

CLUBROOT PREVENTION AND PROTECTION FAQ

THE BEST WAY TO KEEP YOUR CANOLA SAFE FROM A CLUBROOT INFESTATION IS TO TAKE AN INTEGRATED AND PROACTIVE APPROACH. EVEN BEFORE SYMPTOMS ARE EVIDENT, START WITH THE ADOPTION OF RESISTANT HYBRIDS TO HELP PREVENT INITIAL ESTABLISHMENT OF THE PATHOGEN.

Q: WHAT DOES AN EFFECTIVE CLUBROOT MANAGEMENT PLAN LOOK LIKE?

- 1.** Aim to practice a 1-in-3 year canola rotation.
 - Rotate to alternative crops. Clubroot spores are very long-lived in the soil, up to 17 years. Ideally, use a minimum 1-in-3 year clubroot resistant canola rotation on infested fields, especially fields where clubroot has caused yield loss or cropping issues.
- 2.** Grow clubroot resistant (CR) canola hybrids if you are in an at-risk-region, even if clubroot has not yet been identified in your fields. CR hybrids prevent disease establishment, yield well and are very good agronomically.
- 3.** Prevent and minimize moving soil, between and within fields. Work on infested areas last, practice soil conservation, and clean equipment, vehicles and boots.
- 4.** Control host weeds and volunteer canola early (<4 weeks).
 - Examples of common host weeds would be stinkweed, wild mustard, shepherd's purse and flaxweed
- 5.** Scout for signs of clubroot and look for virulence shift early and often.
- 6.** Practice patch management. Consider grassing patches to further prevent soil movement.
- 7.** Control pH (liming) strategically to help reduce clubroot infection, especially in dryer years. Clubroot infection occurs more readily in acidic soil; increasing the pH has been shown to help reduce infection.

Q: WHAT ARE CR1 AND CR2 AND HOW DO THEY RELATE TO CLUBROOT MANAGEMENT?

CR1 refers to the resistance gene initially deployed by the industry in 2009. CR2 refers to any clubroot-resistant hybrid capable of avoiding infection when exposed to any of the new pathotypes that can infect CR1 hybrids. As of 2018 survey data, CR1 is still effective in 90% of fields where clubroot has been detected. However, caution should still be exercised if significant infection was observed on a field prior to deployment of CR1.

Q: IF I DON'T HAVE CLUBROOT ON MY FARM, IS IT OKAY TO USE CLUBROOT RESISTANT HYBRIDS?

Yes, in fact it's encouraged. Not only do clubroot-resistant hybrids help prevent any initial establishment of the pathogen, they also yield well and are agronomically very good. There are many cases where clubroot isn't identified in a field until large patches have been established, causing total yield loss in the infected areas and introducing clubroot beyond the point of control.

Q: WHAT IS RECOMMENDED FOR CROP AND GENETICS ROTATION?

The best approach is to manage spore load with crop rotation and manage genetic resistance breakdown with genetics rotation.

Crop: Data specific to Western Canada (Alberta) recommends at least a 2-year break between growing resistant-canola in infested fields (i.e. 1-in-3 year canola rotation). This can decrease clubroot resting spore loads by up to 90% in moderately infected fields. Longer rotations will decrease spore loads further, but clubroot is still very long lived and can remain dormant for 17+ years. **Genetics:** For the majority of growers in Western Canada who have not identified clubroot on their farm, CR1 is an excellent option and offers the maximum choice in products. If you have been using CR1, you

may want to consider rotating to alternative clubroot resistant sources. There is no reason to wait for it to breakdown before rotating genetics. Given that keeping spore loads low is key to managing clubroot, a proactive approach is the best option.

If clubroot has been identified on your land or close by, the goal should be to not grow the same clubroot-resistance genes more than once consecutively. There is a lot of genetic diversity in clubroot populations (37 identified pathotypes in Canada and counting), so essentially every time you grow the same resistance you may be increasing the number of rare virulent types. Whereas when you rotate resistance, you're never allowing the same virulent pathotype to take hold. To prolong the effectiveness of CR1, it is important when possible to rotate to other CR gene sources.

Q: WHEN SHOULD I START ROTATING TO DIFFERENT SOURCES OF RESISTANCE?

If rotational options are available and the field has confirmed clubroot, or CR1 has been used a number of cycles already, don't wait for it to break down. In many aspects of agriculture, rotation is the best tool to ensure harmful pests don't build up. Keep the pathogen guessing. Use a different resistance gene and avoid resistance breakdown to help ensure clubroot remains manageable.

Q: DO I STILL NEED A 2-YEAR BREAK FROM CANOLA IF I ROTATE CLUBROOT RESISTANCE GENETICS?

It is recommended to still have a 2-year break from canola, especially if clubroot is wide-spread or has caused yield loss or cropping issues in the past. Allowing 2 years between the cultivation of each clubroot-resistant canola crop (or any other potential host crop) is an effective way to manage clubroot resting spore loads. High-resting spore loads will place high pressure on the genetics when they are cultivated regardless of the generation of resistance.

Q: IS A HYBRID WITH CR1 STACKED WITH ANOTHER GENE ENOUGH TO HELP MAINTAIN RESISTANCE DURING A PATHOTYPE SHIFT IN THE FIELD?

CR1 + another gene can effectively manage clubroot infection in fields that have shifted to a virulent pathotype when grown for the first time. However, in fields where CR1 is widely broken down, these hybrids should be treated as a new single gene resistance, since the CR1 component is no longer fully effective. In fields where the shift occurs in small patches, the CR1 component will still be effective on most of the field. Caution should be used to minimize or avoid repeated cultivation of the same gene(s), and CR1 stacks may not always allow this.

Q: HOW LONG BEFORE ANOTHER SOURCE OF RESISTANCE IS COMMERCIALY AVAILABLE?

Pioneer's research and development team is working continuously to transfer a variety of resistance genes into elite canola products like 45CM39. The goal of our native trait development program, in terms of clubroot, is to be able to provide stacks of effective genes, as well as products with single effective genes, that will allow growers to rotate between resistance, avoid new virulence problems and provide sustainable options for moving forward into the future.

Because Pioneer has been leading the industry on this for quite some time, our production is coming to maturity, to the point where within the next few years we expect to release a number of different stacked gene resistance traits that growers can rotate as part of a proactive management strategy.

Q: IF I HAVE A CONFIRMED PATHOTYPE SHIFT IN THE FIELD, CAN I EVER USE CR1 RESISTANCE AGAIN EFFECTIVELY?

Not within a few rotational cycles, and still unlikely in the long run. Ideally, CR1 will not be used on its own again in such fields and using a CR1 + new gene would not count as a true break from CR1. However, more research needs to be done (especially in a Canadian context). CR1 + a new gene may still represent one cycle in a clubroot-resistant gene rotational strategy if treated as a single effective gene.

Q: IF I AM ROTATING SOURCES OF RESISTANCE, IS IT AS IMPORTANT TO MANAGE BRASSICA HOST WEED SPECIES AND VOLUNTEERS?

Yes, volunteers may be susceptible even if they were derived from a clubroot-resistant hybrid grown in the previous season. This increases the spore load in off-years and exposes clubroot resistance genes to pathogen pressure outside of the desired canola growing period. Volunteers will also propagate clubroot if they are present while growing the next canola crop. Control volunteers as early as possible!

Susceptible weedy hosts such as shepherd's purse and stinkweed should also be managed. These weeds will build up spore loads, which increase risk of infection and risk of pathotype shift when the next resistant hybrid is grown.

TO HELP YOU MANAGE CLUBROOT, PIONEER OFFERS A COMPLETE PORTFOLIO OF CLUBROOT RESISTANT HYBRIDS.

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