CLUBROOT: AN EMERGING THREAT TO THE CANOLA INDUSTRY

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INTRODUCTION

Clubroot, caused by the protist Plasmodiophora brassicae Woronin, is one of the most important diseases of crucifers worldwide. Infection by P. brassicae causes the formation of galls on the roots of susceptible plants, which reduces their ability to absorb water and nutrients, resulting in stunting, wilting and premature senescence. Severe yield and quality losses occurred in canola (*Brassica napus* L.) grown on clubroot-infested soils in Quebec (Pageau et al. 2006). However, the disease was not reported on canola or mustard on the Canadian Prairies until 2003, when 12 clubroot-infested canola fields where identified in Sturgeon County, Alberta (Tewari et al. 2005). The discovery of clubroot-infected canola in Alberta was a cause for concern, since the pathogen produces resting spores that can remain viable in the soil for many years (Karling 1968).

CLUBROOT SURVEYS

Following the identification of clubroot on canola in 2003, annual surveys have been conducted in Alberta to evaluate disease distribution and spread. As of 2007, a total of 169 clubroot-infested fields have been identified in 10 counties in central Alberta, the centre of the outbreak (Strelkov et al. In Press). The disease has also been recently found in two canola fields in a county in southern Alberta. In addition, further surveying by agricultural fieldmen in central Alberta has revealed another 79 cases of the disease, for a grand total of 250 affected fields (C. Henkelmann, T. Prefontaine, E. Brock and M. Flock, personal communication). The primary mechanism of clubroot spread between fields is the movement of infested soil on farm machinery, although the possibility of dissemination of the pathogen as a seedborne contaminant is also being investigated.

In most surveyed fields, clubroot distribution was patchy and disease severity was light to moderate. However, about 10% of the fields were very heavily infested, with yield losses ranging from 30% to 100% (Strelkov et al. 2006a; Strelkov et al. 2007a). Although acidic soils are known to favor clubroot development (Karling 1968), the occurrence of the disease in Alberta is not restricted to fields with acidic soils. Nevertheless, a significant negative correlation between index of disease and soil pH has been found, suggesting that acidic soils may be most at risk (Strelkov et al. 2007b). The fairly widespread occurrence of clubroot on canola in central Alberta suggests that the disease has become established in the region.

PATHOTYPES OF PLASMODIOPHORA BRASSICAE

Isolates of P. brassicae differ in their ability to infect different host species and varieties within a species, resulting in the existence of distinct pathotypes or 'races' of the pathogen. Testing of P. brassicae populations from central Alberta revealed that pathotype 3, as classified on the differentials of Williams (1966), is predominant in the province (Strelkov et al. 2006b; Strelkov et al. 2007b). However, populations often consist of a mixture of different pathotypes. Therefore, a simple and efficient method to isolate single resting spores of P. brassicae was developed and the virulence of 24 isolates, representing five populations of the pathogen from Alberta, Ontario and British Columbia, was characterized on the differentials of Williams (1966) and Somé et al. (1996) (Xue et al. In Press). The pathotype composition of P. brassicae appeared more diverse when single spore isolates rather than populations of the pathogen were examined. In Alberta, at least three and possibly four pathotypes were identified among the 14 isolates tested, whereas a maximum of only two pathotypes had been previously reported when populations of the pathogen were studied. Testing of single spore isolates confirmed that pathotype 3 or P2, as classified on the differentials of Williams (1966) and Somé et al. (1996), respectively, is predominant in the province. However, the occurrence of other pathotypes at lower frequencies suggests that caution should be used in any breeding strategy, since rare pathotypes of P. brassicae may quickly become predominant if susceptible host genotypes are continuously grown (Xue et al. In Press).

CLUBROOT MANAGEMENT TRIALS

In order to evaluate the effects of soil amendments and chemical soil treatments on crop damage caused by P. brassicae infection, field plots were established in naturally infested soils near Leduc and St. Albert, Alberta. Clubroot severity was significantly lower compared to controls in soils treated with Terraclor 75% WP. This treatment also resulted in reduced seedling mortality, increased plant cover, increased plant height and increased emergence in severely infested soils. Percentage plant cover and height also responded positively to treatment with Ranman at 7.5 L/ha in less severely infested soils. Amendment of infested soils with calcium carbonate, wood ash, or calcium cyanamide did not result in changes in clubroot severity, compared to the untreated control. In severely infested soils, amendment with wood ash at 7.5 t/ha or with calcium cyanamide at 5.0 or 7.5 t/ha resulted in greater plant height and crop cover compared to the untreated control. The results suggest that Terraclor 75% WP and treatment with high levels of calcium carbonate or wood ash have the potential to reduce the effect of P. brassicae on canola. These results are preliminary and further research on clubroot management strategies is ongoing.

CONCLUSIONS

Clubroot is a new disease of canola in Alberta, capable of causing severe yield and quality losses. The number of clubroot-infested fields has increased rapidly since 2003, suggesting that the disease is now established in the region. Local populations of the pathogen appear to be fairly diverse, so genetic resistance (once it becomes available) will have to be used as part of an integrated disease management strategy, in order to ensure its longevity. Research is underway to identify effective chemical soil treatments and amendments for controlling clubroot on canola.

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REFERENCES CITED

Karling, J.S. 1968. The Plasmodiophorales. Hafner Publishing Co. New York.

Pageau, D., J. Lajeunesse, and J. Lafond. 2006. Impact de l'hernie des crucifères [*Plasmodiophora brassicae*] sur la productivité et la qualité du canola. Can. J. Plant Pathol. 28:137-143.

Somé, A., M.J. Manzanares, F. Laurens, F. Baron, G. Thomas, and F. Rouxel. 1996. Variation for virulence on *Brassica napus* L. amongst *Plasmodiophora brassicae* collections from France and derived single-spore isolates. Plant Pathol. 45:432-439.

Strelkov, S.E., T. Cao, V.P. Manolii, M.R. Lange, E. Smith-Degenhardt, D. Orchard, and J.P. Tewari. 2006a. Incidence of clubroot on canola in Alberta in 2005. Can. Plant Dis. Surv. 86:91-93.

Strelkov S.E., J.P. Tewari, E. Smith-Degenhardt. 2006b. Characterization of *Plasmodiophora brassicae* populations from Alberta, Canada. Can. J. Plant Pathol. 28:467-474.

Strelkov, S.E., V.P. Manolii, T. Cao, S.F. Hwang, and D. Orchard. 2007a. Incidence of clubroot on canola in Alberta in 2006. Can. Plant Dis. Surv. 87:109-111.

Strelkov, S.E., V.P. Manolii, T. Cao, S. Xue, S.F. Hwang. 2007b. Pathotype classification of *Plasmodiophora brassicae* and its occurrence in Brassica napus in Alberta, Canada. J. Phytopathol. 155:706-712.

Strelkov, S.E., V.P. Manolii, S.F. Hwang, R.J. Howard, A. Manolii, Q. Zhou, M. Holtz, and Y. Yang. Incidence of clubroot on canola in Alberta in 2007. In Press.

Tewari, J.P., S.E. Strelkov, D. Orchard, M. Hartman, R.M. Lange, and T.K. Turkington. 2005. Identification of clubroot of crucifers on canola (Brassica napus) in Alberta. Can. J. Plant Pathol. 27:143-144.

Williams, P.H. 1966. A system for the determination of races of *Plasmodiophora brassicae* that infect cabbage and rutabaga. Phytopathol. 56:624-626.

Xue, S., T. Cao, R.J. Howard, S.F. Hwang, and S.E. Strelkov. Isolation and variation in virulence of single spore isolates of *Plasmodiophora brassicae* from Canada. Plant Dis. In Press.