2004-21. Evaluation of clubroot control with rotation, fungicides and soil amendments
(Characterization of the clubroot disease problem on canola)

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Introduction

Clubroot has emerged as an important disease of canola (*Brassica napus*) in Alberta, Canada. Historically this disease has mainly been a concern in cruciferous vegetable production in eastern parts of Canada and British Columbia. This disease had been identified in home and market gardens in Alberta prior to identification of this disease in canola. Clubroot is caused by the obligate parasite *Plasmodiophora brassicae* Woronin, which is a devastating soil borne disease of cruciferous crops. The pathogen typically causes the formation of galls (club-shaped tumor-like growths) on both tap and lateral roots and occasionally on the base of the stem. The galls stunt the growth of infected plants by interfering with nutrient and water transport and can also cause the infected plant to wilt. Ultimately the disease can cause major yield and quality losses.

Primary Findings

1. Incidence of clubroot on canola in Alberta, Canada from 2003-2007.

The first reported case of clubroot on canola in the Canadian prairies was in 2003 in Sturgeon County, Alberta. Since 2003 there have been annual surveys for clubroot in Alberta. These results have indicated that clubroot is spreading and is more widespread than originally thought. As of 2007, at least 250 clubroot-infested fields had been identified in 10 counties in central Alberta, one county in southern Alberta, and a rural area in northeast Edmonton. In fields that showed a low level of disease, most clubroot infested plants were identified near field entrances, which would suggest that the pathogen was introduced into the field on contaminated farming equipment. In moderately infested fields, the infected plants occurred in patches, mostly in low lying areas. This reflects the high moisture requirement of clubroot. In highly infested fields, the infected plants were uniform throughout. The soil pH in the clubroot-infested fields typically ranged from 4.8 to 7.6 with an average value of 6.2. Acidic soils and high moisture are known to favor the development of clubroot. The most typical cropping history of infested fields was a canola-cereal-canola-cereal rotation.

2. Potential problems associated with clubroot on canola.

Clubroot can pose a serious threat for canola production, which stems from the long term persistence of clubroot spores in the soil. The pathogen produces resting spores that can remain viable in soil for at least seven years. As such, once a field becomes contaminated with clubroot it is nearly impossible to eradicate the pathogen. Additionally, clubroot can cause significant yield reductions in canola. Yield losses in Alberta have typically been around 30 to 50% in the most severely affected fields; however 100% yield loss (field not harvested) was observed in one case. Clubroot also affects canola quality; a reduction of oil content of 4.7 - 6.1% has been observed in infected plants. Prevention of spread and crop rotation are the simplest and most effective approaches for clubroot management currently. There are currently no economical in-crop control measures for clubroot in canola on the Prairies.

3. Resistance of canola cultivars to *P. brassicae,* casual agent of clubroot.
Currently there are no commercial canola varieties that have total resistance to clubroot. A study was conducted that included 48 canola (*B.napus* and *B. rapa*) cultivars that were included in the 2004 Prairie Canola Variety Trials (PCVT) and the results showed that all varieties were highly susceptible to a local population representing pathotype 3 of clubroot. However, research has found that European winter canola, rutabaga, and certain varieties of the *B. napus* parental species (*B. rapa* and *B. oleracea)* are good sources of genetic resistance. Focus is now on transferring the genetic resistance from these sources into spring canola germplasm for the Canadian market.

4. Isolation and variation in virulence of single spore isolates of *P. brassicae*.
Many different strains or pathotypes of *P. brassicae* exist. Therefore, a simple and efficient method to isolate single resting spores of *P. brassicae* was developed. Recent testing of *P. brassicae* populations from central Alberta has indicated that pathotype 3 is the predominant pathotype in the province. However, because other pathotypes exist at lower frequencies, specific challenges exist for both breeders and farmers. For breeders, the challenge is incorporating resistance to more than one pathotype of clubroot. Otherwise, the lower frequency pathotypes may quickly become predominant if susceptible host cultivars are grown in tight rotation, essentially breaking down the developed genetic resistance. The challenge for farmers will be to manage the released genetic resistance to clubroot to ensure its longevity in the Canadian market.

5. Molecular detection of *P. brassicae*.
A method for the molecular detection of the clubroot pathogen has been developed. It is a simple, one-step polymerase chain reaction (PCR) protocol that was developed to detect *P. brassicae* in plant and soil samples. PCR-based techniques are applied to the detection of fungal pathogens in plant and soil samples because they can provide rapid, sensitive and reliable results. In infected root tissue, *P. brassicae* could be detected 3 days after inoculation, whereas clubroot symptoms were not visible until 24 days. No DNA was amplified from plants, other fungi or bacteria. This demonstrates that the primers used in the PCR have a high specificity for the pathogen. A challenge associated with testing soil from a particular field for the occurrence of *P. brassicae* is the patchy distribution in which clubroot often occurs. Thus, the absence of the pathogen from a particular soil sample may not necessarily be an indication that the field it was collected from is free of clubroot.

Clubroot can be an economically devastating disease in canola and producers are encouraged to monitor their fields for the presence of *P. brassicae* and manage their operations to prevent the spread of this disease.