Fusarium spp. isolated from heads and roots/crowns of wheat and barley in Saskatchewan in 1998-99 and their ability to cause Fusarium head blight

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Introduction

A study was undertaken to identify root/crown pathogens of common and durum wheat and barley across Saskatchewan, determine their distribution in different soil types, and compare *Fusarium* spp. isolated from infected roots/crowns with those causing Fusarium head blight (FHB). Determining whether the most important *Fusarium* spp. associated with FHB in wheat and barley can also be found in infected roots/crowns, and the pathogenicity of these isolates to heads, would be an important step in trying to understand the epidemiology of FHB, and prevent the further spread of this disease in the province.

Materials and Methods

In 1998 and 1999, heads and plant parts at and below soil level were collected from 30-50 plants per field at the milk to dough stages. Common and durum wheat samples were collected from 145 fields in 1998 and 211 fields in 1999, and barley samples were collected from 72 fields in 1998 and 62 fields in 1999, in 19 crop districts in Saskatchewan. Surface-sterilized infected kernels, subcrown internodes and crowns were plated on MPDA (Burgess et al., 1988) agar for identification of *Fusarium* spp.

Isolates from the most important and/or frequent *Fusarium* spp. isolated from heads and subcrown internodes/crowns were tested for pathogenicity to the durum and common wheat cultivars AC Avonlea and AC Elsa, respectively. A spore suspension (1X 10^5) was sprayed onto heads at anthesis, plants were incubated at high humidity for 24 h at 22EC. Following this period the plants were kept at 22EC, 16 h light/8 h dark until they are rated for FHB symptoms at 7 d, 14 d and 21 d after inoculation.

Results and Discussion

The same *Fusarium* spp., and at similar frequencies, were isolated from subcrown internodes/crowns of common/durum wheat and barley (Tables 1 and 2). Similar species were also isolated from heads of common/durum wheat and barley, although in some cases they were found at different frequencies. Overall, there was less *F. culumorum* but more *F. poae* isolated from heads of barley than from those of common/durum wheat.

Most of the *Fusarium* spp. isolated from infected heads of common/durum wheat and barley were also found in lesioned subcrown internodes/crowns of plants, although at different frequencies (Tables 1 and 2). *Fusarium poae*, one of the most common species associated with FHB in Saskatchewan, and *F. graminearum*, were found at very low levels in subcrown internodes/crowns. Conversely, *F.*

equiseti and *F. culmorum* were the most commonly found species in subcrown internodes/crowns but not in heads. *F. avenaceum* was isolated at higher levels in 1999 than in 1998 from both heads and subcrown internodes/crowns.

Table 1. Frequency of isolation of *Fusarium* spp. from heads, roots and crowns of common and durum wheat crops sampled across Saskatchewan in 1998 and 1999.

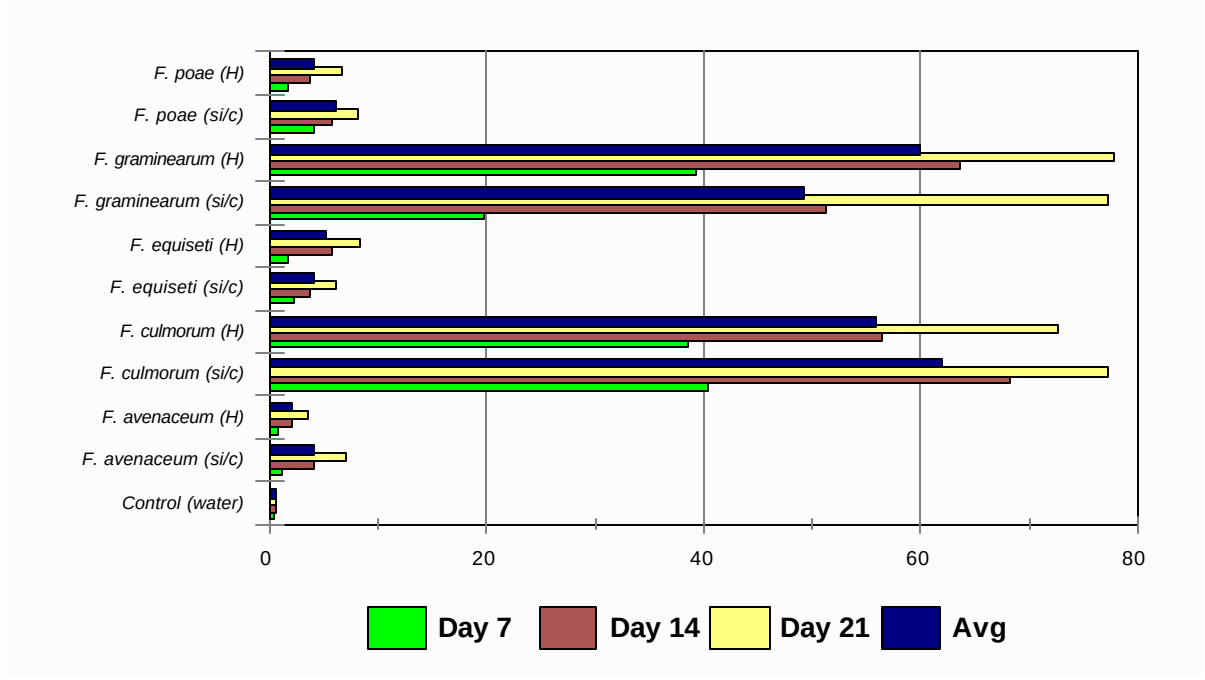
	Heads		Subcrown internodes		Crowns	
Fusarium spp.	1998	1999	1998	1999	1998	1999
	%					
F. acuminatum	0	2	10	15	10	10
F. avenaceum	5	36	4	13	7	18
F. culmorum	7	10	29	21	23	25
F. equiseti	2	3	48	37	51	40
F. graminearum	28	2	0	4	2	2
F. heterosporum	1	3	0	0	0	0
F. moniliforme	<1	1	0	0	0	0
F. oxysporum	1	1	9	9	7	4
F. poae	36	23	0	<1	<1	<1
F. sporotrichioides	16	19	0	0	0	1

Table 2. Frequency of isolation of *Fusarium* spp. from heads, roots and crowns of barley crops sampled across Saskatchewan in 1998 and 1999.

	Heads		Subcrown internodes		Crowns	
Fusarium spp.	1998	1999	1998	1999	1998	1999
	%					
F. acuminatum	0	<1	3	8	8	2
F. avenaceum	<1	23	5	8	5	9
F. culmorum	1	0	22	35	12	29
F. equiseti	1	8	53	37	68	58
F. graminearum	14	11	2	3	1	1
F. heterosporum	<1	0	0	0	0	0
F. moniliforme	0	1	0	0	0	0
F. oxysporum	<1	1	14	10	6	2

F. poae	68	40	0	<0	0	<1
F. sporotrichioides	16	16	0	0	<1	0

These observations agree with other reports indicating that *F. avenaceum*, *F. graminearum*, *F. poae* and *F. sporotrichioides* were the most, or among the most, common species found in infected wheat seed (e.g. Clear and Patrick, 1990). Other reports have also found that *F. equiseti, F. oxysporum*, *F. acuminatum* or *F. graminearum* were most frequently isolated from roots (e.g. Gordon and Sprague, 1941; Hill et al., 1983; McMullen and Stack, 1983; Smiley and Patterson, 1996).



Results from the pathogenicity tests on AC Avonlea and AC Elsa showed that *F. graminearum* and *F. culmorum* were the most pathogenic species (AC Elsa in Fig. 1). This agrees with other reports (Miller, 1994; Wong et al., 1995). Overall for each of the species tested, isolates from heads and subcrown internodes/crowns were equally pathogenic to wheat heads.

Fig. 1. Mean percent infection of AC Elsa heads inoculated with *Fusarium* spp. Isolates from heads (H) or subcrown internodes/crowns (si/c) at 7, 14 and 21 days after inoculation and average of these three ratings.

All of the *F. graminearum* isolates from heads produced perithecia (sexual reproductive structures) when plated on carnation leaf agar, indicating they belonged to Group II (Windels and Holen, 1989). Most of the *F. graminearum* isolates found in subcrown internodes/crowns from areas where FHB was present also produced perithecia. However, none of the subcrown internodes/crowns isolates from areas where FHB has not been found produced perithecia, suggesting they belonged to Group I. These isolates were used in the pathogenicity study (above). These observations suggest that even though *F. graminearum* isolates belonging to Group I were also able to cause FHB under controlled conditions they might not be important in the development of FHB under natural conditions in Saskatchewan. These findings also suggest

that *F. graminearum* colonizing subcrown internodes/crowns in FHB-infected areas might play a role in the epidemiology of this disease in Saskatchewan.

Conclusions

The observation that most of the *Fusarium* spp. isolated from infected heads were also found in infected subcrown internodes/crowns suggests that inoculum in debris from plant parts at or below soil level might be a source of infection for heads, and/or that infected heads/kernels might be contributing to root infections.

Based on our observations, we conclude that measures to keep *Fusarium* populations low, such as avoiding their introduction to fields through infected seed and controlling root rot and seedling blight, might be important in managing the spread of FHB, especially *F. graminearum*, in Saskatchewan.

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