

# CLUBROOT OF CANOLA

## FACTSHEET

### CROPS

### Introduction

Clubroot is a soil-borne disease caused by a microbe, *Plasmodiophora brassicae*. Clubroot affects the roots of cruciferous field crops such as canola, mustard, camelina, oilseed radish, taramira and cruciferous vegetables such as arugula, broccoli, Brussels sprouts, cabbage, cauliflower, Chinese cabbage, kale, kohlrabi, radish, rutabaga and turnip. Cruciferous weeds (such as stinkweed, shepherd's purse, wild mustard) can also serve as hosts.

### Symptoms

- Clubroot alters root hormone balance, increasing root cell division and growth, resulting in galls.
- Deformed roots are less able to absorb water and nutrients, leading to stunting, wilting, yellowing, premature ripening and seed shrivelling.
- The cause of suspicious above-ground symptoms can be confirmed by digging up plants to check roots for galls (see photo).
- Clubroot affects canola yield and quality to a similar degree as other diseases affecting water and nutrient uptake, and its impact depends on soil conditions and the growth stage of the crop when infection occurs.



**Clubroot galls on canola**

Photo: Canola Council of Canada



**Clubroot galls on canola**

Photo: Saskatchewan Agriculture

**Clubroot is of particular concern because the disease can cause devastating yield losses with limited control options. In areas where it has not yet occurred, clubroot is also of concern because the disease can spread through movement of soil contaminated with resting spores.**



## Spread of Clubroot

- Infected roots will eventually disintegrate, releasing resting spores into the soil that may then be transported by earth tag on agricultural or industrial field equipment, vehicles, tires, animals, and shoes, or transported by wind and water erosion, or through contaminated inputs such as manure.
- Resting spore numbers will decline over time when non-host crops are grown, but a small proportion can survive in soil for up to 20 years.
- Clubroot is primarily a soil-borne disease; it does not infect seed but it may be found in soil attached to seed or other plant parts.

|                           |                                  | Level of Risk for Clubroot  |   |  |
|---------------------------|----------------------------------|---|---|--|
|                           |                                  | Low   |   | High   |
| Importance of Risk Factor | Very Important<br>↑<br>Important | Good crop rotation with canola no more than once every 4 years.                                       | Sometimes grow canola every 2 to 3 years.                               | Have grown canola 2 or more years in a row.                          |
|                           |                                  | Sanitation procedures are regularly followed.   | Some sanitation procedures in place.                                    | No sanitation procedures.  |
|                           |                                  | You scout crops regularly for disease and have not seen clubroot symptoms.                            | You sometimes scout crops and investigate unusual symptoms.             | You rarely scout crops or investigate unusual symptoms.              |
|                           |                                  | Regardless of soil conditions, clubroot risk will be lowered with sanitation and good crop rotations. | Dry years may reduce disease<br>High soil pH will not prevent clubroot. | Wet years may increase disease<br>Low soil pH may increase clubroot. |

**Clubroot is a declared pest in Saskatchewan under *The Pest Control Act*.**

## Best Practices for Prevention and Management (from The Clubroot Management Plan - [www.agriculture.gov.sk.ca](http://www.agriculture.gov.sk.ca))

- Plant susceptible crops, including resistant varieties, no more than once every four years. Crop rotation will restrict clubroot development by limiting the increase of clubroot resting spores and preventing the increase of clubroot inoculum. Clubroot resistant varieties may aid in reducing disease development and reducing the chances of clubroot establishing itself.
- Restrict movement of potentially contaminated soil on vehicles and equipment.
  - Cleaning steps may include removal of crop debris and soil and washing of equipment with a power washer using hot water or steam and misting with disinfectant (one to two per cent bleach), followed by an additional rinse with water.
- Scout crops regularly and carefully for plant diseases and signs of clubroot.
- Clubroot spores may survive livestock digestion. Avoid use of straw, hay, green feed, silage and manure from infested or suspect areas.
- The risk of spreading clubroot through contaminated seed or plant material is much lower than through transporting contaminated soil on field equipment and vehicles. However, avoid seed with earth tag from infested areas to prevent introduction to clean fields.



**Premature ripening of canola in Alberta**  
Photo: Saskatchewan Agriculture

### For more information:

- Visit the Saskatchewan Ministry of Agriculture website at [www.agriculture.gov.sk.ca](http://www.agriculture.gov.sk.ca); or
- Visit [www.clubroot.ca](http://www.clubroot.ca); or
- Contact the Agriculture Knowledge Centre at 1-866-457-2377 or e-mail [aginfo@gov.sk.ca](mailto:aginfo@gov.sk.ca); or
- Visit your local Regional Office.

Suspect samples can be submitted to:  
The Crop Protection Laboratory  
346 McDonald Street  
Regina, SK, S4N 6P6  
Phone: 1-306-787-8130  
(mail, courier or drop off samples in person)

# Is your canola at risk?

## CLUBROOT:

### A disease of canola and vegetables



Symptoms of clubroot include stunting, wilting, yellowing and premature ripening of canola plants (left), and the formation of galls on canola roots (right).

## Prevent Clubroot Spread in Saskatchewan!

- Plant canola no more than once every 4 years.
- Scout canola fields regularly and stay alert for suspicious stunting, wilting, yellowing and premature ripening.
- Check roots to confirm the presence of galls.
- Control cruciferous weeds and volunteer canola or mustard.
- Clean your equipment before moving it to another field: the disease is spread through movement of contaminated soil.



Saskatchewan  
Ministry of  
Agriculture

For more information, visit [www.clubroot.ca](http://www.clubroot.ca) or the Saskatchewan Agriculture website: [www.agriculture.gov.sk.ca](http://www.agriculture.gov.sk.ca).

If you have questions or suspect clubroot, call your local Regional Office or the Agriculture Knowledge Centre at 1-866-457-2377

## **Clubroot Management Plan**

Developed by the Saskatchewan Clubroot Initiative

June 2011

### **Clubroot Overview**

#### What is clubroot?

Clubroot is a soil-borne disease caused by a microbe, *Plasmodiophora brassicae*. Clubroot affects the roots of cruciferous field crops such as canola, mustard, camelina, oilseed radish, taramira and cruciferous vegetables such as arugula, broccoli, Brussels sprouts, cabbage, cauliflower, Chinese cabbage, kale, kohlrabi, radish, rutabaga and turnip. Cruciferous weeds (e.g. stinkweed, shepherd's purse, wild mustard) can also serve as hosts.

#### What are the symptoms of clubroot?

Invasion of the interior of host roots alters hormone balance and leads to increased cell division and growth, resulting in clubroot galls. These deformed roots have a reduced ability to absorb water and nutrients leading to stunting, wilting, yellowing, premature ripening and shrivelling of seeds. The cause of these above-ground symptoms can be confirmed by digging up suspect plants to check roots for gall formation. Clubroot affects canola yield and quality to a similar degree as other diseases affecting water and nutrient uptake, and its impact depends on soil conditions and the growth stage of the crop when infection occurs. Early infection of seedlings tends to result in great yield losses. Spore germination in *Plasmodiophora*, infection and disease development are favoured by warm soils, high soil moisture and low soil pH.

#### Is there surveillance in place for clubroot?

A canola disease survey is conducted annually in the province by a collaboration of plant pathologists, agronomists and crop specialists from the Saskatchewan Ministry of Agriculture, Agriculture and Agri-Food Canada and private industry. The objective of the canola disease survey is to monitor the presence and severity of common canola diseases, as well as detect the appearance of new diseases such as clubroot.

#### Where has clubroot been found?

Clubroot affects crucifers worldwide, and was first identified in Europe in the thirteenth century. In Canada, clubroot is primarily established in vegetable growing regions of British Columbia, Quebec, Ontario and the Atlantic provinces. It has also been found in canola in Quebec since 1997. After 45 years of large scale production of canola in western Canada, the disease was reported for the first time in this crop near Edmonton, Alberta. Since then, clubroot has been confirmed in more than 15 counties in Alberta, and was added as a declared pest to Alberta's *Agricultural Pests Act* in 2007.

Clubroot symptoms have not been observed on any of the Saskatchewan canola crops randomly selected for canola disease surveys. In 2008, 30 soil samples were tested using both DNA diagnostics to detect *Plasmodiophora brassicae* and a bioassay in which canola plants are grown in a sample of the soil and observed for clubroot symptoms after six weeks. One soil sample from west-central Saskatchewan was found to be positive for clubroot using these tests, despite the absence of symptoms in the crop.

How does clubroot spread?

Infected roots will eventually disintegrate, releasing resting spores into the soil, which may then be transported by wind, water erosion, animals/manure, shoes/clothing, vehicles/tires or earth tag on agricultural or industrial field equipment. Resting spore numbers will decline over time when non-host crops are grown, but a small proportion can survive in soil for up to 20 years. Clubroot is primarily a soil-borne disease; it does not infect seed but it may be found in soil attached to seed or other plant parts. Clubroot does not present any legal phytosanitary issues for trade.

What is the oil and gas industry doing about clubroot?

The Canadian Association of Petroleum Producers has developed a set of best management practices designed to promote the development of effective and achievable procedures to minimize the spread of clubroot pathogen spores in areas in which susceptible crops are grown.

What are growers doing about clubroot?

Those who grow susceptible host crops should follow the recommended best management practices. These include proper crop rotation and sanitation for prevention and management of clubroot. Growers are advised to scout susceptible crops diligently and contact the Saskatchewan Ministry of Agriculture if clubroot is suspected. Currently, fungicides are not a practical solution for clubroot in canola and there are no foliar products or seed treatments registered for control of clubroot on canola in Canada. Most Canadian canola varieties are susceptible to clubroot, but resistant varieties are becoming available in the marketplace.

Growers are also funding clubroot research through their canola levy. Saskatchewan researchers at Agriculture and Agri-Food Canada in Saskatoon are working in collaboration with the University of Alberta (U of A), Alberta Agriculture and Rural Development (AARD), the University of Guelph, and Ibaraki University in Japan to isolate, screen and discover indigenous microorganisms for biological control of clubroot on canola. The research is part of an integrated disease management approach supported by provincial canola development commissions and grower associations, and the Canola Council of Canada. Researchers at the U of A and AARD have also been studying the pathogen and control options, and both public and private research programs have been screening Brassica germplasm and developing clubroot resistant or tolerant canola lines for western Canada.

What are canola industry organizations doing about clubroot?

The industry organizations are assisting growers through education and awareness for the prevention of the spread of clubroot in Saskatchewan. The organizations help direct the canola levy to appropriate research initiatives which include the development of clubroot tolerant and resistant canola varieties. The canola industry organizations are also assisting the Saskatchewan Ministry of Agriculture through the Saskatchewan Clubroot Initiative.

What is the province doing about clubroot?

As part of a provincial clubroot management plan, the Saskatchewan Clubroot Initiative was established to promote awareness and identify priorities for clubroot prevention and management. In June 2009, the Saskatchewan Minister of Agriculture declared clubroot a pest, giving municipalities powers to handle clubroot under *The Pest Control Act*. These powers include the appointment of Pest Control Officers to enforce, enter land, perform inspections, collect specimens or issue orders to any person; the authority to pass bylaws to prevent, control or destroy clubroot; and the ability to require individuals to take actions to control or destroy clubroot on the land they own, occupy or control. Education and awareness continue to be a priority to help growers and industry members prevent the spread of clubroot into and within Saskatchewan.

Where can I get more information?

For more information on clubroot, please visit [www.clubroot.ca](http://www.clubroot.ca) or the Saskatchewan Ministry of Agriculture's website at [www.agriculture.gov.sk.ca](http://www.agriculture.gov.sk.ca) or contact the Agriculture Knowledge Centre at 1-866-457-2377.

**Objective**

To promote awareness and minimize the risk of clubroot in Saskatchewan.

**Best Practices for Prevention and Management**

1. Plant susceptible crops, including clubroot resistant canola varieties, no more than once every four years. Crop rotation will not prevent the introduction of clubroot to fields that are free of the pathogen, but it will restrict clubroot development by limiting the increase of clubroot resting spores and preventing the increase of clubroot inoculum, as well help alleviate the impact of other plant pathogens.
2. Scout crops regularly and carefully.
  - Identify suspicious above-ground symptoms including wilting, stunting, yellowing and premature ripening of canola or other susceptible crops.
  - Wilting is likely to be more apparent in hot weather (usually afternoon).
  - Field entrances and approaches are likely to be contaminated with clubroot spores first. Therefore, symptoms will often appear there first.
  - Confirm cause of above ground symptoms by checking the roots for galls.
  - If clubroot is suspected, inform the Saskatchewan Ministry of Agriculture by contacting the Agriculture Knowledge Centre (1-866-457-2377) or your local Saskatchewan Ministry of Agriculture regional office.
3. Practice good sanitation by restricting movement of potentially contaminated soil to non-contaminated regions.
  - For Saskatchewan producers, this means restricting entry into their fields of vehicles, field machinery or oil rig equipment with earth tag from infested regions unless it has been properly sanitized. Ask questions about where the equipment is from and what sanitation measures have been used before the equipment left the infested area, dealer or auction site.

- Cleaning steps may include: removal of crop debris and soil, washing of equipment with a power washer using hot water or steam and misting with disinfectant (1-2 per cent bleach solution), followed by an additional rinse with water.
4. Clubroot spores may survive livestock digestion. Avoid use of straw, hay, greenfeed, silage and manure from infested or suspect areas.
  5. The risk of spreading clubroot through contaminated seed or plant material is much less than through transporting contaminated soil on field equipment and vehicles. However, avoid seed with earth tag from infested areas to prevent introduction to clean fields.
  6. To minimize the risk of accidental release of *P. brassicae*, appropriate containment guidelines should be followed when conducting research involving *P. brassicae* in greenhouses, growth cabinets or laboratories. Because clubroot is not widespread in Saskatchewan, field plot research should not be conducted here. Preventative measures should also be followed when conducting disease surveys in Saskatchewan. Contact Faye Dokken-Bouchard or Pat Flaten for a copy of the current Recommendations for Managing Risks associated with Clubroot Research in Saskatchewan.

**In addition, in fields where clubroot has been confirmed through the observation of disease symptoms in a susceptible crop and the detection of the pathogen's DNA in a plant or soil sample, the following measures should be taken:**

1. Plant susceptible crops, including clubroot resistant canola varieties, no more than once every four years, and rotate sources of disease resistance. Resistance to clubroot does not mean full immunity to the disease. Tight rotations of resistant varieties may lead to propagation and spread of new clubroot pathotypes that the variety has no resistance to, breaking down the effectiveness of the clubroot resistance. Although the signs and symptoms of clubroot may not be present, plants may still host disease and propagate new spores, increasing the potential severity of the disease in the future; therefore a minimum of four years is required between susceptible crops, including clubroot resistant canola varieties.
2. Minimize traffic to and from fields and practice good sanitation by restricting movement of soil from the contaminated field to other areas. Any individuals or companies who may be accessing the land should be informed that clubroot is present on the land so they may limit traffic and/or ensure proper sanitation. Procedures for proper sanitation are outlined in point #3 of the previous section.
3. If infestation is only near the current field access, consider seeding perennial grass to that area and create a new access point as far from the contaminated area as possible.
4. Use direct seeding and other soil conservation practices to reduce erosion. Resting spores can be readily moved in soil transported by wind or water erosion. Reducing the amount of tillage will reduce the spread of the organism within the field and to other fields.

## Responsibilities

1. Saskatchewan Ministry of Agriculture
  - Co-ordinate efforts to monitor crops in the province for clubroot.
  - Compile and distribute the Saskatchewan Clubroot Management Plan.
  - Manage legislation and regulations pertaining to clubroot as a declared pest.
  - Extend clubroot education to the agriculture industry and the general public, as well as provide information to the oil and gas industries, environmental companies, landscaping companies, equipment dealers and auction companies and custom applicators, seeders, and harvesters.
2. Producers and Producer Groups
  - Implement best management practices which adhere to the Saskatchewan Clubroot Management Plan.
  - Producer groups including the Saskatchewan Canola Growers Association, SaskCanola, the Saskatchewan Mustard Development Commission, the Saskatchewan Vegetable Growers Association and the Saskatchewan Seed Potato Growers' Association assist in educating Saskatchewan producers about clubroot prevention and management.
3. Saskatchewan Association of Rural Municipalities (SARM).
  - Help educate Saskatchewan producers about clubroot prevention and management.
  - Rural municipalities have the authority under *The Pest Control Act* to undertake prevention and enforcement measures related to the spread and control of clubroot disease.
4. Agricultural Retail Industry
  - Help educate the Saskatchewan agriculture industry about clubroot.
  - Take measures such as equipment cleaning to prevent the introduction and minimize the spread of clubroot from infested areas.
5. Equipment Dealers, Auctioneers and Custom Applicators
  - Help educate those purchasing equipment from infested areas (destined for Saskatchewan), as well as the custom application, seeding and harvesting industries about clubroot.
  - Take measures such as equipment cleaning to prevent the introduction and minimize the spread of clubroot from infested areas.
6. Oilfield, Gas, Road Construction, and Other Companies Operating on Agricultural Land
  - Help educate the Saskatchewan oil, gas and other field operators about clubroot.
  - Take measures such as equipment cleaning to prevent the introduction and minimize the spread of clubroot from infested areas.
7. Saskatchewan Clubroot Initiative
  - Provide a forum to represent the interests and views of Saskatchewan's agricultural research and production sectors, producer and other industry groups and municipal government regarding the management of clubroot.

- Provide consultation in the development of the Saskatchewan Clubroot Management Plan as well as evaluation and revision of the recommendations as required.
  - Help educate the Saskatchewan agriculture, equipment, oil, gas and other industries about clubroot and the economic and agronomic impacts the disease poses.
8. Researchers and Funding Agencies
- Researchers should familiarize themselves with the Recommendations for Managing Risks Associated with Clubroot Research in Saskatchewan and use them to develop suitable measures for their unique research situation. Funding agencies should also be aware of these recommendations and may wish to consider the importance of containment protocols in research proposals when considering supporting clubroot projects in Saskatchewan. For a copy of these guidelines, contact F. Dokken-Bouchard or P. Flaten.

### **References**

*Alberta Clubroot Management Plan*, Alberta Clubroot Management Committee (revised May 2010) [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex11519](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex11519)

*Best Management Practices: Clubroot Disease Management*, Canadian Association of Petroleum Producers (July 2008)

**Saskatchewan Clubroot Initiative**

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