Impact of Crop Management Systems on *Fusarium* Populations in Spring Wheat and Barley on the Canadian Prairies

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Fusarium head blight (FHB) is a very damaging disease of cereal crops that has been spreading to western regions of the Prairies. Crown/root rot (CRR) can also be caused by the same *Fusarium* spp. responsible for FHB and it too is widespread in this region. In Saskatchewan, *F. avenaceum* is one of the most common CRR and FHB pathogens of wheat and barley. Increasing *Fusarium* levels in cereal tissue might result in greater development of FHB in succeeding cereal crops and contribute to its spread.

Past research in western Canada and other regions has shown that the presence of fungal pathogens in wheat roots was affected by agronomic practices, including tillage system and crop rotation, although results have not always been consistent. However, previous CRR studies in western Canada have differed in the levels of *Fusarium* spp. isolated from wheat and barley. For example, none or very few of the fungi isolated from spring wheat or barley roots in studies done throughout western Canada up to about a decade ago were identified as *F. avenaceum,* a wide-host range pathogen which was one of the most common *Fusarium* spp. in crowns/roots of cereal crops surveyed across Saskatchewan in the late 1990's. Apparent changes in the presence or prevalence of *Fusarium* spp. in underground cereal tissue might be attributed, at least partly, to changes in agronomic practices. In recent years, western Canadian producers have become more reliant on alternative crops and have adopted increasingly more conservation tillage practices.

Given the potential role of fungal colonization of plant tissue in the future development of root and head diseases, and the continued spread westward of FHB, it is of interest to determine the impact of current production trends, including continuous diversified cropping, reduced tillage system and organic crop management on *Fusarium* populations in underground tissue of cereal crops. Four different studies were recently conducted at different locations in Saskatchewan with the objective of identifying and quantifying *Fusarium* spp. in spring wheat and barley crops, and to compare *Fusarium* populations in crops grown under different crop management systems. These studies took place in west-central (Alternative Cropping Systems study at AAFC Research

Farm, Scott), eastern (barley and wheat survey in crop districts 1B and 5A), and south-western (crop management study of durum wheat in Swift Current) Saskatchewan.

In all studies, *Cochliobolus sativus* was the most widespread and commonly isolated fungus, and the species most associated with severely discolored subcrown internodes, especially in barley. Among the *Fusarium* spp., *F. avenaceum* and *F. equiseti* were the most common isolates.

Results obtained from all four studies indicated that production systems that do not include summerfallow in previous years but with a high frequency of noncereal crops under reduced tillage management helped to control CRR levels caused by *C. sativus* in wheat and barley, but favoured infections by *Fusarium* spp., especially *F. avenaceum*. Overall, growing barley and common wheat after two years of noncereal crops, particularly pulses, resulted in the highest levels of *F. avenaceum*. These findings were supported by the observation that *F. avenaceum* was present at the highest levels in living underground tissue and residues of noncereals, especially pulses. In addition, organic management resulted in a reduction in populations of pathogenic *Fusarium* spp., such as *F. avenaceum* and *F. culmorum*.

While the lower percent isolation of *C. sativus*, and higher isolation of *F. avenaceum*, associated with reduced tillage might be due to changes in microenvironment resulting from lower soil disturbance, differences in fungal isolations were also found to be correlated to previous glyphosate applications, especially in barley. Analysis of fungal isolations from subcrown internodes of crops grown in eastern Saskatchewan under minimum-till only showed negative or positive effects of previous glyphosate use on fungal levels but not on CRR severity. Cereal crops grown in glyphosate-treated fields had a consistently lower isolation of *C. sativus*, whereas barley crops grown in those fields also had increased isolation of *F. avenaceum* and other *Fusarium* spp. Whether this is due to glyphosate effects on plant susceptibility or on fungal populations is not known. Reduced *C. sativus* infection levels might make it possible for increased growth of other fungi, including *Fusarium* spp., on plant tissue in the absence of competition, and/or the higher levels of some of the latter species in reduced tillage systems might be due to a direct stimulatory effect of glyphosate formulations. The observation that isolation of *Fusarium* spp. increased in fields that had been previously treated with glyphosate also agree with studies on FHB in wheat and barley in the same region of eastern Saskatchewan, and with previously reported studies on *Fusarium* infections in other crops.

These are the first studies in western Canada that established a relationship between alternative crops grown continuously under reduced tillage systems and *Fusarium* infections in underground cereal tissue, particularly those caused by *F. avenaceum*. The association of current production trends with increases in cereal diseases caused by *Fusarium* spp. in western Canada could be attributed to the wide host range of the pathogens or their ability to colonize nonhost plant residues, and/or to direct or indirect effects of lower tillage intensity and glyphosate use. These observations would explain the occasional isolation or absence of *F. avenaceum* in previous CRR studies of wheat and barley conducted in western Canada. Increased *Fusarium* populations could contribute to the development of crown/root rot and FHB in cereal crops grown the following season(s), especially in areas with conditions more conducive to disease development than where these studies were conducted. The observation that the same production factors that

affected *Fusarium* infections of underground tissue also affected their isolation from FHB-affected heads suggests that identification of agronomic practices that might help to control CRR caused by *Fusarium* spp. might also help to reduce the development of FHB.

Further work is needed to more clearly establish the effect of cropping sequence versus tillage/input system on *Fusarium* infections, and to elucidate the mechanism(s) responsible for the changes in populations of pathogenic *Fusarium* spp. under different tillage/input systems. This research is warranted considering the continuing adoption of conservation tillage practices and incorporation of alternative crops in continuously cropped cereal-based systems by western Canadian producers, and the increased development of important wheat diseases caused by *Fusarium* spp. in this region. In particular, the role that a year summerfallow might play in reducing *Fusarium* spp. in currently popular production systems should be further investigated.

Continuing research would allow us to devise appropriate recommendations aimed not only at lowering populations of *Fusarium* pathogens in affected areas but also for preventing their further spread in western Canada.

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