The application of hydrated lime to bring an acidic soil up to pH 7.2, and/or weed control of cruciferous weeds did not affect clubroot severity on a clubroot resistant variety. The yield of a susceptible canola variety almost doubled with the application of hydrated lime, and had similar yield as a ‘second’ generation clubroot-resistant variety without lime.

Management of clubroot disease, caused by *Plasmodiophora brassicae* Wor., requires an integrated approach including the use of resistant varieties, extended crop rotations, and preventing the spread of soil from field to field. But with the loss of the effectiveness of clubroot resistance in some canola varieties due to the emergence of new, virulent pathotypes of *P. brassicae*, other management practices such as liming and control of cruciferous weeds and volunteer canola may be necessary to help manage the disease.

A research study was conducted by the University of Alberta to compare the effectiveness of hydrated lime, Ca(OH)$_2$, weed management and the use of clubroot-resistant genetics on clubroot severity, incidence, and yield. Field trials were established in a naturally infested clubroot nursery at one site in 2018 and two sites in 2019 at the Crop Diversification Centre North, Alberta Agriculture, Forestry and Rural Economic Development, Edmonton, Alberta.
At site 1, the pH of the soil was 5.3, and the pH was 5.23 at site 2, and 5.48 at site 3. Hydrated lime was applied to target a pH of 7.2. This resulted in an application rate of 5.7 T/ac (14.09 T/ha) at site 1, 4.65 T/ac (11.49 T/ha) at site 2, and 3.48 T/ac (8.60 T/ha) at site 3. The hydrated lime was incorporated with a rototiller to a depth of 4 inches (10 cm).

In 2018, the clubroot-resistant variety 45H29 and a clubroot-susceptible variety 45H31 were seeded. Clubroot galls developed on the resistant variety, indicating a virulence shift from pathotype 3H to 3D. As a result, in 2019, 45H29 was replaced with 45CM39, a canola variety with ‘second’ generation resistance to pathotypes 2B, 3A, 3D and 5X.

Plots were hand-weeded every two weeks after canola emergence until the end of July. This ensured that clubroot spore densities were not influenced by clubroot galls that could have formed on susceptible weeds such as stinkweed.

**Lime and weeding improved disease management in the susceptible variety**

Soil samples were collected from the plots, and resting spore density was estimated for each treatment. Lime application or weed management did not significantly affect spore densities in plots with the resistant variety. In plots where the clubroot-susceptible variety was grown, hydrated lime plots had 48 to 80% lower resting spore densities than the untreated control plots.

Shoot height, shoot weight, and gall weight were evaluated at the end of July in both years, and the galls were visually assessed to calculate an Index of Disease. Application of hydrated lime or weed management did not affect clubroot severity for the resistant variety, which remained low in all treatments at less than 10% Index of Disease. The clubroot Index of Disease was 41% lower for the resistant variety compared to the susceptible variety.

For the susceptible variety, application of hydrated lime decreased clubroot severity by 34 to 36% compared to the control plot without hydrated lime. For example, the treatment of lime application with no weed control had an Index of Disease of approximately 35%, while the no-lime treatment had an Index of Disease of around 76%.

Application of hydrated lime increased canola yield by 70 to 98% in plots with the susceptible canola variety. These yields were similar to yields of the resistant variety, indicating the effective suppression of clubroot disease when pH of the soil is raised to 7.2. There was no yield benefit for hydrated lime application in the resistant variety.
The results of this study show the importance of keeping clubroot spore levels low to continue to receive the benefits of clubroot resistant genetics. Scouting fields each year is critical to know if there is clubroot in a field, and to know if the clubroot genetic package in your varieties remain effective against the pathotypes in the field.

While the application of hydrated lime or weed management did not reduce disease severity or improve yield in the resistant variety, these management tools may help prolong the effectiveness of genetic resistance. For example, lime application could be used as a tool to control clubroot patches where genetic resistance is no longer effective. Visit clubroot.ca to learn more about management of clubroot disease.

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Clubroot galls on stinkweed. Photo courtesy Brittany Visscher.