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# Distribution of *Fusarium* spp. causing head blight and root rot in cereals in Saskatchewan in 1998

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## Introduction

*Fusarium* spp. are important cereal pathogens that can cause diseases of heads/seeds, crowns and roots. Some of the *Fusarium* spp. responsible for Fusarium head blight (FHB) have also been found associated with root rot of wheat (Windels and Holen, 1989).

In Saskatchewan, Sallans and Tinline (1969) identified *Cochliobolus sativus* as the main root rot pathogen in wheat, although *Fusarium* spp. have also been isolated from diseased subcrown internodes (Harding, 1973).

There has not been a comprehensive study of cereal root rot pathogens in Saskatchewan to determine the relative importance of these different fungi, their distribution in different soil types, and whether or not the *Fusarium* spp. isolated from infected roots are the same as those causing FHB. Determining whether the most important *Fusarium* spp. associated with FHB can also be found colonizing roots would be an important step in trying to understand the epidemiology of FHB.

## Materials and Methods

In 1998, heads and roots were collected from 69 barley, 107 common wheat (Canada Western Red Spring and Canada Prairie Spring) and 35 durum wheat fields covering 19 crop districts across Saskatchewan, in soil zones I (Brown soil), II (Dark Brown Soil) and III (Black/Grey soil) (Fig. 1). Heads from 50 plants, and roots from up to 30 plants, were sampled randomly from each cereal field at milk to dough stages. Heads were then analyzed for Fusarium head blight symptoms and kernels from infected heads were surface sterilized in 10% Javex for 1 minute and plated on PDA for identification of *Fusarium* spp. Roots were washed in tap water, and subcrown internodes examined. The number of subcrown internodes with lesions, and the percentage of those with >25% of their surface area discolored, were recorded. To identify the pathogens causing root rot, subcrown internodes were surface sterilized in 10% Javex for 1 min and plated on MPDA (Burgess et al., 1988). For both FHB and common root rot, an average percent infection and severity was determined for each field, and crop district.

## Results

Heads FHB was found in common and durum wheat, and barley, in all crop districts. Overall, the percentage of fields with FHB symptoms was 53% for common wheat, 60% for durum wheat and 59% for barley (see Fernandez et al., 1999).

Several *Fusarium* spp. were isolated from wheat (common and durum) and barley kernels from heads with FHB symptoms (Fig. 2). In general, the most frequently recovered *Fusarium* spp. were *F. poae* and *F. graminearum*, followed by *F. sporotrichoides*. Less commonly found were *F. culmorum* and *F. avenaceum*. Each of the other species was isolated at a frequency of 2% or less. *F. poae* was more frequent in barley than wheat, whereas *F. graminearum*, *F. culmorum* and *F. avenaceum* were more common in wheat than barley.

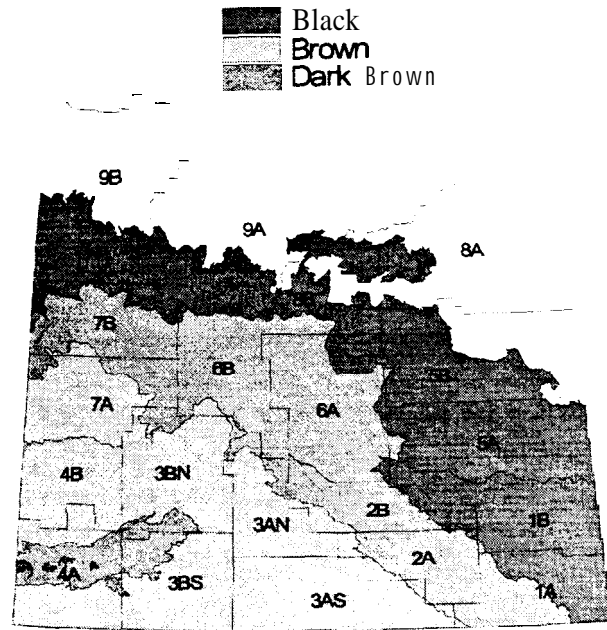


Fig. 1. Saskatchewan crop districts and soil zones

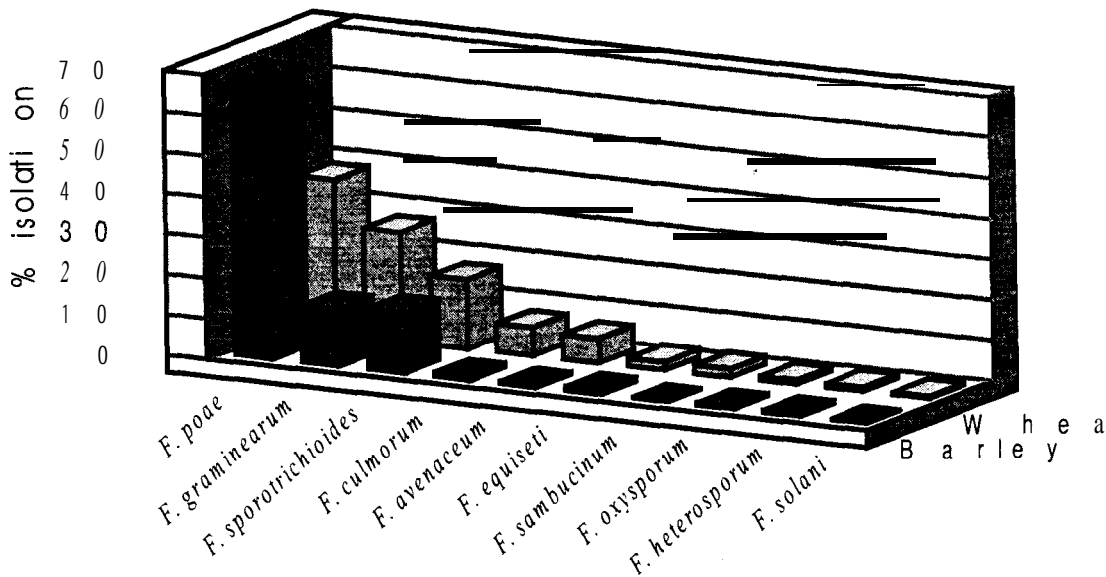
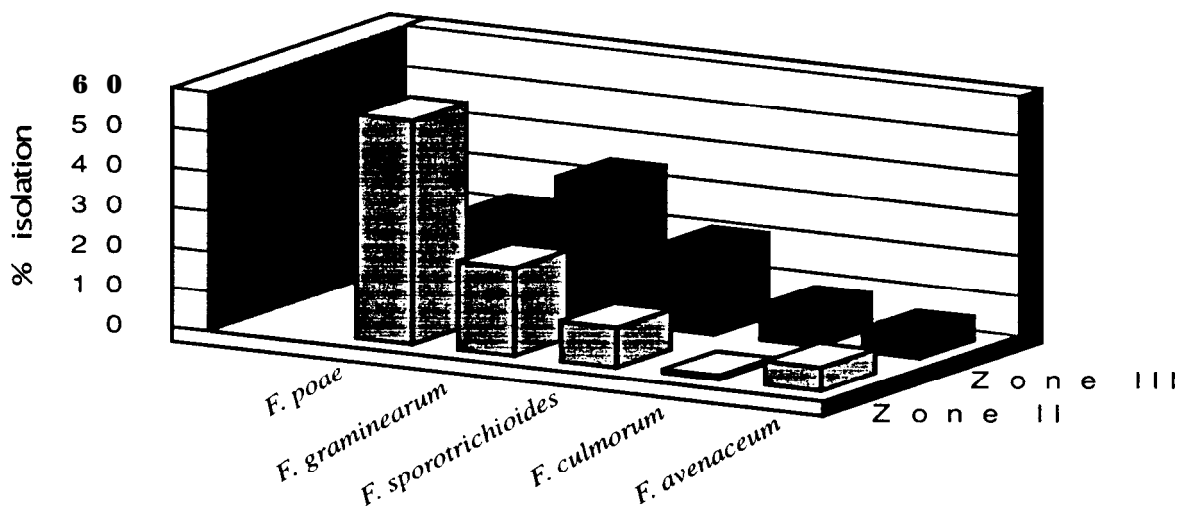
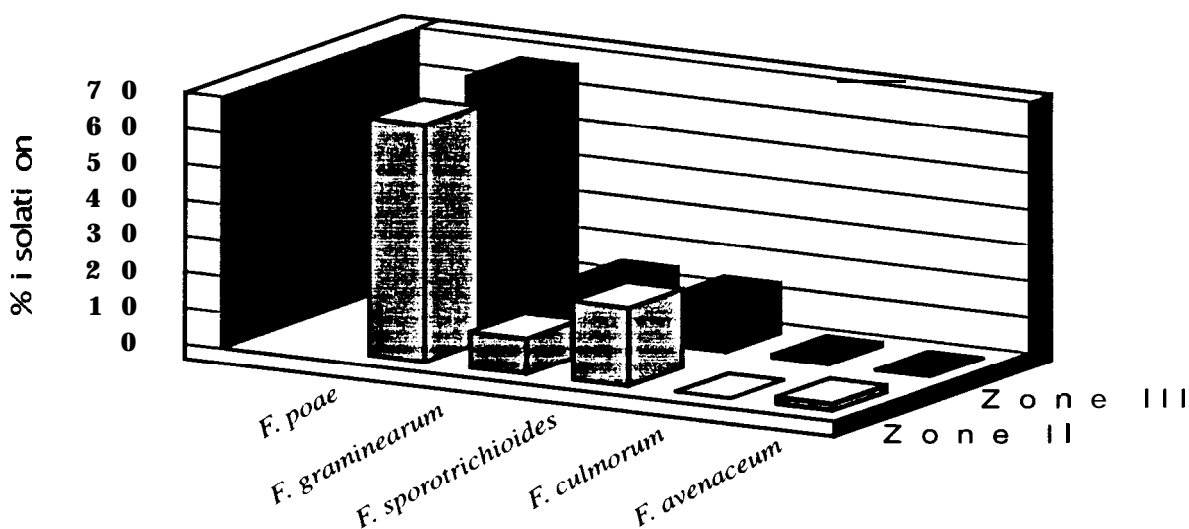


Fig.2 *Fusarium* spp. isolated from wheat (common and durum and barley kernels from heads with FHB symptoms collected in Saskatchewan in 1998.

The frequency of *F. poae* in wheat, and of *F. sporotrichioides* in barley, was greater in Zone II than in III, whereas the frequencies of *F. graminearum* in both barley and wheat, and that of *F. sporotrichioides* and *F. culmorum* in wheat, were greater in Zone III than in II (very few isolations were made in Zone I, therefore this area was left out of the analysis) (Figs. 3 and 4).



**Fig.3. Most frequent *Fusarium* spp. isolated from wheat (common and durum) kernels of heads with FHB symptoms collected in Zone II (Dark Brown soil) and III (BlacWGrey soil) in Saskatchewan in 1998.**



**Fig.4. Most frequent *Fusarium* spp. isolated from barley kernels from heads with FHB symptoms collected in Zone II (Dark Brown soil) and III (BlacWGrey soil) in Saskatchewan in 1998.**

Subcrown internodes. Most fields sampled had plants with subcrown internodes having common root rot symptoms. Overall, an average of 60% of wheat and 66% of barley subcrown internodes were discolored. The mean percentage of subcrown internodes with more than 25% of their area discolored was also greater for barley (25%) than for wheat (15%).

*Cochliobolus sativus* was the most **commonly** isolated pathogen from **subcrown** internodes of wheat and barley (48% for both). *Fusarium* spp. constituted an average of 3.1% of the isolations, and other

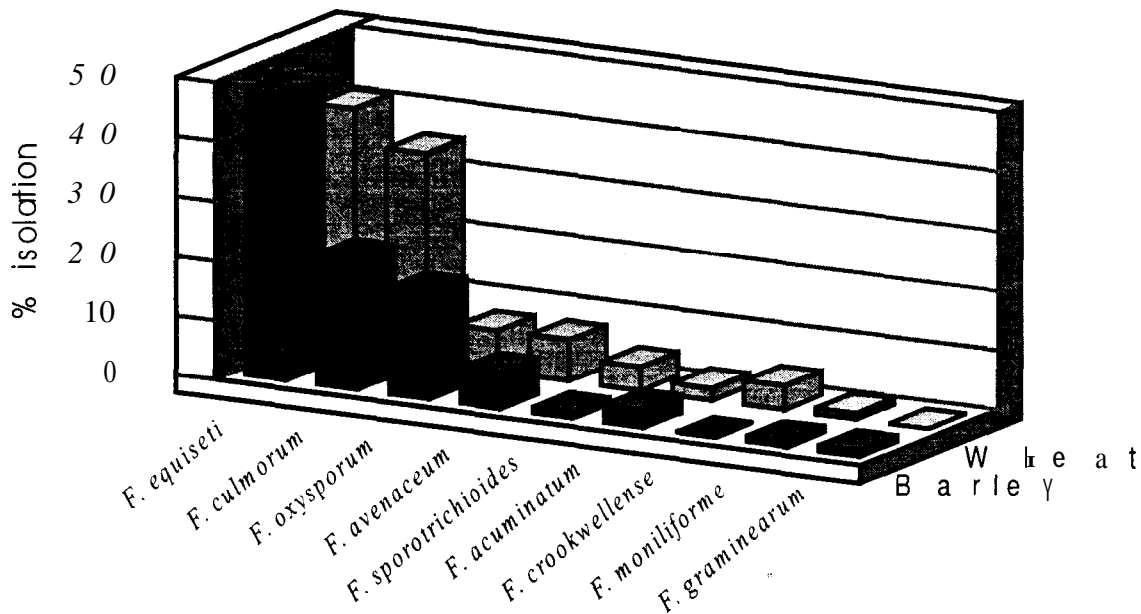


Fig.5. *Fusarium* spp. isolated from subcrown internodes of wheat (common and durum) and barley plants collected in Saskatchewan in 1998.

fungi (*Rhizoctonia solani*, *Microdochium bolleyi* and others) 2.1% of the isolations.

Of the total number of *Fusarium* spp. isolations made from subcrown internodes, the most common ones were *F. equiseti* and *F. culmorum*, followed by *F. oxysporum*, and *F. avenaceum* (Fig. 5). Each of the other *Fusarium* spp. were isolated at a frequency of 2% or less. *F. graminearum* was found in only one barley sample.

There did not appear to be major differences between wheat and barley in the frequency of individual fungi. However, as was observed in kernels, *F. culmorum* was more common in wheat than in barley (Fig. 5), and more frequent in Zone III than in the other two (Figs. 6 and 7).

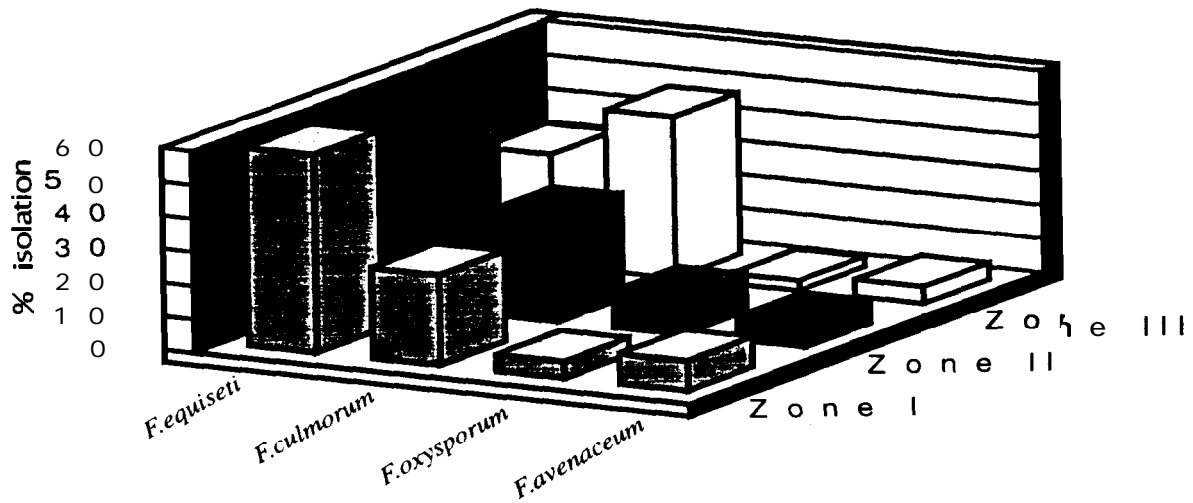


Fig.6. Most frequent *Fusarium* spp. isolated from wheat (common and durum) subcrown internodes of plants collected in Zone I (Brown soil), II (Dark Brown soil) and III (BlacWGrey soil) in Saskatchewan in 1998.

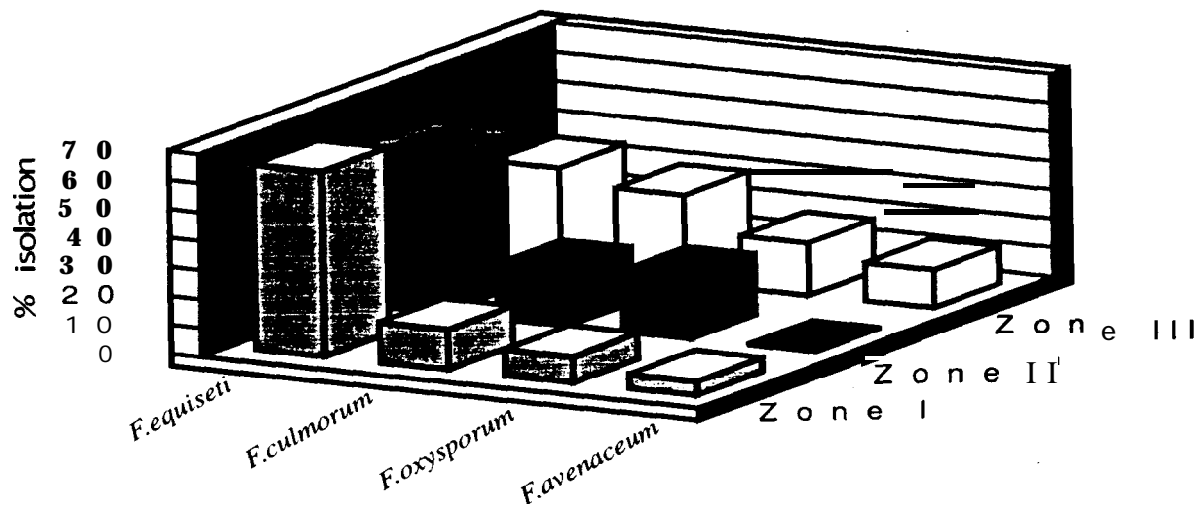


Fig.7. Most frequent *Fusarium* spp. isolated from barley subcrown internodes of plants collected in Zone I (Brown soil), II (Dark Brown soil) and III (Black/Grey soil) in Saskatchewan in 1998.

## Discussion

Our observations from kernels agree with other reports indicating that *F. avenaceum*, *F. graminearum*, *F. poae* and *F. sporotrichoides* were the most, or among the most, common species isolated from infected wheat seed (e.g. Clear and Patrick, 1990).

The observation that *C. sativus* was the most common pathogen isolated from **subcrown** internodes of wheat and barley also agrees with other reports (e.g. Sallans and Tinline, 1969). Previous reports have also found that the *Fusarium* spp. most frequently isolated from roots were *F. equiseti* (e.g. McMullen and Stack, 1983), *F. oxysporum* (e.g. Gordon and Sprague, 1941), *F. acuminatum* (Hill et al., 1983), or *F. gramineurum* (Smiley and Patterson; 1996). Other reports have found *F. graminearum* and *F. culmorum* at low frequencies in roots (e.g. Hill et al., 1983). In our study, *F. gramineurum* was isolated only once, but *F. culmorum* was among the most frequent species isolated from **subcrown** internodes of wheat and barley.

Over half of the *Fusarium* spp. found in kernels from diseased heads of wheat and barley were also found in the **subcrown** internodes of plants collected in the same fields. For *F. culmorum*, a similar trend was observed in both kernels and **subcrown** internodes, it was more common in wheat than in barley, and most frequent in Zone III. For the other fungi, their relative importance in kernels and **subcrown** internodes differed.

*F. gramineurum* and *F. poe*, the most frequent species associated with FHB, were for the most part absent from **subcrown** internodes. However, *F. gramineurum* has often been found in **subcrown** internodes of wheat in Saskatchewan fields (Fernandez, personal observations).

The most pathogenic species on wheat have been reported to be *F. gramineurum* and *F. culmorum* (e.g. Miller, 1994). Most of the species associated with both kernels and **subcrown** internodes in this study are considered minor pathogens.

## Conclusions and Future Work

- The observation that many of the *Fusarium* spp. isolated from infected kernels were also found in **subcrown** internodes of both wheat and barley plants suggests that inoculum in soil/debris might be a source of infection for heads. This would be of significance for *F. culmorum*, an important head pathogen, and one of the most commonly found fungi in **subcrown** internodes. However, pathogenicity on heads of the isolates from the **subcrown** internodes is not known; pathogenicity tests of the *Fusarium* spp. isolated from **subcrown** internodes on heads will be conducted.

- *Fusarium* spp. are also important crown pathogens; identification of fungi from lesions in crowns and lower culms is underway.

- Because of annual variations in isolations of *Fusarium* spp. from underground plant parts (McMullen and Stack, 1983), similar surveys will be conducted in the next couple of years to develop a more comprehensive picture of the distribution of *Fusarium* spp. in different plant organs across Saskatchewan.

## Acknowledgements

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