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Effect of Bacillus spp. on enzyme activity and potassium uptake in lowland rice (*Oryza sativa*) under iron toxicity

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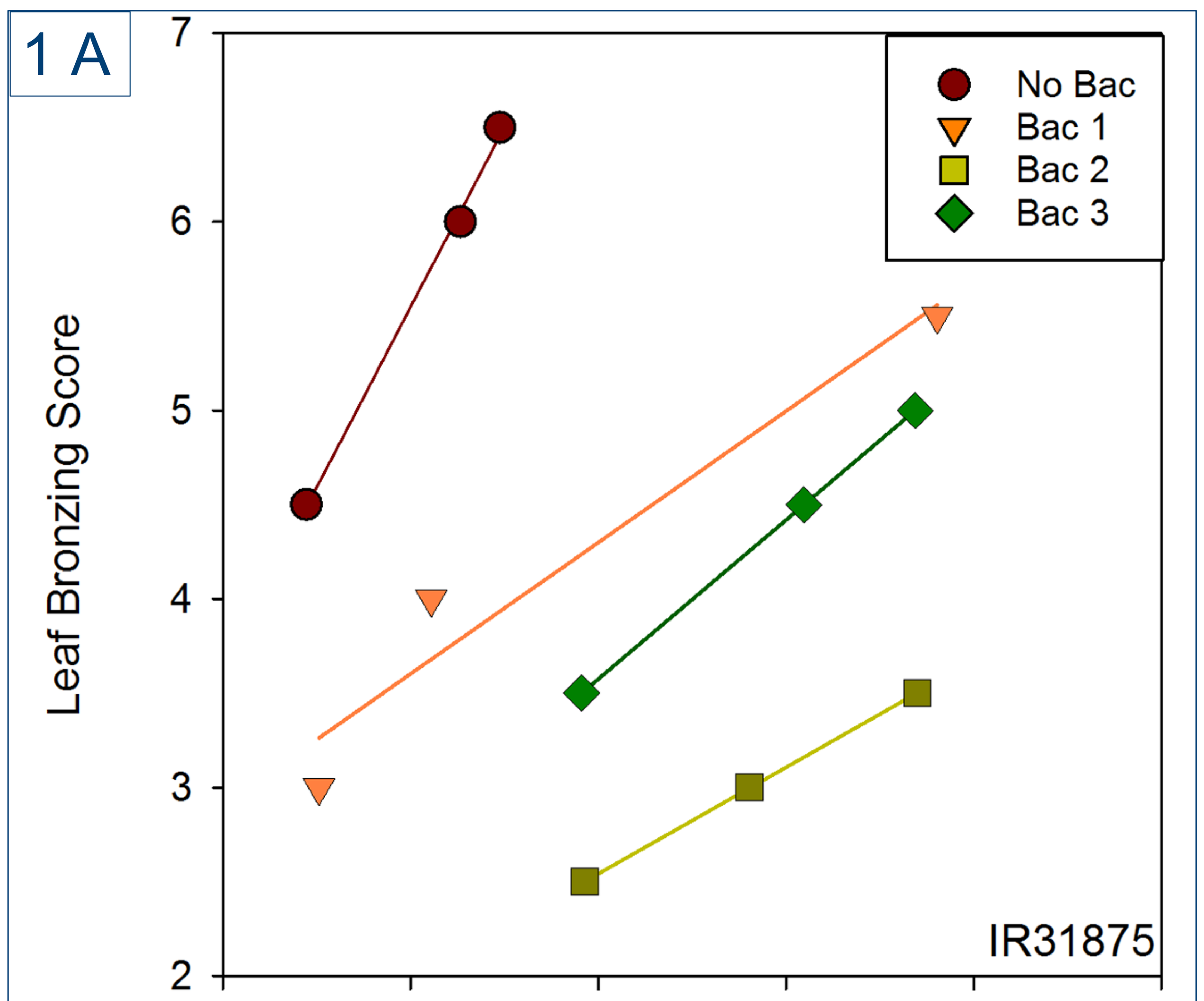
Introduction

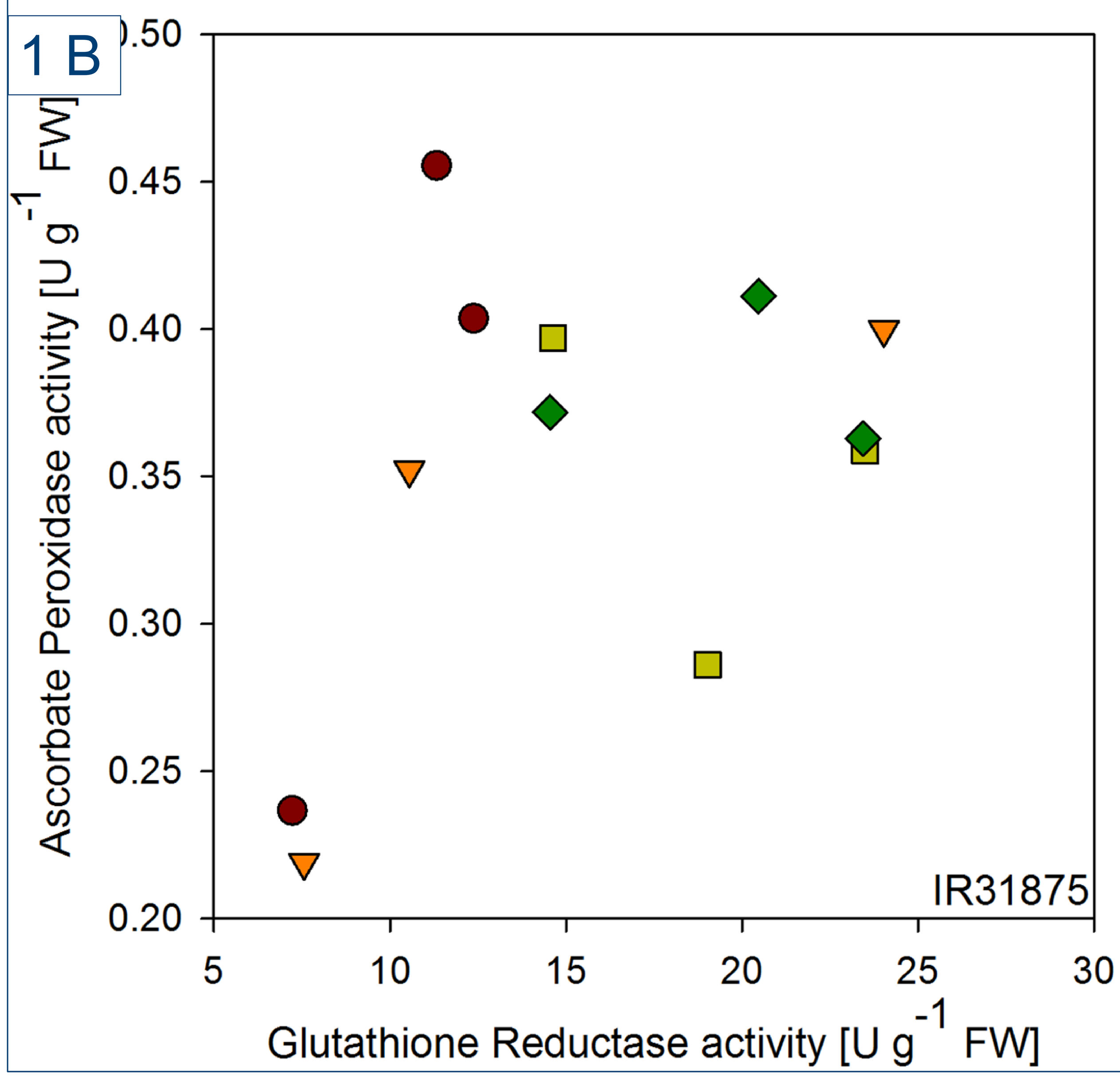
Plant associated bacteria can influence the ability of lowland rice to withstand toxic concentrations of soluble iron (FeII) in the soil.
Iron toxicity is a major constraint for lowland rice production. We evaluated the effect of three Bacillus isolates on the tolerance of different lowland rice cultivars against excess iron. Activities of enzymes involved in reactive oxygen species (ROS) scavenging and potassium concentration were related to the effects of bacteria inoculation on leaf bronzing scores and iron concentration within the plants.

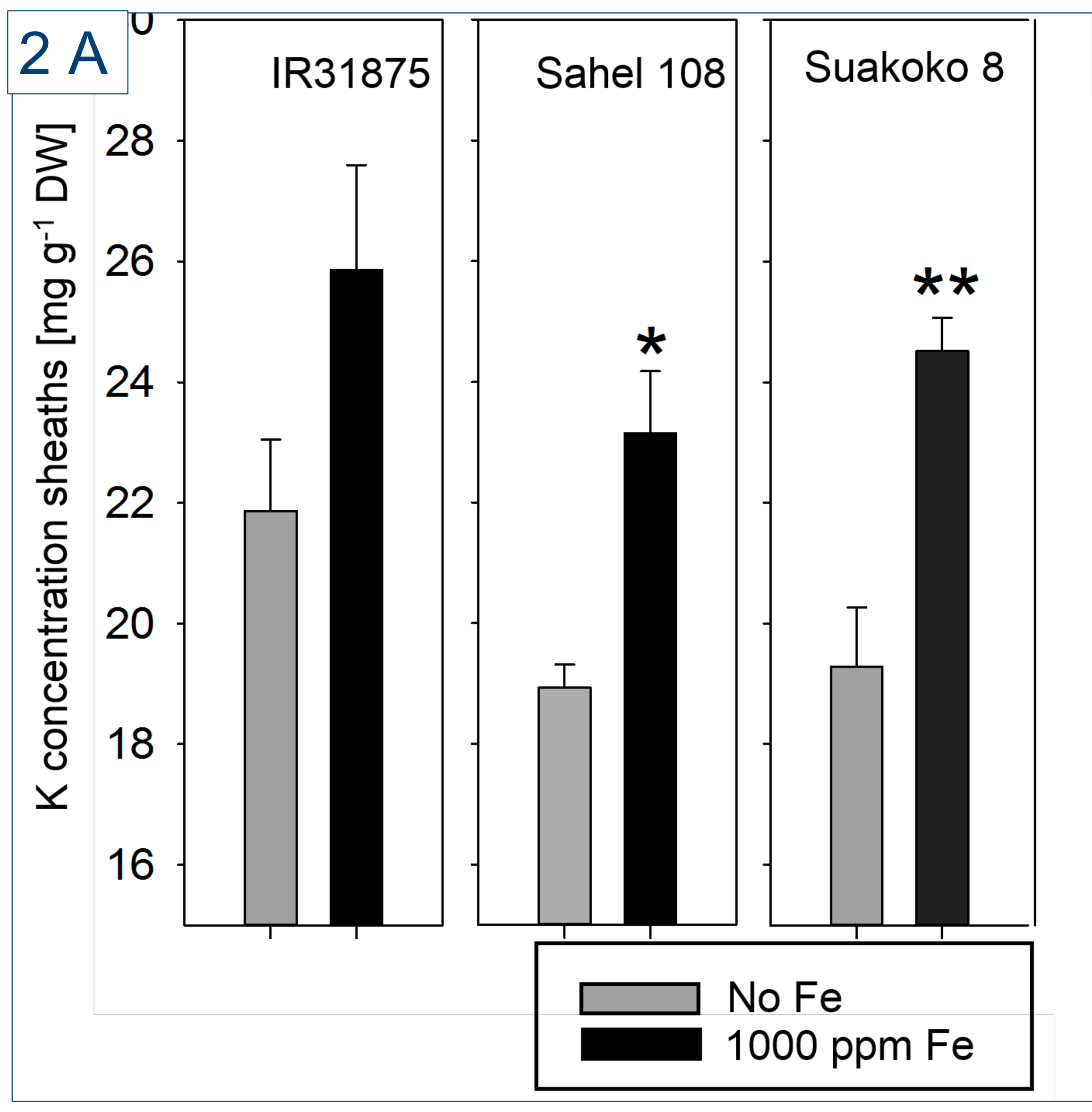
Conclusions

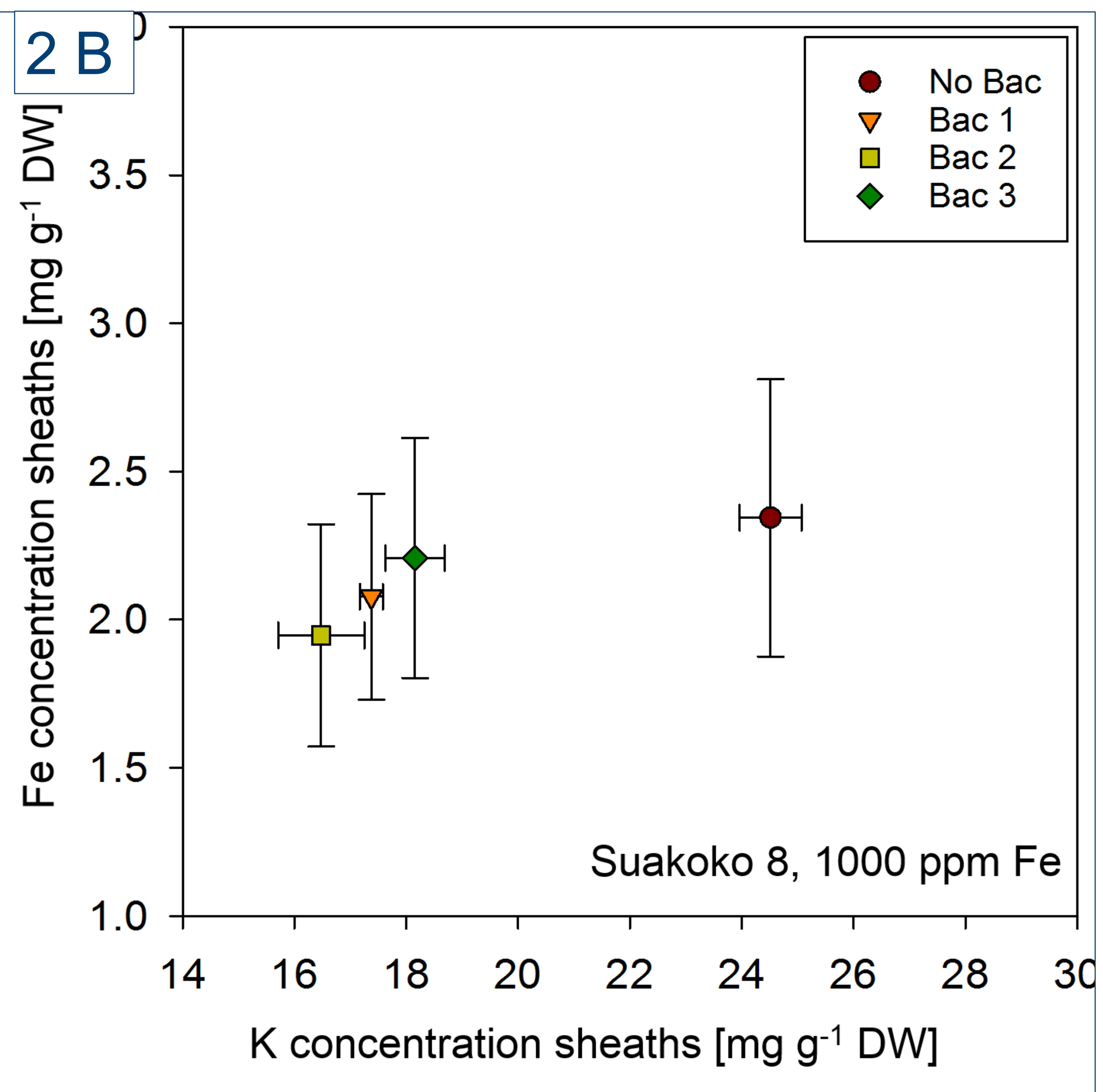
- The effects of Bacillus spp. on lowland rice under iron toxicity differ between cultivar x Bacillus strain combinations.
- In IR31875, bacteria inoculation leads to mitigation of leaf symptoms possibly through mechansims involving the ascorbate/glutathione redox cycle.
- In Suakoko 8, bacteria inoculation affects the concentration of potassium within different tissues. How this negatively affects the tolerance against iron toxicity requires further investigation.

Preliminary Results and Discussion









Higher mean glutathione reductase (GR) activity in sheaths of inoculated IR31875 but positive correlation between GR activity and leaf symptom score within each bacteria treatment (**1A**). No correlation between GR and ascorbate peroxidase (APX) activity in the sheaths of bacteria inoculated IR31875 (**1B**).
Does ascorbate oxidase, not APX activity mainly contribute to AsA/GSH cycle?
Is glutathione (GSH), the product of GR activity, taken out of the AsA/GSH cycle through increased synthesis of phytochelatins?

Potassium concentration in sheaths of all three cultivars increased in iron treated, non-inoculated plants (**2A**). Potassium concentration in sheaths of bacteria- inoculated Suakoko 8 highly significantly reduced as compared to the non-inoculated plants, while Fe concentration not significantly affected (**2B**) and leaf symptom score increased (data not shown).
How does K concentration influence tolerance to iron toxicity?

Notes on Materials and Methods

Plants were grown in original Yoshida solution under greenhouse conditions with 12h light/dark period for three weeks before they were inoculated with cell suspensions (10^7 CFU/ml) of three different Bacillus isolates (B1= *B.pumilus* D7.4, B2= *B.megaterium*, B3= *B. pumilus* Ni9MO12 rif.res.). Nutrient solution containing the bacteria was removed after 7 days, prior to iron treatment. Iron was applied in the form of Fe (II) ($FeSO_4 \cdot 7H_2O$) to a concentration of 1,000 ppm Fe (II) for 7 days. Hypoxic conditions to prevent iron oxidation in the root zone were induced by N_2 gas diffusion for 15 minutes every two hours and O_2 content monitored. Leaf bronzing was assessed visually on fully expanded leaves for the entire plant 8 days after treatment.
Enzyme activity was determined photometrically in the sheaths of the second youngest fully developed leaves. Iron content was measured photometrically single organ. Potassium concentration was measured by flame photometer in single organs.

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