



Clubroot yield losses assessed

CATEGORY [disease](#) | April 26, 2022

Yield losses to clubroot disease, caused by *Plasmodiophora brassicae*, increased linearly as the Disease Severity Index (DSI) increased. Under greenhouse conditions, an increment of 1% in DSI resulted in a decrease of 0.9% to 1.0% in yield; under field conditions, this percentage was reduced to 0.54% to 0.62%. While the rate of yield reduction was similar among susceptible and resistant cultivars, overall yield loss was lower in the resistant cultivars because they developed less disease.

Previous research in Alberta by Hwang et al. ([2011](#)) found that clubroot severity and disease loss increased at greater inoculum concentrations. The research found that 65% of the difference in canola yield was related to inoculum levels.

The objective of this research was to further investigate the effect of *P. brassicae* inoculum concentration on canola cultivars with varying levels of resistance. Inoculum concentration effects were assessed on clubroot incidence, severity and impact on yield.

A susceptible canola cultivar was compared with first-generation and second-generation clubroot resistant (CR) varieties. The first-generation CR cultivar is resistant to the 3H pathotype. The second-generation CR cultivar is resistant to pathotype 3H and partially resistant to pathotype 5X.

These canola cultivars were inoculated with different quantities of *P. brassicae* inoculum and monitored for disease severity, yield, pods per plant and 1000-grain weight.

Pathotype 3H was predominant in Alberta before the introduction of resistant cultivars, and it is still common in Alberta and Saskatchewan. Pathotype 5X was the first pathotype to overcome the resistance to pathotype 3H in first-generation cultivars.

Two experiments were conducted as part of the research. A field experiment was conducted in 2018 and 2019 at biosecure field nurseries at the Crop Diversification Centre North, Alberta Agriculture, Forestry and Rural Economic Development, Edmonton, Alberta. The plants were inoculated with pathotype 5X or a mix of pathotypes 5X and 3H at 5×10^4 (50,000), 5×10^6 (5 million) and 5×10^8 (500 million) resting spores per plant.

A greenhouse experiment was also conducted with plants inoculated with pathotypes 5X, 3H or a mixture of both at 1×10^3 (1,000), 1×10^4 (10,000) and 1×10^6 (1 million) resting spores per plant.

Disease levels increased with higher spore levels

Clubroot incidence and disease severity index (DSI) both increased as inoculum levels increased. The susceptible cultivar had the highest levels of disease, and the lowest levels were in the cultivar with first-generation clubroot resistance.



In the greenhouse experiment, pathotype, inoculum density and canola cultivar all had a significant effect on DSI. The DSI was lowest for inoculation with pathotype 5X, while 3H + 5X caused the same DSI as pathotype 3H alone. The highest DSI in the greenhouse was found on the clubroot-susceptible cultivar, while the lowest was found on the first-generation resistant cultivar and an intermediate level of disease was found on the second-generation resistant cultivar.

In the field experiment, canola cultivar and inoculum density had a significant effect on DSI – the pathotype did not. The DSI was similar between the two resistant cultivars, and the highest DSI occurred with the susceptible cultivar.

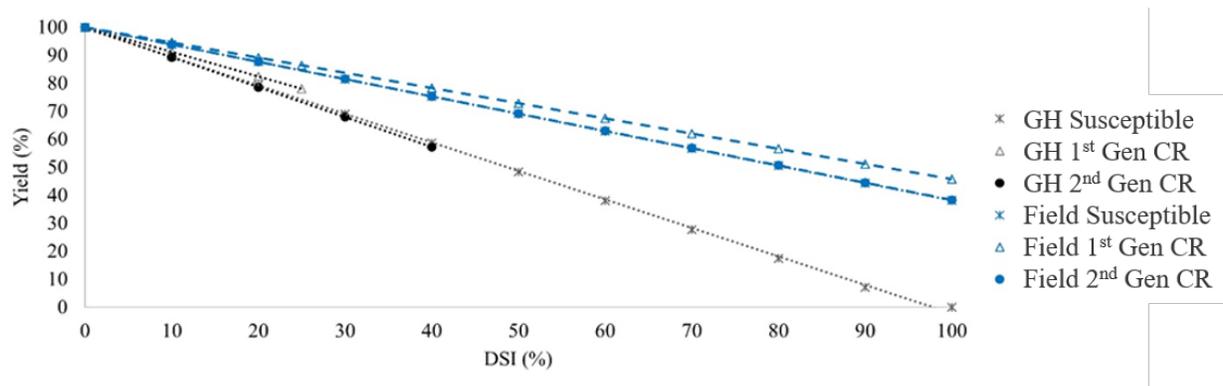
Yield impact quantified

Canola cultivar and DSI affected yield, but the pathotype did not affect yield. The highest yield was from the first-generation resistant cultivar and the lowest was with the susceptible cultivar.

In both the greenhouse and field trials, yield, pods per plant and 1000-grain weight decreased linearly with increasing DSI. Under greenhouse conditions, an increase of 1% in the DSI resulted in a decrease of 0.9% to 1.0% in yield. This percentage decrease was 0.54% to 0.62% under field conditions. Therefore, we can summarize the findings to indicate that, depending on the conditions, yield losses can vary between 0.6% and 1% for each 1% DSI.

This linear yield reduction was equal for all three cultivars, but the susceptible cultivar suffered greater yield losses because it developed a higher DSI. The first-generation CR cultivar had a maximum yield loss of 54.3% and the second-generation CR cultivar had a maximum yield loss of 61.7% under field conditions.

Average yield losses caused by clubroot in a susceptible canola cultivar vs. cultivars with first-generation or second-generation resistance under field (blue lines) and greenhouse (black line)



Adapted from Botero-Ramirez et al. (2021).

Interestingly, the linear rate of yield decline was similar for susceptible and clubroot-resistant cultivars. The only difference was that the susceptible cultivar developed more severe symptoms. This means that once clubroot symptoms begin to develop on a resistant cultivar, the yield decrease will be similar to those of a susceptible cultivar with a similar degree of infection.

The results of the research highlight the importance of using clubroot-resistant varieties. It also highlights the importance of management practices that help to keep clubroot concentration levels in the soil at low levels. Previous research by Ernst et al. (2019) showed that a 2-year break from clubroot-resistant canola resulted in a 95% decrease in clubroot resting spore concentrations. In the third year after the harvest of clubroot-resistant canola, resting spore concentrations were similar to those of host-free control plots.

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Andrea Botero-Ramírez, Sheau-Fang Hwang & Stephen E. Strelkov (2021): Effect of clubroot (*Plasmodiophora brassicae*) on yield of canola (*Brassica napus*), Canadian Journal of Plant Pathology.
<https://doi.org/10.1080/07060661.2021.1989801>

Photos by Andrea Botero-Ramírez