

Clubroot of Canola: Overview of an Emerging Problem

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Clubroot, caused by the obligate parasite *Plasmodiophora brassicae* Woronin, is an important soilborne disease of the Brassicaceae family. While clubroot has long been a problem in the production of cruciferous vegetables in many regions of Canada, it was not reported on the Canadian canola (*Brassica napus* L.) crop until 2003, when it was identified in 12 canola fields in central Alberta (Tewari et al. 2005). Annual surveys conducted since then suggest that clubroot on canola is spreading, with 831 confirmed field infestations as of 2011 (Strelkov et al. 2012). While most cases of clubroot are still confined to central Alberta, the disease has also been identified in a few fields in southern Alberta and in Saskatchewan. The spread of clubroot is a major concern, since the disease can cause yield losses of 30 to 100% in severely infected canola crops.

As would be expected for a soilborne plant pathogen, the primary mechanism of spread between fields is via the movement of *P. brassicae*-infested soil on farm equipment and other machinery (Cao et al. 2009). There is also the potential for pathogen movement as an external contaminant on seeds and tubers, but this risk is small and can be effectively mitigated by proper seed cleaning and/or fungicidal treatments (Rennie et al. 2011; Hwang et al. 2012). Indeed, while quantifiable levels of *P. brassicae* infestation could be found on six of 16 seed and tuber samples harvested from clubroot infested fields in Alberta, the pathogen was found only on one of 30 commercially cleaned seed samples (Rennie et al. 2011). Similarly, all fungicidal seed treatments tested in a recent study significantly reduced viable inoculum levels on artificially infested seed lots (Hwang et al. 2012). Additional work is underway to quantify the extent of pathogen movement by soil and water erosion, which could also contribute to the dissemination of *P. brassicae*, at least on a local scale.

Canadian populations of *P. brassicae* appear to be fairly diverse, with at least five pathotypes identified (Howard et al. 2010) on the differential set of Williams (1966). Pathotype 3 is the most common, representing 87% of the populations and 72% of the single-spore isolates characterized from Alberta thus far. However, the current pathotype designations likely do not reflect the full pathogenic diversity of *P. brassicae* on canola, and the development of a new differential system may be required for the Canadian context (Howard et al. 2010). Knowledge of the virulence of pathogen populations is important for the development of resistant host cultivars.

Until recently, the management of clubroot was restricted largely to the cleaning of equipment to prevent disease spread to new fields, and long rotations out of canola in those fields in which the pathogen was already present (Strelkov et al. 2011). However, a number of clubroot-resistant canola hybrids are now available on the Canadian market, collectively representing an important tool for the successful management of this disease. These hybrids appear to have good resistance to the predominant pathotypes of *P. brassicae* from Canada, and as of 2011 (the second year in which clubroot resistant canola genotypes were extensively cropped) the resistant cultivars appeared to be performing well (Strelkov et al. 2012). Disease severity in clubroot resistant canola crops was very low, with indices of disease (IDs) ranging from 0.2 to 10.2%. In contrast, very high levels of clubroot (IDs >60%) were observed in some of the canola crops planted to susceptible cultivars (Strelkov et al. 2012).

Genetic resistance will have to be carefully managed, however, since the pathotype composition of *P. brassicae* populations can shift rapidly in response to the selection pressure imposed by the cropping of resistant cultivars (Seaman et al. 1963). Recent greenhouse studies showed that the resistance in various *Brassica* genotypes quickly eroded after repeated exposure to the same pathogen population (LeBoldus et al. 2012), suggesting that the same situation could arise under field conditions. In order to prolong the effectiveness of clubroot resistance, resistant canola should be cropped in rotation with non-hosts of *P. brassicae* such as legumes and cereals. Clubroot resistance sources should also be rotated when canola crops are grown in the same field.

Over the last few years, clubroot has emerged as one of the most important diseases of canola in central Alberta, and may well become a problem in other parts of the Canadian prairies. Ultimately, the sustainable management of this disease will require an integrated approach, in which the deployment of clubroot resistant cultivars is combined with other strategies including crop rotation, sanitation and continued pathogen surveillance.

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