SEED-BORNE FUSARIUM ON CEREAL CROPS IN SASKATCHEWAN IN 2021

CROP: Cereal crops (Wheat, Durum, Barley and Oats)

LOCATION: Saskatchewan

NAMES AND AGENCIES:

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ABSTRACT: Commercial plate tests from four seed labs for seed-borne *Fusarium graminearum* and total *Fusarium* spp. were summarized. A total of 2460 wheat, 869 durum, 885 barley, and 373 oat samples were reported. Compared to 2020, combined frequency for *F. graminearum*-free samples increased from 66.5% to 95.6% and mean percent infection rates were down from 1.5% to 0.9%. Total *Fusarium* spp. frequency and severity decreased significantly compared to 2020.

INTRODUCTION AND METHODS: Test results from four seed testing laboratories were acquired and combined. The tests were conducted from September 2021 through May 2022 and are assumed to be from the 2021 crop. These tests were conducted by either agar-plating or quantitative polymerase chain reaction (PCR) techniques. In the case of PCR tests, the presence or absence of DNA of all *Fusarium* spp. or of *F. graminearum* allowed calculation of percent infection. No attempt was made to select fusarium-damaged kernels (FDK) so the samples can be considered random. The percent frequency of all *Fusarium* spp. including *F. graminearum* (total Fusarium), and the percent frequency of *F. graminearum* alone, were calculated. The mean percent infection was calculated for both total *Fusarium* spp. and *F. graminearum*. Individual *Fusarium* spp. other than *F. graminearum* were not reported, as not all labs provided that information. The results of 4587 tests were combined, reported by Saskatchewan crop district and provincial means determined.

RESULTS AND COMMENTS: Despite favourable spring seeding conditions, extremely hot and dry weather impacted crop development during the growing season. Warm and dry conditions throughout the fall provided farm operators the opportunity to complete harvest well ahead of the normal timeframe. Because of challenging growing conditions, several of the major field crops experienced their largest year-over-year yield decrease on record, falling to levels not seen in more than a decade. (Statistics Canada 2021)

Cereal yields were below 10-year averages (Saskatchewan Ministry of Agriculture 2020). The average wheat yield was 30 bu/acre compared to the 10 year average of 41 bu/acre. Durum yield was 19 bu/acre compared to the 10-year average of 38 bu/acre. Average barley yield was 34 bu/acre, down significantly from the 10-year average of 61 bu/acre. Oat yield was 49 bu/acre, also down from the 10-year average of 83 bu/acre.

A total of 2460 wheat, 869 durum, 885 barley and 373 oat samples were processed during the period covered by this report. This represented a decrease in durum samples (5.7%) and an increase in oat (25.6%), wheat (26.2%) and barley (8.7%) samples compared to 2020 (Olson et al. 2021).

Fusarium graminearum frequency and severity (mean % infection) was calculated for wheat, durum, barley, and oat individually and combined. Frequency and severity of total *Fusarium* spp. was calculated individually and combined as well (Tables 1, 2, 3, 4 and 5). The frequency of *F. graminearum* in 2021 was 4.4%. This was significantly lower than the 33.5% reported in 2020 (Olson et al. 2022) and below the 2019 level of 40.6% (Olson et al. 2021), the 2018 level of 22.0% and the 2017 level of 23.1% (Olson et al. 2020a,b). The severity of *F. graminearum* at 0.9% was the lowest level since 2017 (Table 1). Total *Fusarium* frequency was 64.6%, which was below the previous year (Table 1). Total *Fusarium* severity was 2.9%, the lowest level reported since 2017 (Table 1).

Wheat – The percentage of *F. graminearum*-free samples in 2021 was 97.2% (Table 2), up from the 65.0% reported in 2020 (Olson et al. 2022). The mean infection rate was 0.8%, down from the 1.6% reported in 2020. Total *Fusarium* spp.-free samples were 38.0% compared to 16.4% in 2020. The mean percent infection decreased from 2020 to 2.5%.

Durum – Of the 869 samples, 88.1% were found to be *F. graminearum*-free. Mean percent infection was 1.0% (Table 3). In 2020, the frequency of *F. graminearum*-free samples was 64.4% and the mean percent infection was 1.8% (Olson et al. 2022). The total *Fusarium* spp.-free frequency was 48.1%, up from the 18.8% reported in 2020 and the mean percent infection was 1.5%, down from 3.4% in 2020.

Barley – The percentage of *F. graminearum*-free samples was 96.3% in 2021, up from 68.8% in 2020 (Olson et al. 2022). Mean infection was 0.7% compared to 1.0% in 2020. Total *Fusarium* spp.-free samples were 24.4%, up from 14.1% in 2020. The total *Fusarium* spp. mean infection was 3.1%, down from 4.1% in 2020 (Table 4).

Oat – Of the 373 samples, 99.7% were found to be *F. graminearum*-free. This was higher than the 91.2% reported in 2020 (Olson et al. 2022). Mean infection was 0.5%, down slightly from 0.6% in 2020. Total *Fusarium* spp.-free samples were 9.7% up from 5.3% in 2020. The total *Fusarium* spp. mean infection was 6.5%, down from 7.5% in 2020 (Table 5).

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Table 1. Five-year summary of frequency (%PFS) and severity (mean % infection) of *Fusarium graminearum* and total *Fusarium* spp. of wheat, durum, barley and oat combined.

		Combined frequency and severity			
		Fusarium graminearum		**Total *Fusarium* spp.[1]**	
Year	No of samples	%PFS[2]	Mean % infection	% PFS	Mean % infection
2017[a]	3378	76.9	1.5	12.9	3.7
2018[a]	3307	78.0	1.4	28.4	3.3
2019[a]	4529	59.4	1.8	17.6	4.5
2020[a]	3983	66.5	1.5	15.8	4.2
2021	4515	95.6	0.9	35.4	2.9

[1]All Fusarium spp. = total *Fusarium spp*. including *F. graminearum*
[2]%PFS = percent pathogen-free samples
[a]2017 (Olson et al. 2020b), 2018 (Olson et al. 2020a), 2019 (Olson et al. 2021), 2020 (Olson et al. 2022)

Table 2. Number of wheat samples tested from September 2021 to May 2022 and levels of infection with *Fusarium graminearum* and *Fusarium* spp. in each Saskatchewan Crop District.

2021 seed-borne pathogens of wheat						
	F. graminearum			**Total *Fusarium* spp.**		
Crop District	# tests	% PFS[1]	Mean % Infection	# tests	% PFS	Mean % Infection
1A	60	76.7	0.8	61	42.6	1.7
1B	67	97.0	0.5	69	47.8	1.6
2A	13	84.6	0.5	19	52..6	0.9
2B	113	99.1	0.5	112	78.6	1.3
3AN	13	100.0	0.0	13	69.2	1.9
3AS	28	100.0	0.0	27	63.0	1.2
3BN	54	96.3	0.5	54	64.8	1.1
3BS	2	100.0	0.0	2	100.0	0.0
4A	0	nd[2]	nd	0	nd	nd
4B	14	100.0	0.0	14	78.6	1.0
5A	76	100.0	0.0	74	33.8	2.7
5B	144	98.6	0.5	138	18.1	3.5
6A	236	98.3	0.6	239	55.2	1.4
6B	383	96.3	0.6	383	51.2	1.5
7A	175	97.7	0.7	175	44.6	1.4
7B	149	98.7	1.0	149	40.3	1.1
8A	127	96.1	0.9	127	10.2	4.5
8B	215	100.0	0.0	215	28.4	2.4
9A	306	98.0	0.6	293	25.6	3.1
9B	285	96.5	1.3	249	8.8	3.6
Total/mean	2460	97.2	0.8	2413	38.0	2.5

[1]%PFS = percent pathogen-free samples
[2] nd = no data

Table 3. Number of durum samples tested from September 2021 to May 2022 and levels of infection with *Fusarium graminearum* and total *Fusarium* spp. in each Saskatchewan Crop District

2021 Seed-borne pathogens of Durum						
	F. graminearum			**Total *Fusarium* spp.**		
Crop District	# tests	%PFS[1]	Mean % Infection	# tests	% PFS	Mean % Infection
1A	51	47.1	1.6	60	21.7	2.4
1B	13	92.3	0.5	13	38.5	1.1
2A	105	76.2	0.7	151	47.0	1.4
2B	175	97.7	0.6	178	51.7	1.0
3AN	26	96.2	1.5	28	46.4	1.8
3AS	154	80.5	0.9	170	44.1	1.8
3BN	60	96.7	0.5	60	48.3	1.1
3BS	6	100.0	0.0	6	50.0	2.0
4A	2	100.0	0.0	2	0.0	2.5
4B	24	100.0	0.0	21	61.9	0.8
5A	14	100.0	0.0	14	28.6	0.9
5B	2	100.0	0.0	2	0.0	0.8
6A	33	97.0	0.2	32	40.6	1.0
6B	31	90.3	0.6	31	61.3	1.5
7A	90	98.9	1.0	90	72.2	1.5
7B	8	100.0	0.0	8	25.0	1.8
8A	1	100.0	0.0	1	0.0	3.0
8B	0	nd[2]	nd	0	nd	nd
9A	0	nd	nd	0	nd	nd
9B	2	100.0	0.0	2	50.0	1.5
Total/mean	797	88.1	1.0	869	48.1	1.5

[1]%PFS = percent pathogen-free samples
[2] nd = no data

Table 4. Number of barley samples tested from September 2021 to May 2022 and levels of infection with *Fusarium graminearum* and total *Fusarium* spp. in each Saskatchewan Crop District.

2021 seed-borne pathogens of barley						
	F. graminearum			**Total *Fusarium* spp.**		
Crop District	# tests	% PFS[1]	Mean % Infection	# tests	% PFS	Mean % Infection
1A	21	71.4	0.5	17	17.6	1.4
1B	17	100.0	0.0	8	25.0	0.8
2A	7	42.9	0.9	8	12.5	1.8
2B	34	100.0	0.0	4	50.0	1.0
3AN	3	100.0	0.0	3	66.7	4.5
3AS	25	96.0	0.5	16	37.5	1.3
3BN	16	100.0	0.0	13	53.8	0.6
3BS	2	100.0	0.0	2	100.0	0.0
4A	0	nd[2]	nd	0	nd	nd
4B	13	100.0	0.0	10	70.0	1.0
5A	22	100.0	0.0	9	0.0	3.2
5B	63	100.0	0.0	53	13.2	5.5
6A	92	98.9	0.5	70	34.3	1.7
6B	149	95.3	0.6	149	34.2	1.6
7A	83	96.4	0.8	83	28.9	1.6
7B	1	0.0	1.5	1	0.0	4.0
8A	46	93.5	0.5	42	4.8	6.9
8B	92	100.0	0.0	92	23.9	2.5
9A	118	96.6	1.1	111	18.0	4.3
9B	81	96.3	0.5	62	3.2	4.5
Total/mean	885	96.3	0.7	753	24.4	3.1

[1]%PFS = percent pathogen free samples
[2]nd = no data

Table 5. Number of Oat samples tested from September 2021 to May 2022 and levels of infection with *Fusarium graminearum* and total *Fusarium* spp. in each Saskatchewan Crop District.

2021 seed-borne pathogens of oat						
	F. graminearum			**Total *Fusarium* spp.**		
Crop District	# tests	%PFS[1]	Mean %	# tests	% PFS	Mean %
1A	9	88.9	0.5	6	33.3	4.4
1B	8	100.0	0.0	5	20.0	3.0
2A	0	nd[2]	nd	0	nd	nd
2B	9	100.0	0.0	8	50.0	0.5
3AN	2	100.0	0.0	2	50.0	2.5
3AS	1	100.0	0.0	1	0.0	2.0
3BN	4	100.0	0.0	4	50.0	1.0
3BS	0	nd	nd	0	nd	nd
4A	0	nd	nd	0	nd	nd
4B	1	100.0	0.0	1	0.0	0.5
5A	4	100.0	0.0	4	50.0	3.0
5B	54	100.0	0.0	54	7.4	5.0
6A	12	100.0	0.0	12	33.3	2.5
6B	42	100.0	0.0	42	19	5.0
7A	2	100.0	0.0	2	50.0	3.0
7B	11	100.0	0.0	11	9.1	4.0
8A	47	100.0	0.0	43	0.0	6.7
8B	28	100.0	0.0	28	7.1	7.0
9A	74	100.0	0.0	71	1.4	7.2
9B	65	100.0	0.0	55	1.8	10.1
Total/mean	373	99.7	0.5	349	9.7	6.5

[1]%PFS = percent pathogen free samples
[2]nd = no data