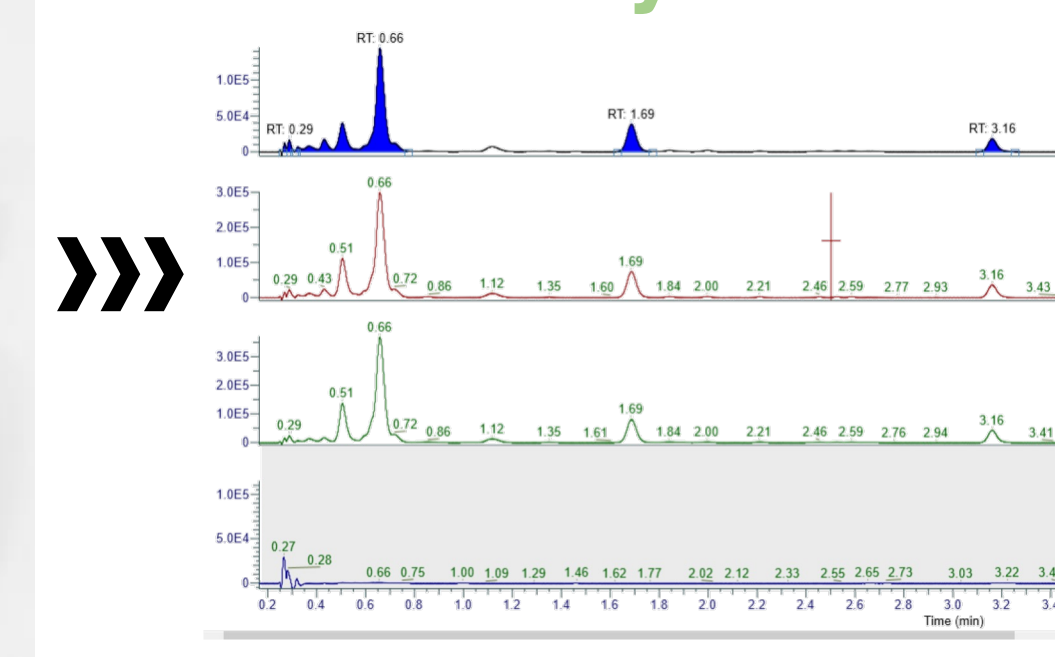


Photosystem I (PSI) and II (PSII)

Fluorometer

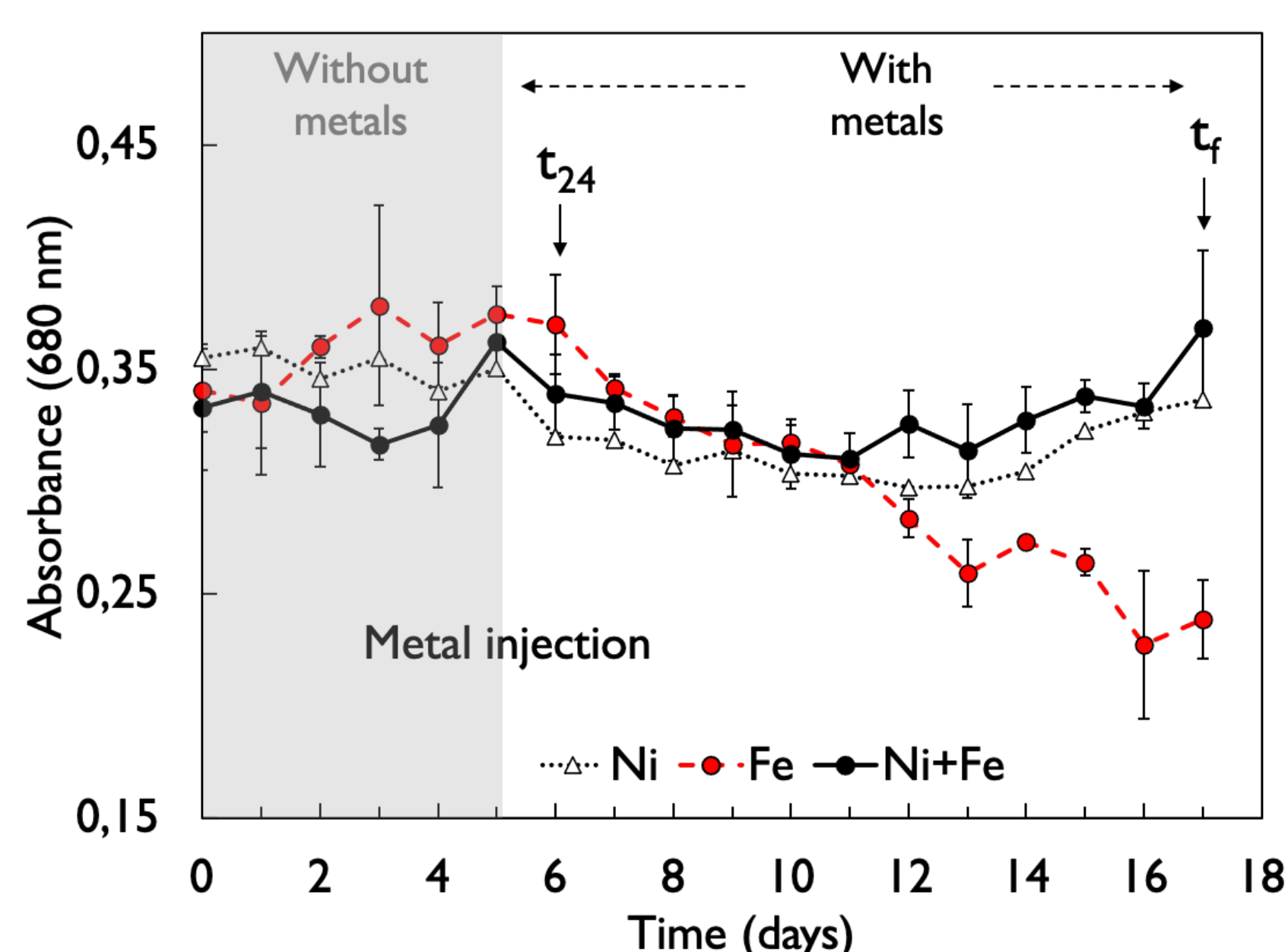
Rapid and non invasive measure of chlorophyll a fluorescence

Metabolomic analysis



Results and Discussion

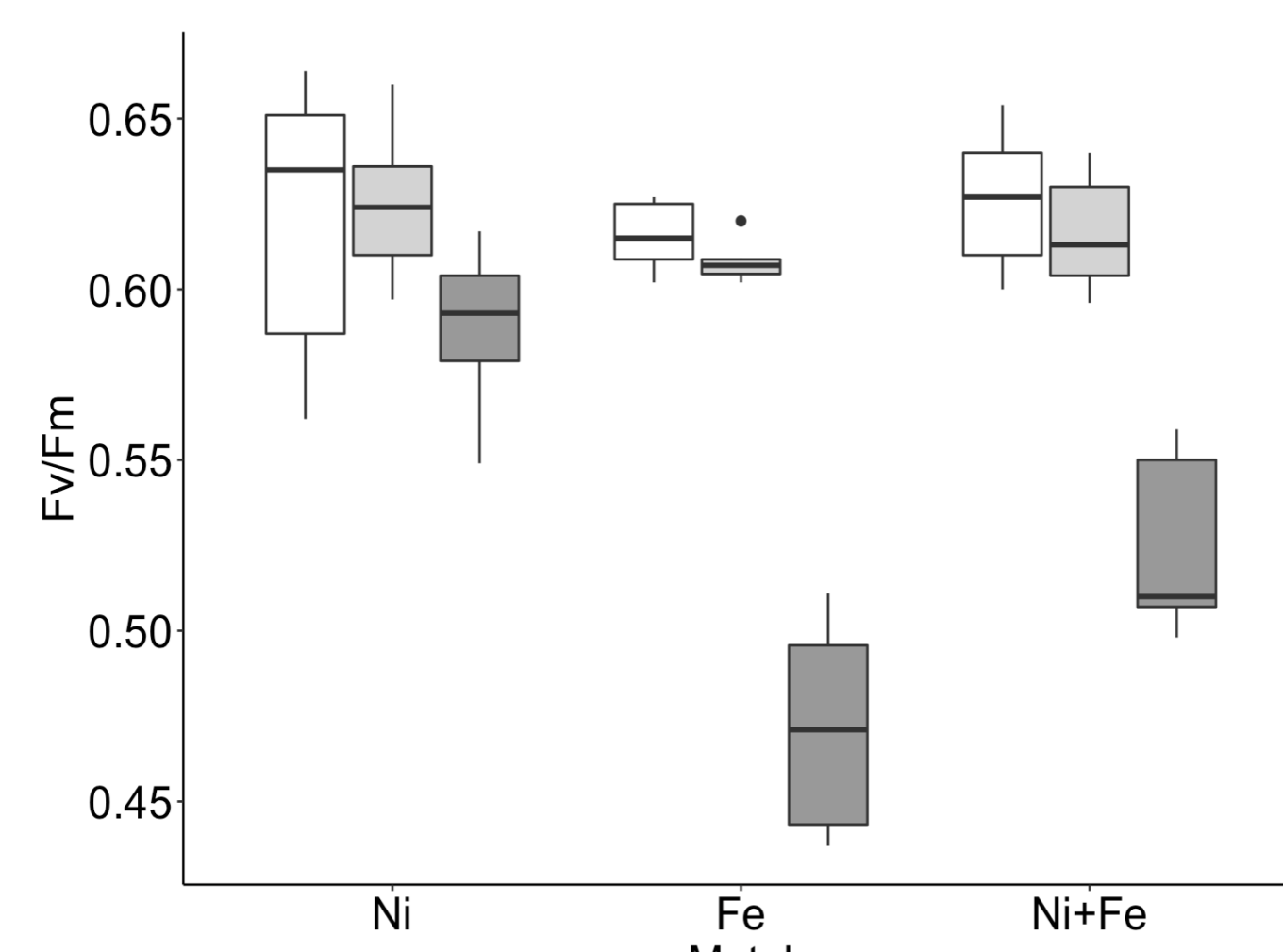
1. Growth performance



Growth **decline** in presence of iron

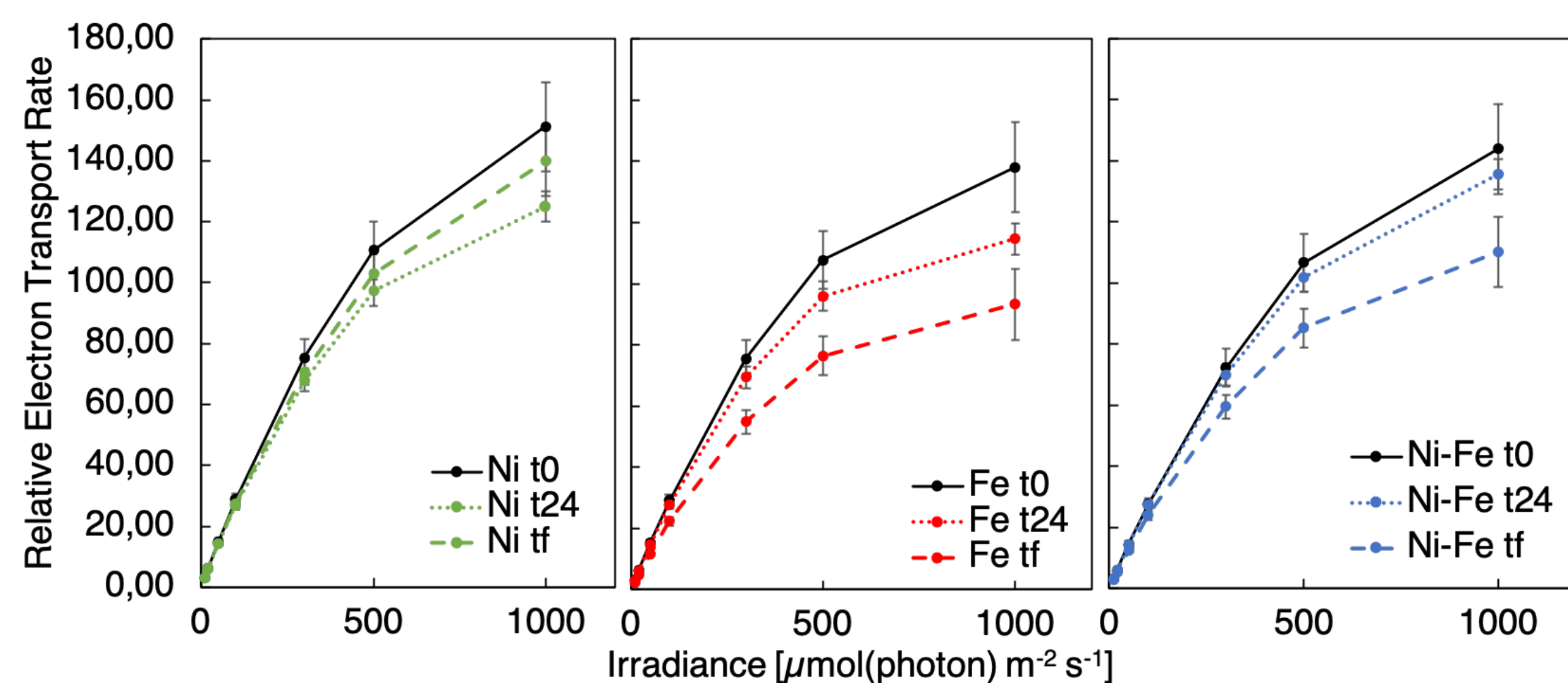
2. PSII photosynthetic efficiency

Maximum quantum yield



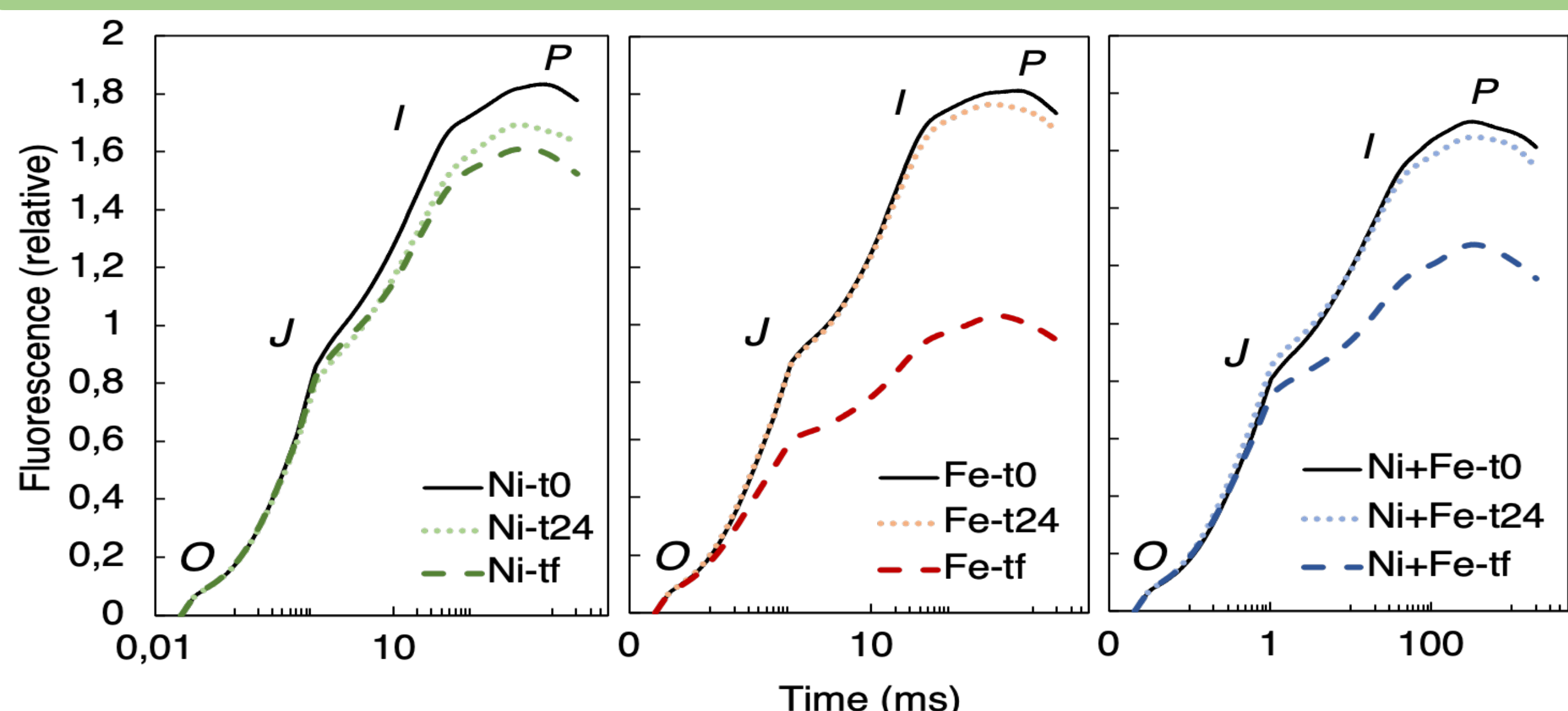
25% decrease of the maximum photosynthetic efficiency of the PSII in the presence of iron

Photosynthetic activity following light intensity



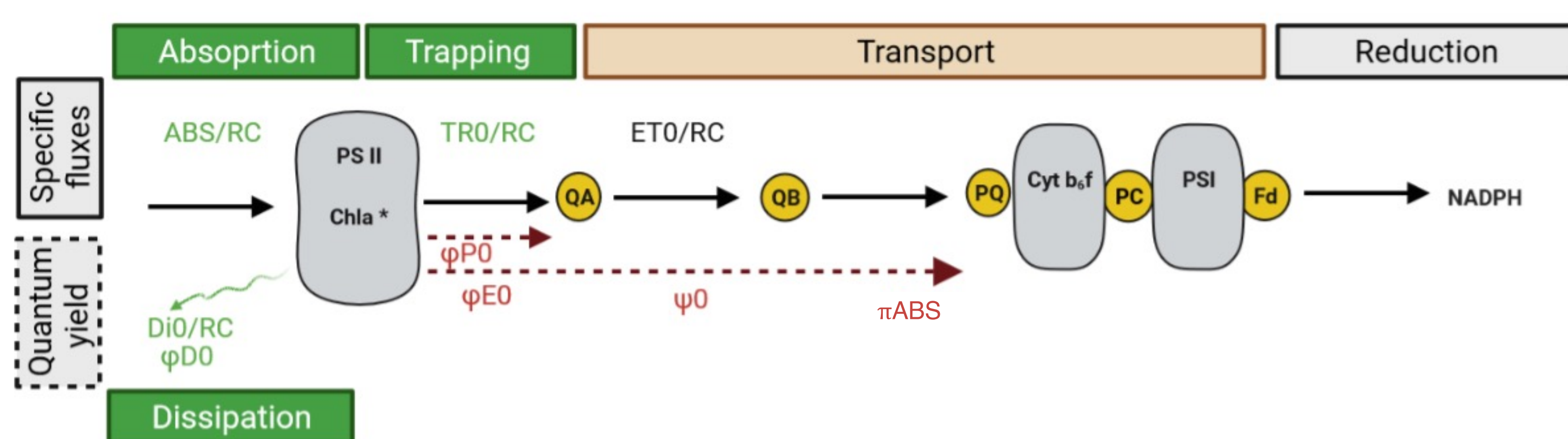
Negative impact of iron on the photosynthetic activity (rETR)

3. Electron transport chain



Negative effect of iron on electron transport chain

4. Fluxes and yield variation between compartments



In presence of iron:

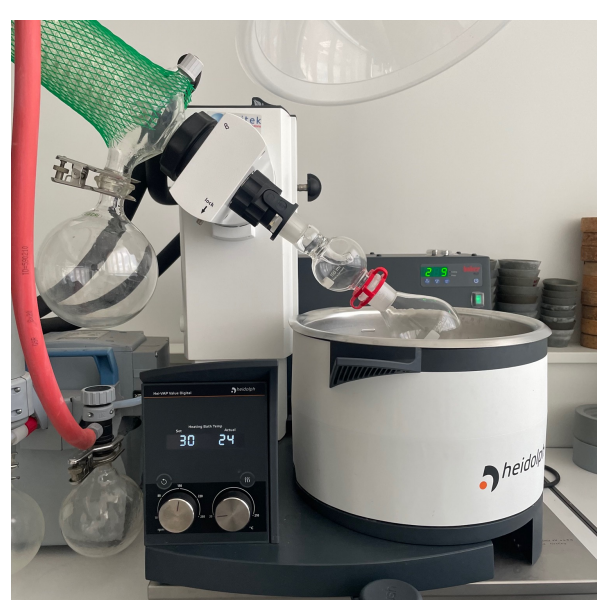
The **absorption**, **trapping** and **dissipation** capacities of the energy in the PSII is **increased**; whereas, the electron transfer yields **decreased**.

Conclusion

- ✓ Contrary to iron, which **reduces** photosystem II efficiency at high concentration, nickel does not influence growth and PSII
- ✓ The **mixture** of nickel and iron did not show a **synergistic** effect but showed a **concentration effect**
- ✓ However, **none** of the 2 metals caused the **complete death** of microalgae

Work in progress

Metabolite extraction



Sample analysis

- UV
- HRMS Orbitrap
- GCMS
- NMR

Data processing



Molecular networks



Interpretation

- ✓ **Chemodiversity** assessment
- ✓ Metabolite **families** identification
- ✓ **Structural diversity** depending on metal conditions