Reduction of resting spores of *Plasmodiophora brassicae* with wheat and lime

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Introduction and Objective

Plasmodiophora brassica, the cause of clubroot disease of brassica crops, survives as persistent resting spores in soil. Clubroot of canola (*Brassica napus*) is managed with genetic resistance, but resistance is not durable. Applying lime to soil often reduces clubroot severity by increasing the pH to > 7.2, but possibly also by suppressing the germination of resting spores. Growing grasses and cereal crops can reduce inoculum in soil (Fig. 1), possibly by stimulating spore germination. The objective of this study was to assess the interaction of lime and wheat on resting spore reduction in a short-duration study under controlled conditions

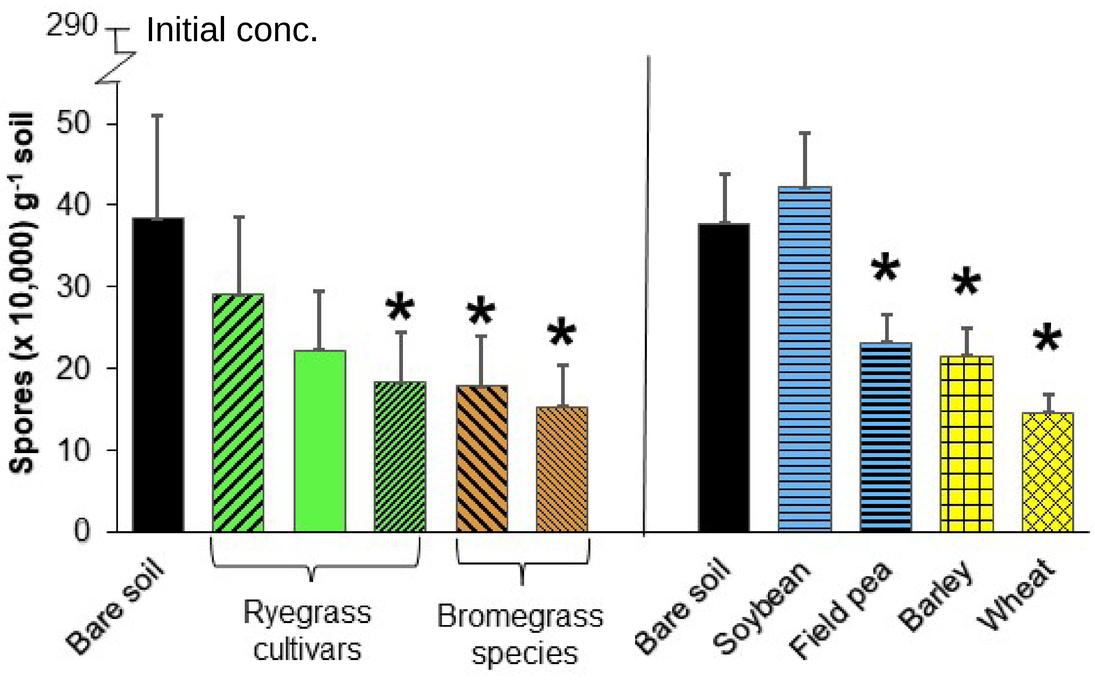

Fig. 1. Effect of crop on reduction in resting spore concentration in an 8-week study under controlled conditions (Drury et al., Plant Pathol. doi.org/10.1111/ppa.13601).

Methods

- A replicated study in a factorial RCBD design was conducted over 8 weeks in soil inoculated with spores of *P. brassicae*. There were six reps (pots) per treatment (**Fig. 2**).
- Target concentration was 5×10^5 spores g^{-1}, actual = 2.3×10^5 .
- One factor was calcium hydroxide (a fast release form of lime) applied to achieve a low (6.4), intermediate (7.) and high (7.6) pH. The second factor was a cereal crop (spring wheat cv. AAC Connery) at 10 seeds/pot vs. bare soil (control).
- Shanghai pak choi (highly susceptible), included to ensure that the pathogen was viable, developed severe clubroot in each repetition.
- Resting spore concentration (log) was estimated using qPCR.
- ANOVA analysis was conducted using SAS PROC GLIMMIX.

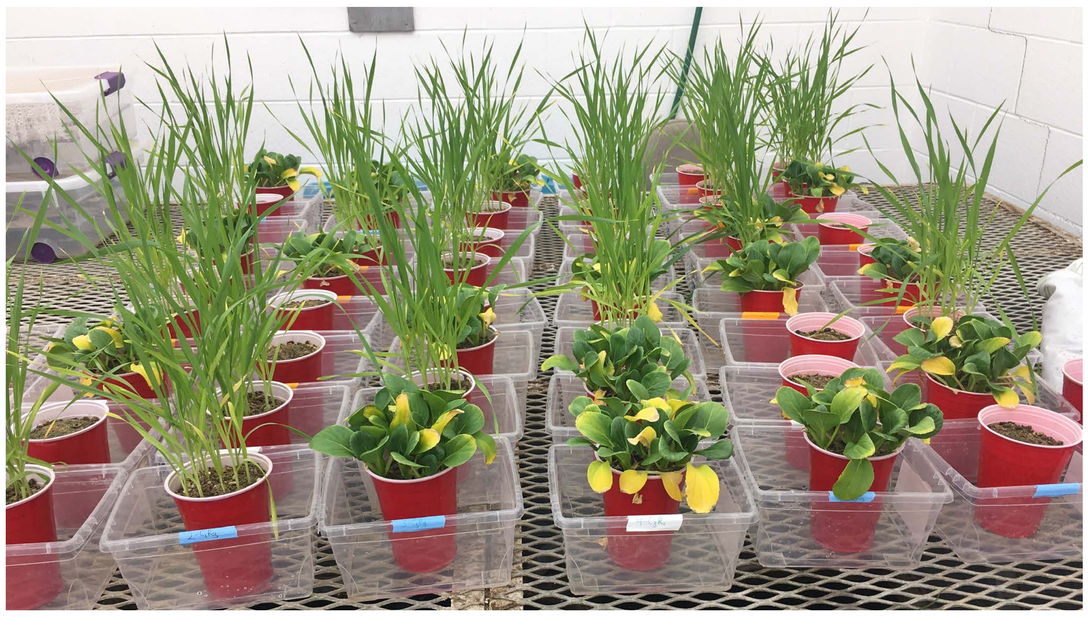

Figure 2. Seedlings of wheat, Shanghai pak choi (susceptible control) and bare soil at three rates of lime incorporated in soil inoculated with *Plasmodiophora brassicae*.

Discussion and Conclusions

- The presence of wheat consistently reduced spore numbers in this short-duration study.
- Addition of lime reduced spore numbers.
- Effect of wheat and lime were additive, not negative.
- This result supports a previous study where growing a cereal crop reduced resting spore concentration.

Results

- The initial estimates of spore concentration under-estimated spore numbers; concentration in bare soil was much higher after 8 weeks than in the initial assessments. N.B. this obligate pathogen cannot produce spores outside of a susceptible host!
- Wheat consistently reduced spore concentration and application of lime reduced numbers (**Figs. 3 and 4**). There was no interaction between crop and pH. Soil pH changed slightly over the experiment to a final pH of 6.9, 7.0 and 7.1 for the three lime treatments.
- These factors appear to act independently; the largest reduction in resting spore concentration was achieved with wheat at high soil pH.

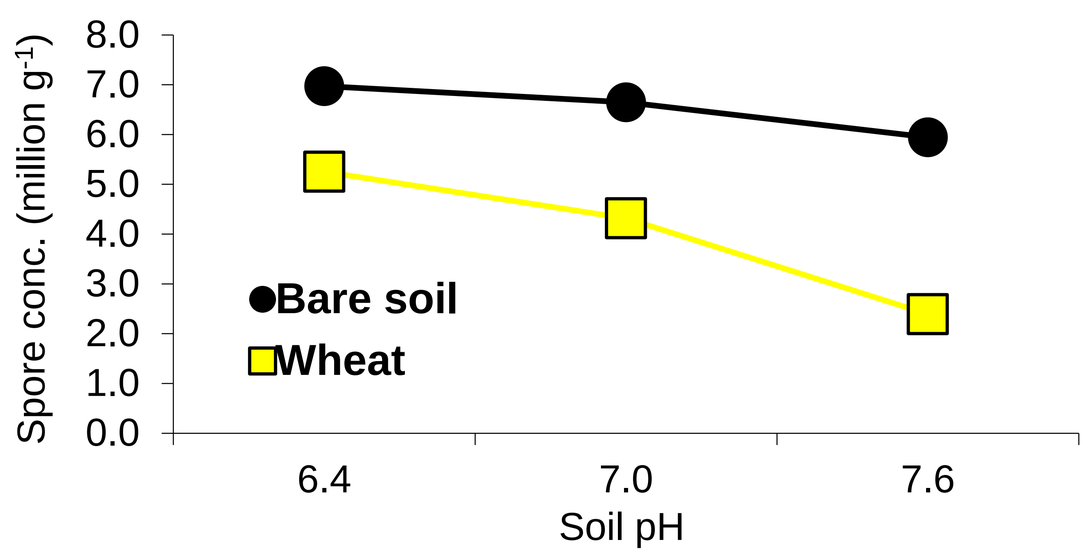

Figure 3. Effect of a wheat crop and application of hydrated lime on recovery of resting spores from soil inoculated with *Plasmodiophora brassicae* after 8 weeks (growth room).

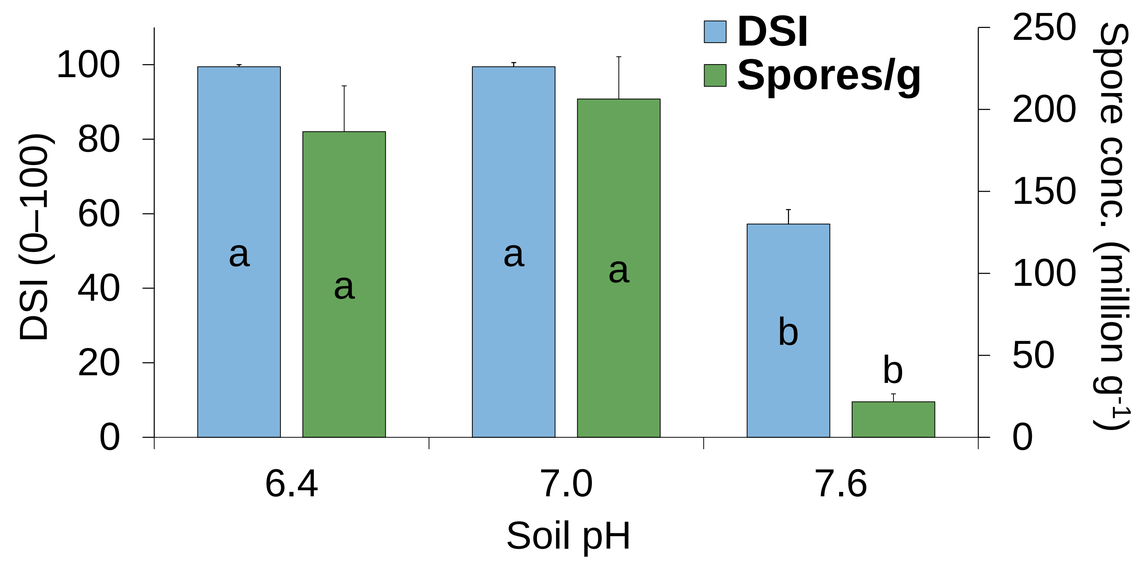

Figure 4. Effect of the application of hydrated lime on the disease severity index (DSI) in Shanghai pak choi and on the recovery of resting spores from soil inoculated with *Plasmodiophora brassicae* after 6 weeks (growth room).

Acknowledgements

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