

Frequently asked questions – clubroot in canola.

At BASF, our goal is to keep growers informed about the latest agronomic research information. That's why we're providing this question and answer section to address several key findings on managing clubroot in canola.

Q. Does growing an InVigor clubroot-resistant hybrid mean I will not see clubroot symptoms in my field?

A. Clubroot resistance protects the crop from being infected, but it does not control spores in the soil. That's why a low number of plants within the field may exhibit clubroot symptoms. These plants may be non-resistant volunteers from previous crops, off-types or potentially a new clubroot pathotype to which InVigor hybrids may be susceptible. For more information, reach out to your local BASF representative.

Q. What is the best time to grow second-generation clubroot-resistant hybrids?

A. Ideally, growers should start seeding a second-generation clubroot-resistant hybrid before symptoms appear in their first-generation hybrid. In fields where clubroot has been confirmed, second-generation hybrids should replace first-generation hybrids after two cycles (assuming at least a one-in-three-year rotation). Growers can transition to a second-generation hybrid earlier than this if symptoms appear in their first-generation hybrid.

Q. Will InVigor clubroot-resistant hybrids prevent the spread of clubroot to non-infested fields?

A. While growing InVigor clubroot-resistant hybrids on a clubroot-infested field may reduce the level of spores being released back into the soil from a canola crop, it will not control spores already contained in the soil. In other words, it will not prevent the spread from field to field through soil transfer. It's very important to remain diligent with sanitation practices, keeping footwear, tools, vehicles and equipment clean in order to slow the spread of clubroot. At a minimum, large chunks of soil should be removed from equipment prior to leaving an infected field. The best sanitation product is bleach in a 2% solution.

Q. Can clubroot be spread via seed?

A. Clubroot is not a seed-borne disease. Clubroot can only spread through resting spores contained in soil. That's why seed only plays a role in clubroot spread if earth tag is present on the seed surface. Earth tag are the soil particles that may be resting on the seed coat of harvested seed. The risk associated with disease spread via earth tag is very low. The primary means of disease spread is soil transfer on equipment—and represents a much greater risk. With a small-seeded crop such as canola, earth tag is not a significant issue and the cleaning and treating process further reduces risk. InVigor seed production takes a proactive approach to produce hybrid canola seed in fields not affected by clubroot. These steps include education of seed production staff, intensive field surveys prior to growing the seed crop, a minimum four-year rotation from brassica crops (canola, mustard and rapeseed) and a survey of every seed production field prior to harvest to confirm clubroot is not present.

Q. Are there any seed treatments or soil amendments available for clubroot?

A. Currently, there are no effective seed treatments or soil amendments available for controlling clubroot.

Q. Does rotating clubroot-resistant hybrids alone help prevent resistance?

A. Our recommendations on when to employ first- and second-generation genetics apply to all seed brands and not just InVigor. To date, there are limited sources of clubroot resistance available in commercial hybrids. Switching to a different canola brand does not ensure protection unless the resistance mechanisms are different and effective against the pathotypes that exist in your field. As more clubroot resistance sources are found, and a greater availability of genetic resistance diversity becomes available, then it makes sense to switch to a different source of resistance (or generation) that is effective against the pathotypes identified to cause the disease in your situation.

Q. Why doesn't BASF label their resistance mechanisms?

A. Currently, we label our clubroot-resistant hybrids as either containing first-generation and/or second-generation resistance mechanisms. The science and understanding of this pathogen continues to evolve, and we're only starting to learn about clubroot population dynamics. Clubroot pathotypes within any given field or gall are more diverse than originally thought and current tests only generalize the predominant pathotype present. Due to this uncertainty and lack of specificity in pathogen identity, there is too great a risk in assigning genetic resistance to a particular field. In addition, since there are currently no commercial testing facilities that provide pathotyping for clubroot, understanding the specific details of clubroot in your field isn't a reality for most growers, so a more detailed description of the genetic resistance mechanisms present in a hybrid at this time will only add more confusion to an already complex problem.

Q. Are certain areas of Western Canada more prone to clubroot development?

A. Although clubroot is established primarily in North-Central Alberta, geography does not equate to immunity. Diligent scouting is recommended in all canola growing regions, especially considering clubroot in canola has also been identified in Saskatchewan, Manitoba and Eastern Canada.

Discover more questions and answers related to clubroot in canola at agsolutions.ca/clubroot; for more information, call AgSolutions® Customer Care at 1-877-371-BASF (2273).



Always read and follow label directions.

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We create chemistry

INVIGOR HYBRID CANOLA
InVigor Clubroot Resistance Options

Together, we're in it for the long haul.

Clubroot is a constantly evolving disease in canola. As such, management practices need to evolve alongside the disease to minimize its impact today, as well as in the future. Sustainability of the Canadian canola industry guides our position on how to best manage clubroot and how we recommend deploying clubroot-resistant genetics. With all of this in mind, growers should implement an integrated pest management (IPM) strategy that includes:

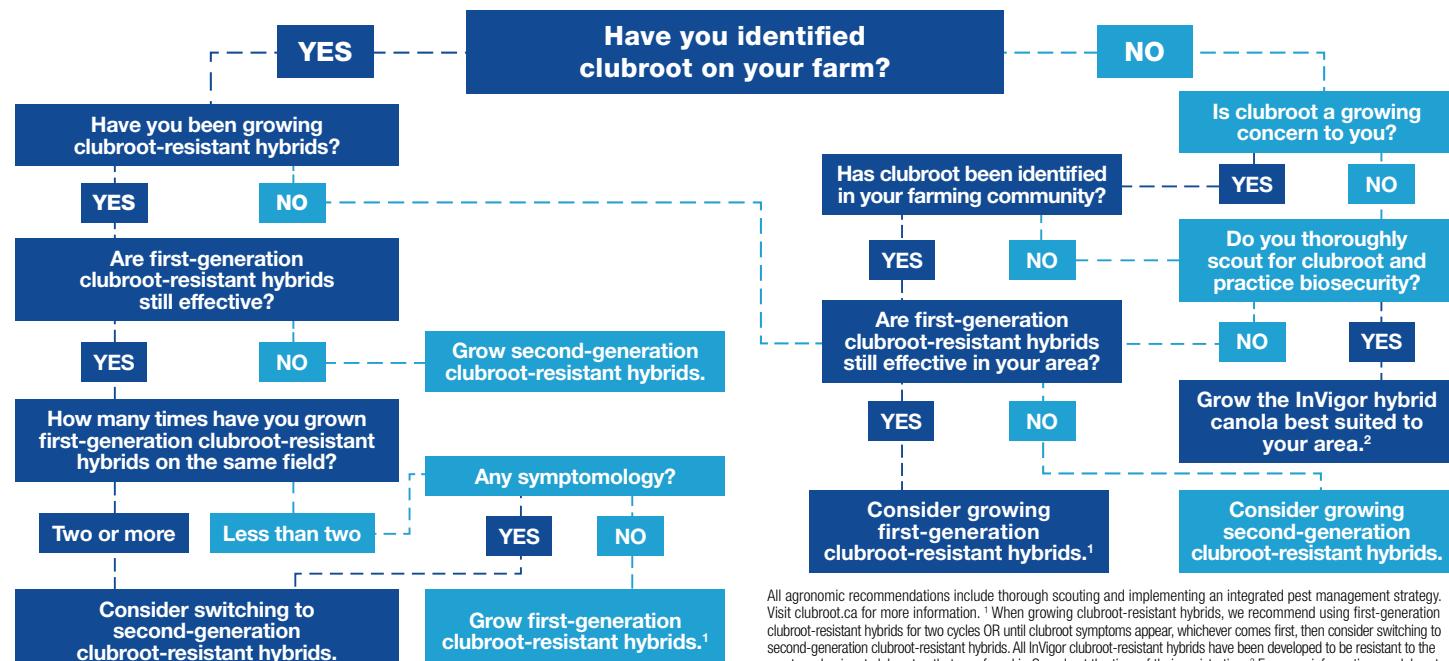
- Canola **rotation** of a minimum of once every three years
- Taking **sanitation** steps to limit the movement of infected soil
- Controlling volunteer canola and other **brassica weeds** that can act as hosts for the disease
- Utilizing **patch management** to limit the movement of clubroot on your farm
- **Scouting** to identify the presence of the disease
- Clubroot-resistant **genetics** are only effective as a sustainable practice as part of an IPM strategy and should not be relied upon alone



Since their launch, InVigor® canola hybrids with clubroot resistance have been planted on 12 million acres across Canada. That's more than any other seed company*. For 2021, growers can choose from eight InVigor clubroot-resistant hybrids – six of which include our patented Pod Shatter Reduction technology.

All InVigor clubroot-resistant hybrids have been developed to be resistant to the predominant clubroot pathotypes found in Canada at the time of their registration.

Our new 300 series hybrid, InVigor L340PC, as well as InVigor L345PC, InVigor L352C, InVigor Choice LR344PC, InVigor L255PC, InVigor L234PC and InVigor L241C and InVigor Health L258HPC, all contain the same **first-generation** clubroot resistance genetics. InVigor L234PC contains this resistance profile plus it contains **second-generation** clubroot resistance to additional emerging clubroot pathotypes to help defend against the ever-evolving pathogen. To assist in determining the risk of clubroot on your farm and selecting the correct InVigor hybrid to grow, please refer to the following chart:



*Source: 2019 and 2020 BPI (Business Planning Information) data

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Introducing the new 300 series canola hybrid, InVigor L340PC. This hybrid has demonstrated exceptionally high yield potential, with both high external Western Canada Canola/Rapeseed Recommending Committee (WCC/RRC) trial results and internal InVigor trial results. It features both the patented Pod Shatter Reduction technology as well as first-generation clubroot resistance.*

| | DESCRIPTION | YIELD | TRAITS | STANDABILITY | MATURITY | GROWING ZONES | BLACKLEG |
|---|--|---|--|---------------------|---|---------------------------|-----------------|
| NEW InVigor L340PC | An exciting 300 series hybrid for growers that want it all. A high yielding, mid-maturing, Pod Shatter Reduction hybrid that offers first-generation clubroot resistance and strong standability. | 108.9% of the new checks (InVigor L233P and Pioneer® 45H33) in 2019 WCC/RRC trials 107.8% of InVigor L233P (n=16 trials, 2019) | Patented Pod Shatter Reduction First-generation clubroot resistance | Strong | 1 day earlier than InVigor L252 | All growing zones | R resistant |
| InVigor L345PC | InVigor L345PC offers a significant jump in yield potential over InVigor L233P and features our patented Pod Shatter Reduction technology plus first-generation clubroot resistance. This hybrid is suitable for all growing zones. | 111.9% of the checks (InVigor 5440 and Pioneer® 45H29) in the 2017/2018 WCC/RRC trials 111.4% of InVigor L233P (n=28 trials, 2018) | Patented Pod Shatter Reduction technology First-generation clubroot resistance | Strong | 1 day earlier than InVigor L252 | All growing zones | R resistant |
| InVigor L352C | InVigor L352C has a similar maturity to InVigor L252 with higher yields and features first-generation clubroot resistance. This hybrid is a strong replacement for InVigor L252, since it's the ideal hybrid for growers who prefer to swath their canola. | 108.6% of the checks (InVigor 5440 and Pioneer® 45H29) in the 2017/2018 WCC/RRC trials 104% of InVigor L252 (n=28 trials, 2018) | First-generation clubroot resistance | Strong | 1/2 a day later than InVigor L252 | All growing zones | R resistant |
| InVigor^{choice} LR344PC | The first-of-its-kind InVigor Choice canola hybrid features both the LibertyLink® technology system and TruFlex™ canola with Roundup Ready® Technology. As if that isn't enough, you'll also have the benefits of patented Pod Shatter Reduction technology and first-generation clubroot resistance from InVigor. This hybrid is perfect for growers looking to combine high-yielding InVigor genetics with the flexibility of Liberty® herbicide or Roundup® herbicide applications. | 104.1% of the new checks (InVigor L233P and Pioneer® 45H33) in 2018 WCC/RRC trials 103.6% of InVigor L233P (n=12 trials, 2018) | Patented Pod Shatter Reduction technology First-generation clubroot resistance LibertyLink® technology system and TruFlex™ canola with Roundup Ready® Technology | Strong | Over 1 day earlier than InVigor L252 | All growing zones | R resistant |
| InVigor L234PC | Featuring Pod Shatter Reduction technology and second-generation clubroot resistance, this hybrid is a great fit for growers in known clubroot-affected areas. We recommend growing InVigor L234PC with second-generation clubroot resistance after two cycles of growing first-generation clubroot-resistant hybrids in clubroot-affected areas or when clubroot symptoms are noticed in first-generation clubroot-resistant hybrids (whichever comes first). | 104% of the checks (InVigor 5440 and Pioneer® 45H29) in 2017 WCC/RRC trials | Patented Pod Shatter Reduction technology Second-generation clubroot resistance | Good | 3 days earlier than the average of the checks | All growing zones | R resistant |
| InVigor L255PC | InVigor L255PC offers Pod Shatter Reduction and first-generation clubroot resistance and separates itself from other hybrids due to its very impressive standability. A great fit for growers in the mid to long growing zones. | 109% of the checks (InVigor 5440 and Pioneer® 45H29) in 2016 WCC/RRC trials | Patented Pod Shatter Reduction technology First-generation clubroot resistance | Very strong | 1.5 days later than the average of the checks | Mid to long growing zones | R resistant |
| InVigor L241C | You can expect strong standability and high yields from this mid-maturing hybrid with first-generation clubroot resistance. InVigor L241C is well suited for growers who prefer to swath in all clubroot-affected regions of Western Canada. | 102% of the checks (InVigor 5440 and Pioneer® 45H29) in 2012/2013 WCC/RRC trials | First-generation clubroot resistance | Very strong | 1 day earlier than the average of the checks | All growing zones | R resistant |
| InVigor^{health} L258HPC | InVigor Health L258HPC is a high-yielding hybrid that offers the security of a contract premium. It's suitable for all mid to long growing zones and offers patented Pod Shatter Reduction technology as well as first-generation clubroot resistance. InVigor Health L258HPC produces a specialty oil profile that is more heat stable and higher in oleic acid. | 104.9% of the checks (InVigor 5440 and Pioneer® 45H29) in 2017 WCC/RRC trials | Specialty oil Patented Pod Shatter Reduction technology First-generation clubroot resistance | Very strong | 1.5 days later than the average of the checks | Mid to long growing zones | R resistant |

Please note: Maturity and standability are based on performance ratings and data compiled from several InVigor internal trials over multiple years. Results may vary on your farm due to environmental factors and preferred management practices.
n=number of balanced trials.

* To predominant clubroot pathotypes found in Canada at the time of registration. InVigor L340PC, InVigor L345PC, InVigor L352C, InVigor Choice LR344PC, InVigor L255PC, InVigor L241C and InVigor Health L258HPC all share the same first-generation clubroot resistance profile. InVigor L234PC has this resistance profile plus it contains second-generation multi-genetic clubroot resistance to additional clubroot pathotypes to help combat evolving clubroot pathotypes.

Best management practices for clubroot.

While clubroot-resistant hybrids play an important role in managing the disease, they cannot be solely relied upon. It's important that we use them in combination with other strategies to prevent the breakdown of resistance and further spread of disease. That's why BASF continues to recommend an IPM strategy that complements the InVigor clubroot-resistant hybrids you're using on your farm.

Integrated pest management (IPM) with clubroot-resistant hybrids.

Sanitation.

Preventing spread of the disease is important for long-term control, even with clubroot-resistant hybrids. Sanitation practices are essential for fields known to be infested with clubroot; it's also important to ensure that areas without clubroot remain that way.

Keep spore loads low.

Extending canola rotations will help to prevent the buildup of clubroot resting spores. Paired with growing clubroot-resistant hybrids, you can reduce the potential for shifting populations to virulent pathotypes that could overcome resistance. In order to preserve existing clubroot resistance for as long as possible, a minimum two-year break from a host crop is required—and longer if inoculum levels are high.

Weed control.

Control of canola volunteers and other brassica weeds that act as hosts for clubroot will be essential to keeping the selection pressure low by not allowing the disease to build up in the non-canola years.

Scouting.

Even growers using clubroot-resistant hybrids should scout their field regularly to see if there is any evidence of the resistance breaking down. Also, if you're growing susceptible canola hybrids, scout for clubroot symptomology. If the field is known to be infested with clubroot, scouting should be thorough. In other words, you should examine several different areas of the field to see if there is any indication of resistance failing. If the field is not known to be infested, scouting near the field entry points should occur once near the end of the growing season. If small patches of clubroot are identified, it's crucial to take the time to hand pull and eliminate the galls since one heavily infected plant could produce up to 16 billion spores.



In general, all the prevention strategies should still be employed even with clubroot-resistant hybrids.

For more information on clubroot and the strategies mentioned above, visit www.clubroot.ca.