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Survival of *Plasmodiophora brassicae* over time in trials on the Canadian prairies

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Background:

Plasmodiophora brassicae Wor., which causes clubroot of brassica crops, can persist in soil for many years as resting spores. Liming an acidic soil can reduce clubroot severity, likely by reducing resting spore germination. Also, grass cover crops minimize movement of soil from infested patches, but also have been shown to slightly reduce resting spore numbers under controlled conditions. Spore concentration is important because high levels (≥ 107 spores/g-1 soil) are associated with rapid breakdown of clubroot resistance.

Objective:

To assess the effect of adding lime, grassing infested areas, and their interaction, on resting spore concentration of P. brassicae over time in Canada. Also, to assess the pattern of reduction of resting spore numbers over time under field conditions on the Canadian Prairies.

Methods:

Replicated field trials were initiated at five sites across the Canadian Prairie in 2018 or 2019 to assess changes in spore concentration over time in response to environmental conditions and selected treatments. The soil at three sites was pH neutral to slightly alkaline and acidic (pH ~ 5.5) at two sites. All sites included the application of lime to a target pH of 7.5, a perennial ryegrass cover crop, and a lime x grass interaction treatment, but other treatments were site-specific. Five soil cores per plot (15-cm depth) were collected, bulked, air-dried and spore concentration was assessed using ddPCR. The trials were sampled each year until 2022.

Results:

Application of hydrated lime initially had a larger impact on pH relative to standard lime, but its effect on pH dropped off more quickly over time, as expected. Resting spore concentration was highly variable, which resulted in an inconsistent treatment response over time, both within and among sites. Neither liming nor a grass cover crop consistently reduced spore concentration. One pattern, however, was consistent; spore concentration declined substantially over time at all sites, irrespective of treatment. However, spore concentration remained high enough (> 105 spores g-1) to produce severe symptoms in a susceptible crop at four of five sites. The exception was a site where initial spore numbers were substantially lower than at the other sites.

Conclusions:

The study demonstrated that the concentration of resting spores in soil declines rapidly over the first 2-3 years after a susceptible crop on the Canadian Prairies. Liming and grass cover did not have a consistent effect on spore numbers. Spore concentration remained high enough after 3-4 years to cause clubroot in a susceptible crop. However, the concentration was several orders of magnitude lower than in the first year after a susceptible crop and so much less likely to result in breakdown of the resistance of a resistant cultivar. This study confirms the value of extended cropping rotations for management of clubroot.