

Novel soil microbe *Peribacillus frigoritolerans* shows plant growth-promoting potential in barley (*Hordeum vulgare*)

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Introduction

Plant growth-promoting microbes (PGPM) as biofertilizers

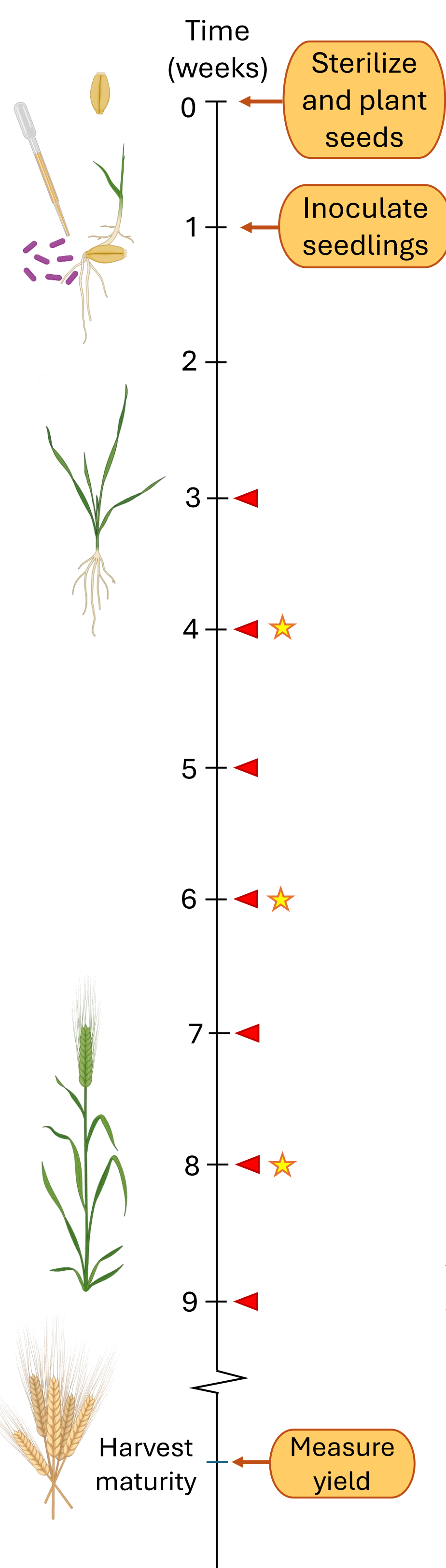
- PGPM can **improve plant growth** and resilience to stress¹
- PGPM may be an **alternative to chemical fertilizers** which have unwanted effects on the environment²
- Applying PGPM can help respond to the large demand for **more productive agriculture**

Barley and PGPM

- Barley is an economically important Canadian crop³, but a limited number of PGPM strains have been applied to barley

Can any of these novel bacteria increase barley growth and yields?

Methods



Microbe inoculant treatments

- *Bacillus pumilus* (Bp)
- *Metabacillus indicus* (Mi)
- *Paenibacillus* sp. (Pn)
- *Peribacillus frigoritolerans* (Pf)
- *Arthrobacter* sp. (Ar)

Control treatments (no inoculants)

- 1/2 strength Hoagland's (1/2C)
- Full strength Hoagland's (1C)

Inoculation

Seedlings were inoculated after 1 week with 1 mL of inoculum each at about 10⁸ CFU/mL.

Biochemical assays

- Nitrite production
- Nitrate production
- Ammonia production

◀ Weekly measurements
★ Biomass

Figure 1. Experimental timeline. Weekly measurements of stem length, chlorophyll concentration, stem width, and leaf width were taken from week 3 to 9. Biomass was measured on weeks 4, 6, and 8.

Results

Barley inoculated with *P. frigoritolerans* developed faster

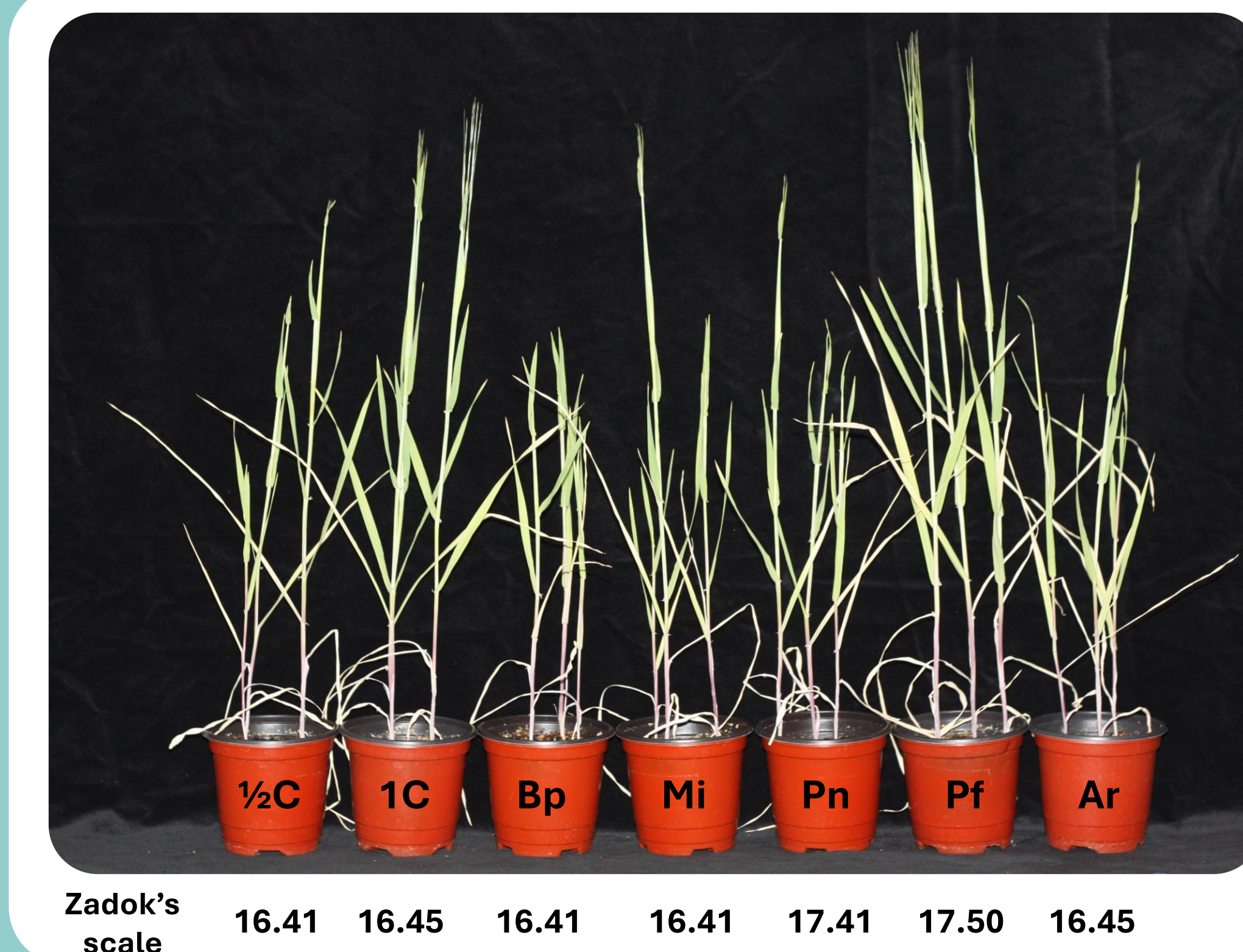


Figure 2. Barley plants 7 weeks after sowing with Zadok's scale for cereal crop development⁴ shown below each plant.

Barley inoculated with *P. frigoritolerans* and control full strength Hoagland's barley had greater masses

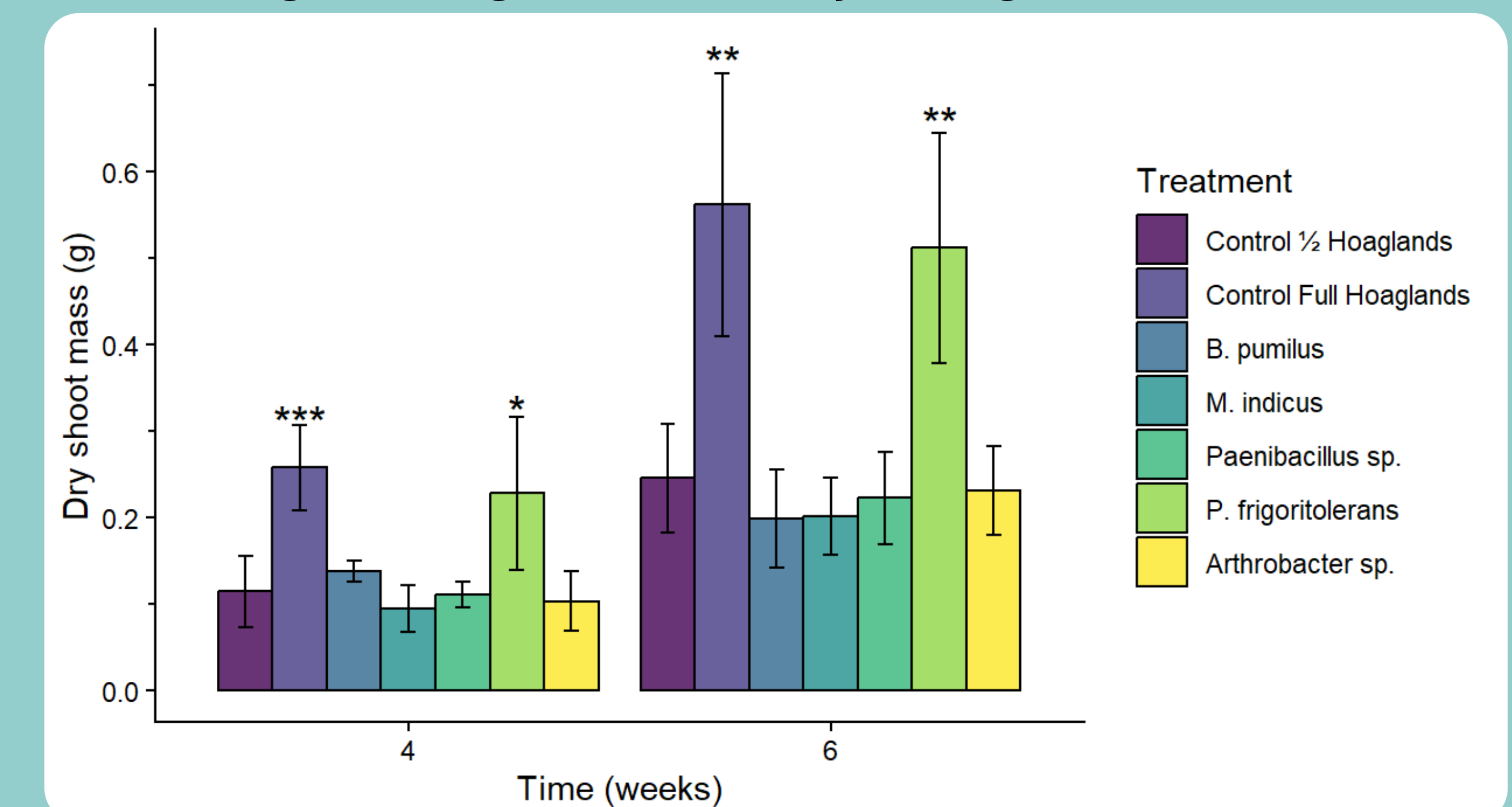


Figure 3. Barley fresh shoot masses. N = 6. Asterisks (*) indicate significant differences based on a one-way student's t-test compared to the control 1/2 Hoagland's treatment group. Significance codes: * p < 0.05, ** p < 0.01, *** p < 0.001

Barley inoculated with *P. frigoritolerans* had higher chlorophyll concentrations

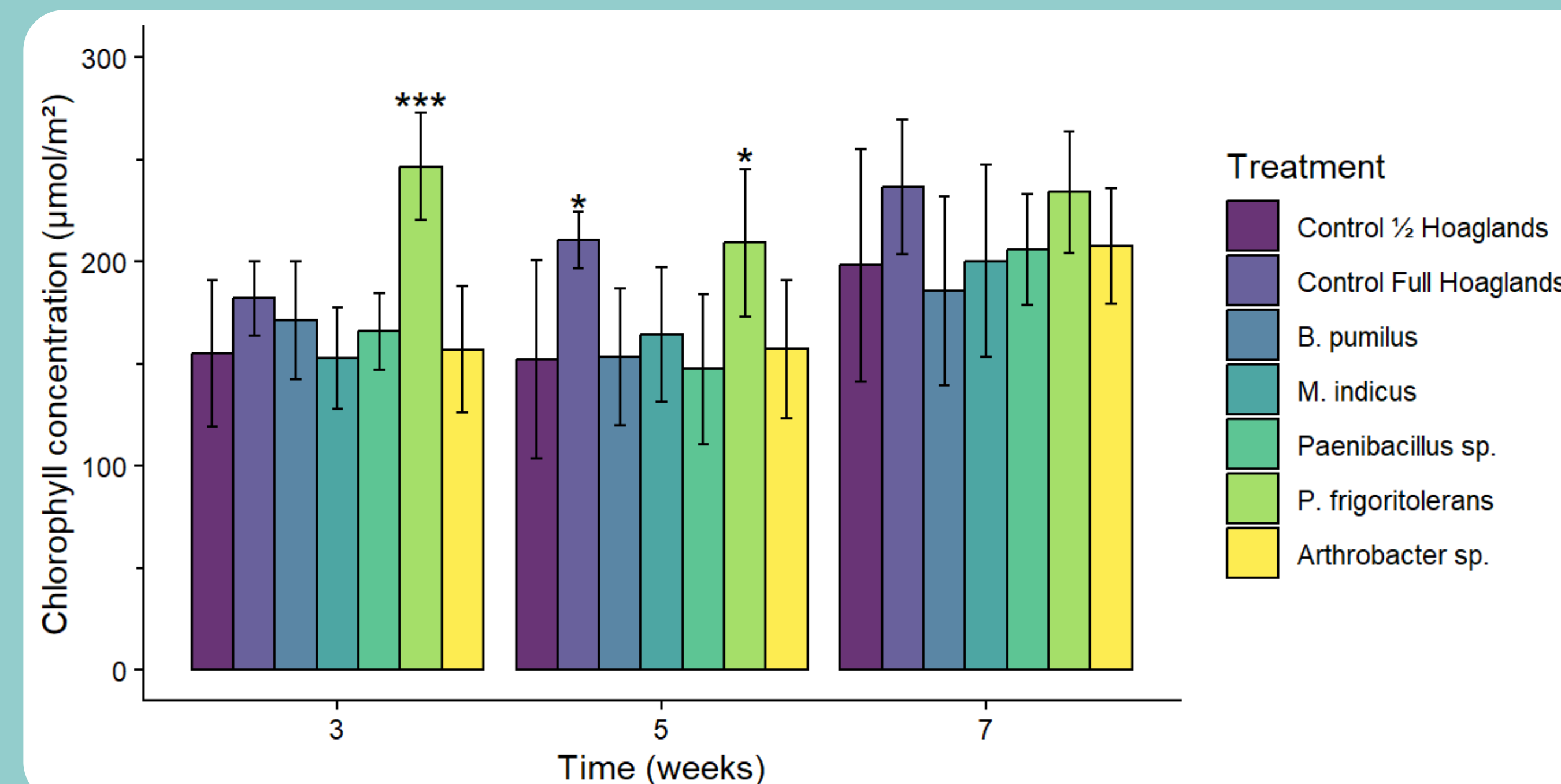


Figure 4. Barley chlorophyll concentrations. N = 6. Asterisks (*) indicate significant differences based on a one-way student's t-test compared to the control 1/2 Hoagland's treatment group. Significance codes: * p < 0.05, ** p < 0.01, *** p < 0.001

P. frigoritolerans and *Arthrobacter* sp. can produce nitrite

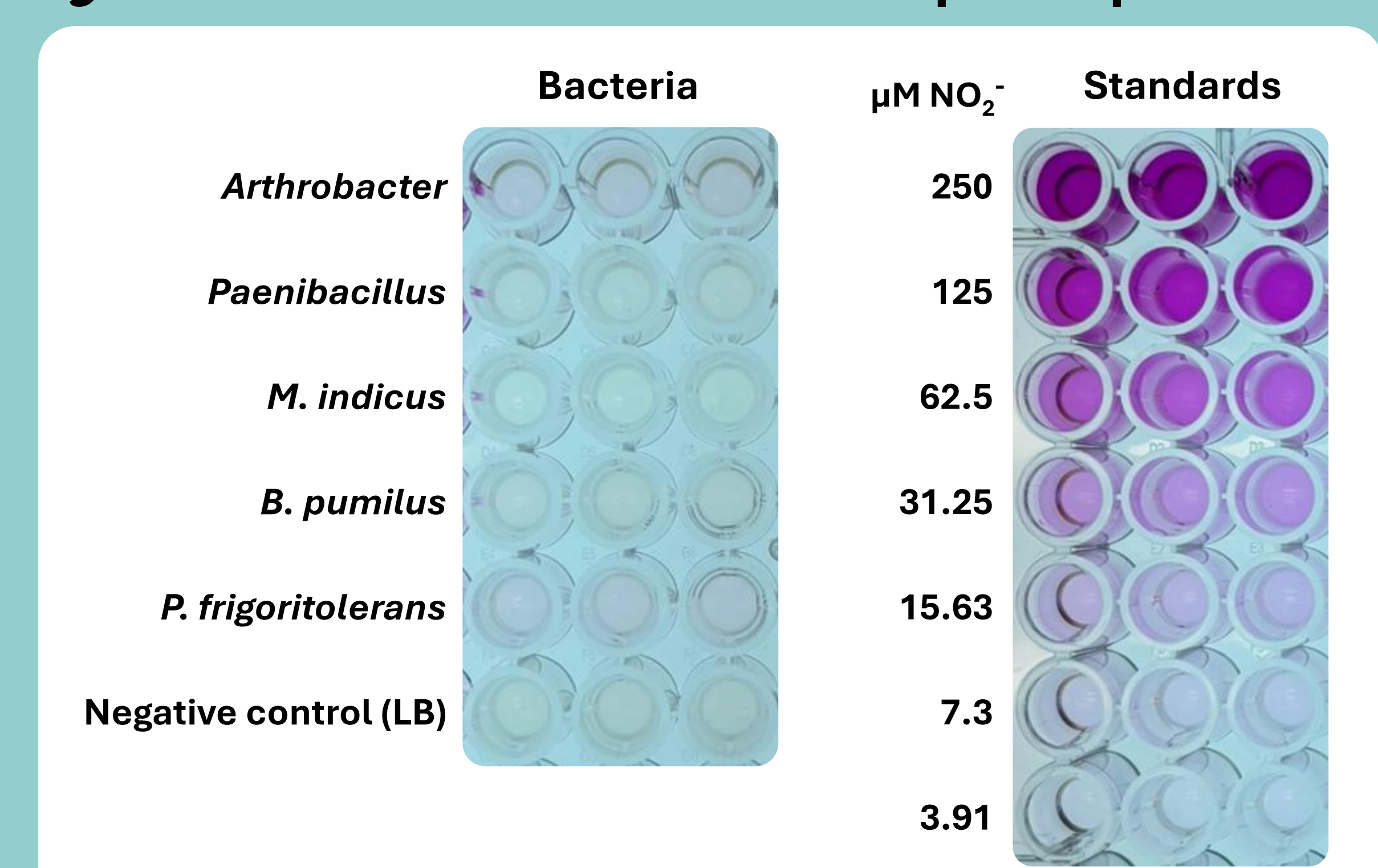


Figure 5. Biochemical test for nitrite production on bacteria in LB. Both *Arthrobacter* sp. and *P. frigoritolerans* appeared to produce nitrite at a concentration of about 5 µM.

Conclusion

Inoculating barley with *P. frigoritolerans* increases their growth rate based on several morphological measurements, possibly due in part to its production of nitrite.

Next Steps

Future experiments will investigate whether *P. frigoritolerans* can improve barley **growth under abiotic stress** such as waterlogging stress. This research can help **increase the efficiency of Canadian agriculture** and further our understanding of plant-microbe interactions.

References

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2. Ward, M. H. (2009). Too Much of a Good Thing? Nitrate from Nitrogen Fertilizers and Cancer. *Reviews on Env Health*, 24(4), 357–363.
3. Izydorczyk, M. S. & McMillan, T. (2024). *Quality of western Canadian barley in 2024: Summary, conditions, and production*.
4. Brook, H., & Cutts, M. (2020). *Crop protection 2020*. Alberta Agriculture and Forestry.