

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 US canola production 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

NEW

InVigor®
L340PC

InVigor®
L345PC

InVigor^{choice}
LR344PC

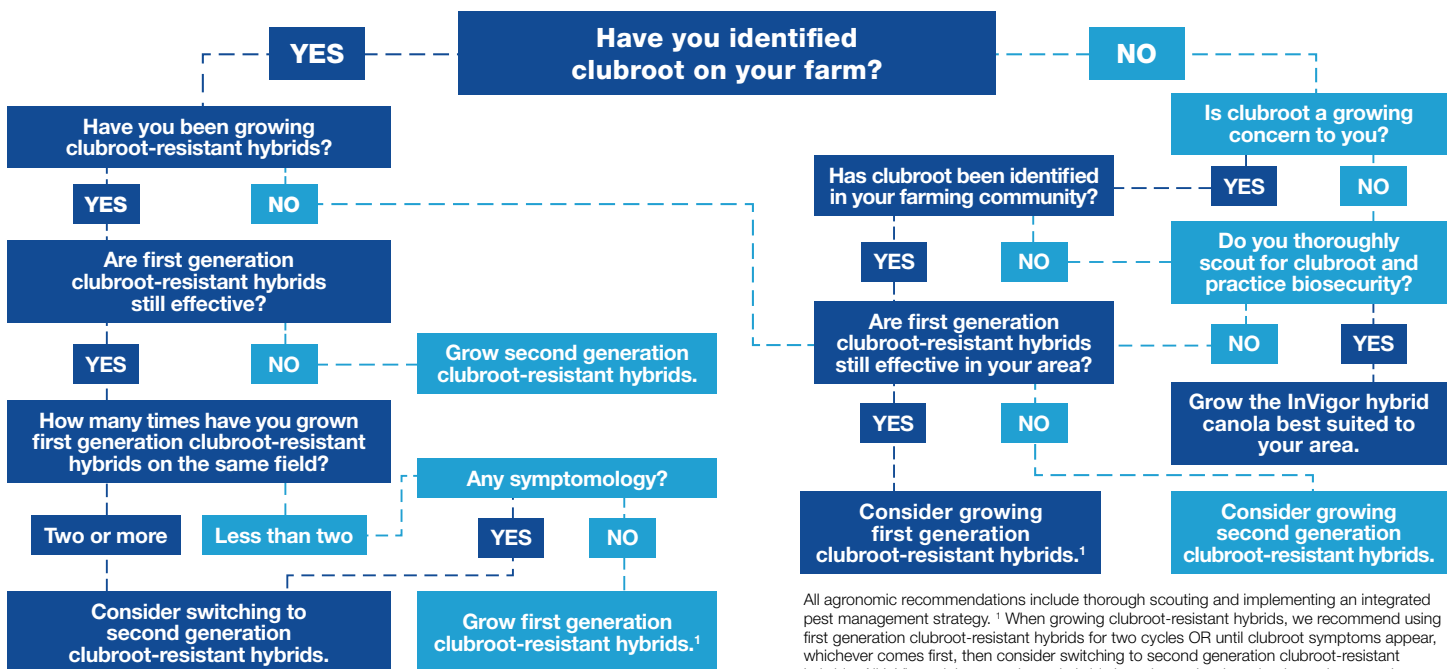
InVigor®
L255PC

InVigor®
L234PC

Since their launch, InVigor® canola hybrids with clubroot resistance have been planted on 12 million acres across Canada, where the clubroot disease pressure is much higher due to tighter rotations. That's more than any other seed company*. For 2021, US growers can choose from five InVigor clubroot-resistant hybrids – all of which include our patented Pod Shatter Reduction technology.

Our new 300 series hybrid, InVigor L340PC, as well as InVigor L345PC, InVigor Choice LR344PC and InVigor L255PC, 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.



All agronomic recommendations include thorough scouting and implementing an integrated pest management strategy. ¹ When growing clubroot-resistant hybrids, we recommend using first generation clubroot-resistant hybrids for two cycles OR until clubroot symptoms appear, whichever comes first, then consider switching to second generation clubroot-resistant hybrids. All InVigor clubroot-resistant hybrids have been developed to be resistant to the most predominant clubroot pathotypes found in the US at the time of their registration.

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

Introducing the new 300 series canola hybrid, InVigor L340PC. This hybrid has demonstrated exceptionally high yield potential in internal InVigor trial results. It features both the patented Pod Shatter Reduction technology as well as first generation clubroot resistance.²

	DESCRIPTION	YIELD	TRAITS	STANDABILITY	MATURITY	GROWING ZONES	BLACKLEG
NEW InVigor L340PC	An exciting 300 series hybrid for growers that want it all. A high yield potential, 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 choice LR344PC ³	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 yield potential 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

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.

² To predominant clubroot pathotypes found in Canada at the time of registration. InVigor L340PC, InVigor L345PC, InVigor Choice LR344PC and InVigor L255PC all share the same first generation clubroot resistance profile. InVigor L234PC has this resistance profile plus it contains second generation multigenetic clubroot resistance to additional clubroot pathotypes to help combat evolving clubroot pathotypes.

³ This product is approved for planting in Washington, Oregon, Idaho, Montana and the following counties of North Dakota: Divide, Williams, McKenzie. For additional information please contact your BASF representative.

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 falling. 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.



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 infested 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 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 the United States more prone to clubroot development?

A. Although clubroot is established primarily in the Langdon, North Dakota area, geography does not equate to immunity. Diligent scouting is recommended in all canola growing regions.

InVigor[®]

BASF
We create chemistry

Always read and follow label directions.

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