Canadian Agronomist

DIGGING INTO RESEARCH

Hydrated lime can help reduce clubroot disease

CATEGORY **disease** | *November 2, 2021*

Research trials found that hydrated lime may be an effective tool for managing clubroot disease in canola when optimal timing and rainfall are achieved. Field and greenhouse trials found hydrated lime more effective than limestone applications, but is much more costly.

Clubroot disease, caused by *Plasmodiophora brassicae*, is managed mainly by the use of clubroot-resistant canola varieties. However, the loss of resistance caused by pathotype shifts can occur quickly. As a result, additional tools that reduce inoculum levels and disease pressure are required to maintain the durability of resistance genes.

Clubroot prefers acidic soils, and the application of lime to increase soil pH may reduce disease. In fact, soil amendments, including lime, have been used for the management of clubroot on vegetable Brassicas.

Limestone ($CaCO_3$) is the main source for agricultural application to neutralize soil pH and improve plant growth. High-calcium hydrated lime is a dry powder produced by combining quicklime (CaO) with water, resulting in the product $Ca(OH)_2$ containing approximately 75% CaO and 25% water. Once mixed with water, hydrated lime quickly dissolves, resulting in a highly alkaline solution.

Research trials were conducted by University of Alberta graduate student Nicole Fox and her supervisors, Drs. Strelkov and Hwang, to evaluate the potential of hydrated lime for reducing clubroot disease development under field conditions; compare the efficacy of varying rates of hydrated lime and limestone for clubroot control at different inoculum levels under greenhouse conditions; and measure the effect of different lime treatments on *P. brassicae* proliferation in canola host roots.

Replicated field trials were conducted in 2017 and 2018 at two sites at Alberta Agriculture and Forestry's Crop Diversification Centre North at Edmonton, Alberta. In 2017 hydrated lime rates were calculated based on the targeted pH relative to the pre-treatment pH of the soil in the plots. The pre-treatment pH at site 1 was 6.3, and was 5.1 at site 2.

To increase pH by 0.5, a rate of 3.36 t lime/ha was used for the calculations. At site 1, the target pH values were 7.0 (4.7 t lime/ha required), pH 7.5 (8.0 t lime/ha) and pH 8.0 (11.4 t lime/ha). At site 2, the target values were pH 6.0 (6.0 t lime/ha), pH 6.5 (9.4 t/ha) and pH 7.0 (12.7 t/ha). To maintain consistency, the same amounts of lime were applied to the trials in 2018, and the plots were placed adjacent to the previous year's plots.

The lime treatments were broadcast and incorporated immediately afterwards to a depth of 3 to 4 inches (8-10 cm). The trials were seeded to a clubroot susceptible canola 7 to 8 days after lime application and incorporation.

In 2017, moderate to high rates of hydrated lime reduced the Index of Disease (ID) by 35 to 91% in the susceptible canola cultivar 8 weeks after seeding. The average ID for the control treatment (pH 6.3) at site 1 was 47%. The high rate of lime reduced ID to 4%, the moderate rate ID was 6.7%, and the lowest rate of lime was 37.5%.

In 2018, due to several environmental factors, no effect of lime treatment was observed in the field trials.

Hydrated lime more effective than limestone

In addition to the field trials, a greenhouse study in 2017 and 2018 compared the efficacy of hydrated lime and limestone in reducing ID in susceptible and resistant canola cultivars, at different application rates and inoculum concentrations.

Canola was planted into a potting medium with an initial pH of 5.3. The potting medium was inoculated with *P. brassicae* resting spores to target concentrations of 1×10^3, 1×10^4, 1×10^5, and 1×10^6 resting spores/g of potting medium.

'Zero Grind' limestone or hydrated lime were applied and incorporated into the soil at rates equivalent to 4.7, 8.1, 11.4 or 14.8 t/ha of lime, to adjust the pH to 6.0, 6.5, 7.0 or 7.5.

In 2017, ID was very high in treatments that did not receive lime at 92 to 100% in the susceptible canola, and low at 9 to 13% in the resistant canola. The application of hydrated lime at all rates eliminated visible symptoms in both cultivars at all inoculum concentrations, with the exception of the rate 8.1 t/ha at 1×10^6 spores/g medium, which developed an ID of 18%.

Limestone was less effective in reducing ID. On the susceptible canola, significant reductions in ID were observed only at the two lower resting spore concentrations, and limestone treatment at any rate had no effect on ID at the two highest spore concentrations. Similar trends were observed with the resistant cultivar.

Overall, the trends in 2018 were consistent with those observed in 2017.

Root tissues from the greenhouse trials were analyzed by quantitative PCR to measure *P. brassicae* proliferation. Inoculum concentration and the type and rate of lime significantly affected the amount of *P. brassicae* DNA present in the root tissue. These results followed a similar trend as observed with ID symptoms, where hydrated lime was much more effective than limestone, especially at higher spore load.

In Alberta, there are almost 1 million acres (400,000 ha) of strongly acidic cropland soil with pH of 5.1 to 5.5, and 4.45 million acres (1.8 million ha) of acidic soil (pH of 5.6 to 6.0). Liming should already be incorporated into many farm management plans to improve plant growing conditions.

While hydrated lime appears to provide superior clubroot control, at a cost of about $320 CAD/tonne it is considerably more expensive than limestone at $54 CAD/tonne. In fields that are infested only mildly with *P. brassicae*, the application of limestone may be sufficient as a tool to manage the

pathogen. Liming an entire field may never be economical, but the application of lime to *P. brassicae*-infested patches in a field, such as hot spots and field entrances, could be an important strategy for clubroot management in canola.

This study was funded by support from the Growing Forward 2 and Canadian Agricultural Partnership programs (Agriculture and Agri-Food Canada and the Canola Council of Canada), Alberta Canola, SaskCanola and the Manitoba Canola Growers. In-kind support from the University of Alberta and Alberta Agriculture & Forestry is also gratefully acknowledged.

Nicole M. Fox, Sheau-Fang Hwang, Victor P. Manolii, George Turnbull & Stephen E. Strelkov (2021): Evaluation of Lime Products for Clubroot (Plasmodiophora brassicae) Management in Canola (Brassica napus) Cropping Systems, Canadian Journal of Plant Pathology. https://doi.org/10.1080/07060661.2021.1940590