WHEAT (*Triticum aestivum, 'multiple cultivars'*)
Fusarium head blight; *Fusarium graminearum*

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Reaction of North Dakota, South Dakota, Montana winter wheat accessions to Fusarium head blight, 2016.

A field experiment was conducted in a Chase silty clay loam (pH = 6.5) near Manhattan, KS. The experimental design was a randomized complete block comprising the Hard (red and white) Winter Wheat Fusarium Head Blight Nursery with 48 entries from the North Dakota, South Dakota, and Montana breeding programs. There were four replications and plots were single rows 7.5 ft long spaced 20 in. apart. Seed was sown on 1 Oct 2015 (1 bu/A). Air-dried corn kernels colonized by two aggressive isolates of *Fusarium graminearum* were spread throughout the test area on 1 Apr, 15 Apr, and 1 May (0.25 oz/ft^2 total). During anthesis, heads were kept wet using overhead, impulse sprinklers applying water 3 min. per hour from 10:00 pm until 5:00 am. For each plot, heading date (50% headed) was determined and visual estimations of percent symptomatic spikelets (FHB index) for the entire plot were taken on 17 May, 21 May, 23 May, 27 May, 30 May, 3 Jun, and 6 Jun. Plots were harvested with a combine on 20 Jun and grain sub-samples were visually rated for percent *Fusarium*-damaged kernels (FDK). Ground grain samples from all plots were sent to the North Dakota State University Toxicology Lab for determination of deoxynivalenol (DON) concentrations. Data for heading date, each rating date, means of all 7 rating dates, FDK, and DON concentrations in grain were subjected to analysis of variance followed by Fisher's protected least significant differences (LSD, $P = 0.05$). Correlations among parameters were also calculated.

Low to moderately severe Fusarium head blight developed in the experiment. It is likely that a prolonged cool and wet weather before, during and after anthesis slowed disease development. By 3 Jun disease development was progressing normally, but some accessions were maturing (FHB6 & FHB7). Overley (early S check) had the greatest mean FHB index (23.7%), and all entries had significantly lower mean index values. Emerson (MR check) had a mean FHB index of 2.3%, which was about 9.5% of Overley and 15.3% of Flourish (late S check) and 14.69% of FHB avg. for all entries. Six entries had a lower mean FHB index than Emerson. But, this difference was not statistically significant at the 0.05 level of confidence. There was a significant negative correlation between heading date and mean FHB index ($n = 192$, $r = -0.5611$, $P < 0.0001$); therefore, direct comparisons among entries with very different heading dates are not valid. Emerson had a DON level of 10.3 ppm and 35 other entries were statistically similar. Flourish had a DON level of 24.3 ppm and was significantly higher than Emerson. Three entries had DON levels significantly higher than Flourish. There was a significant correlation between heading and DON (n = 192, $r = 0.15968$, $P < 0.0269$). Mean FHB index was significantly correlated with DON level and FDK ($n = 192$, $r = 0.33470$, $P < 0.0001$), (n = 192, $r = 0.36052$, $P < 0.0001$), respectively. There was significant positive correlation between FDK and DON ($n = 192$, $r = 0.4629$, $P < 0.0001$).

		Fusarium head blight index (%killed spikelets)									
NAME[z]	Heading date (Julian)[y]	FHB1 17 May	FHB2 21 May	FHB3 23 May	FHB4 27 May	FHB5 30 May	FHB6 3 June	FHB7 6 June	FHB Mean[x]	FDK (%)[w]	DON (ppm)[v]
W2257-2	133	0.00	0.00	0.00	0.50	1.25	4.00	16.75	0.44	10.75	7.15
12K422-4	130	0.00	0.25	0.00	0.75	5.00	5.50	25.00	1.50	8.00	4.97
11M228A-57-2-4	126	0.00	0.00	0.25	1.25	5.75	3.50	22.50	1.81	3.75	5.47
12K508-2	127	0.00	0.00	0.00	1.25	6.00	7.00	15.67	1.81	13.25	10.2
11M228A-57-2-3	125	0.00	0.00	0.00	0.75	8.00	7.75	40.00	2.19	11.75	7.37
12K509(4)-8	126	0.00	0.25	0.25	1.00	7.25	7.00	32.50	2.19	11.75	12.50
Emerson (MR check)	127	0.00	0.00	0.00	1.00	8.00	9.75	24.00	2.25	20.50	10.27
11K229-2-1	128	0.00	0.00	0.50	1.25	10.00	10.00	38.25	2.94	22.50	17.32
11M225-7-2	128	0.00	0.00	0.50	1.00	10.25	13.25	33.00	2.94	18.50	13.42

NAME[z]	Heading date (Julian)[y]	Fusarium head blight index (%killed spikelets) FHB1 17 May	FHB2 21 May	FHB3 23 May	FHB4 27 May	FHB5 30 May	FHB6 3 June	FHB7 6 June	FHB Mean[x]	FDK (%)[w]	DON (ppm)[v]
11M237A-1-2	121	0.00	0.25	0.75	2.25	8.75	8.25	26.75	3.00	3.00	4.72
MSU 45-2-4	132	0.00	0.00	0.25	1.00	11.25	13.50	44.50	3.13	12.75	12.22
11K229-2-2	126	0.00	0.25	1.25	1.50	12.00	13.67	40.25	3.75	13.50	15.80
12K057-1	124	0.00	0.25	0.75	1.50	13.00	14.50	49.00	3.88	8.25	6.675
SD110085-1	126	0.00	0.00	0.25	1.25	15.00	21.25	47.00	4.13	32.00	14.42
SD13099-8	122	0.00	0.25	0.25	2.75	13.50	23.67	53.75	4.19	12.50	12.27
SD10257-2	125	0.00	0.25	0.50	2.50	14.00	16.33	40.00	4.31	10.00	9.97
SD10W089-3-5	127	0.00	0.50	0.50	3.50	12.75	7.33	35.00	4.31	16.75	9.90
MT1078	129	0.00	0.00	0.00	1.75	17.50	28.25	55.00	4.81	19.25	16.22
SD13062-2	119	0.25	1.25	1.50	2.75	15.00	19.50	36.75	5.13	14.25	7.40
SD09113	126	0.00	0.75	1.00	2.00	17.75	26.50	56.75	5.38	27.50	17.10
12K458-44	125	0.00	0.00	0.75	4.00	16.75	24.67	60.00	5.38	15.50	15.65
SD13W064-7	123	0.00	0.50	0.75	3.25	18.50	30.00	65.00	5.75	21.50	11.72
MT1488	126	0.00	0.00	0.50	2.75	20.00	27.50	57.75	5.81	19.75	23.50
MTS1224	130	0.00	0.00	0.50	2.25	20.75	40.25	62.50	5.88	21.20	22.47
SD13117-1	122	0.00	0.75	1.25	4.25	18.50	28.25	52.25	6.19	19.25	17.47
MTS1024	127	0.00	0.00	0.75	3.00	21.25	35.25	66.25	6.25	36.25	16.42
SD09227	124	0.00	0.25	1.00	4.50	20.50	25.75	62.50	6.56	21.25	12.17
MT1444	127	0.00	0.25	0.75	4.25	21.50	30.75	66.25	6.69	22.00	22.97
SD08200	120	0.00	1.00	1.75	4.50	19.75	35.00	55.00	6.75	8.25	13.57
SD13238-3	123	0.00	0.25	1.50	4.75	24.25	36.50	61.67	7.69	20.25	13.85
MT1465	125	0.25	1.00	2.25	4.75	24.00	34.50	63.75	8.00	20.00	20.40
SD13039-1	122	0.00	1.25	1.25	7.50	24.00	22.50	40.00	8.50	21.25	13.22
MT1265	128	0.00	0.00	1.00	5.00	28.00	41.75	72.50	8.50	31.25	39.12
MT1257	126	0.00	0.25	1.75	5.75	28.00	44.00	67.50	8.94	26.25	29.87
SD110060-7	125	0.00	0.75	1.75	8.50	25.00	42.00	66.25	9.00	30.00	13.87
MTW1491	128	0.00	0.00	1.50	4.75	34.25	59.00	81.25	10.13	27.50	25.92
MT1478	123	0.00	0.50	2.50	6.75	34.75	57.25	78.75	11.13	27.50	19.60
11M225-99-2	122	0.00	1.25	2.75	6.75	34.25	41.00	70.00	11.25	12.75	17.80
MT1332	125	0.00	1.00	1.75	9.25	35.25	51.50	82.50	11.81	33.25	32.02
MTS1407	126	0.00	0.75	2.75	9.50	36.00	62.50	73.00	12.25	23.25	18.97
MT1460	125	0.00	1.00	1.75	10.00	36.25	48.00	77.50	12.25	27.50	34.62
DH172	114	2.00	4.25	4.75	9.00	32.00	.	.	12.50	12.00	5.40
SD10W153	114	0.50	4.00	4.50	9.50	35.00	.	.	13.25	11.28	13.60
SD13066-5	119	0.75	2.50	3.50	12.00	37.25	48.25	75.00	13.81	25.00	10.20
Flourish (late S check)	123	0.00	1.00	2.00	9.50	46.25	64.50	88.33	14.69	25.00	24.32
MT1471	126	0.00	0.75	2.25	11.25	45.00	63.00	87.50	14.81	35.75	35.77
MT1348	123	0.25	1.50	3.50	12.75	44.00	65.50	85.00	15.44	23.75	25.17
Overley (early S check)	113	5.25	7.00	11.75	19.50	56.50	70.25	92.50	23.69	30.00	5.92
Average	124	0.19	0.75	1.48	4.81	21.86	30.22	55.28	7.23	19.56	16.06
LSD (P = 0.05)	2.01	0.41	1.12	1.47	3.75	8.46	9.24	12.77	2.93	12.92	8.26

[z]Sorted by data in FHB index Average column. Emerson (MR) and Flourish (S) were used as the moderately resistant and susceptible checks, respectively. Overley was included as an early maturing susceptible check.

[y]Days from January 1

[x]Mean of ratings FHB2-FHB5.

[w]*Fusarium*-damaged kernels.

[v]Deoxynivalenol concentration in ground grain samples.

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Fusarium head blight; *Fusarium graminearum*

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Reaction of Kansas, Nebraska, winter wheat accessions to Fusarium head blight (FHB), 2016.

A field experiment was conducted in a Chase silty clay loam (pH = 6.5) near Manhattan, KS. The experimental design was a randomized complete block comprising the Hard (red and white) Winter Wheat Fusarium Head Blight Nursery with 64 entries from the Kansas and Nebraska breeding programs. There were four replications and plots were single rows 7.5 ft long spaced 20 in. apart. Seed was sown on 1 Oct 2015 (1 bu/A). Air-dried corn kernels colonized by two aggressive isolates of *Fusarium graminearum* were spread throughout the test area on 1 Apr, 15 Apr, and 1 May (0.25 oz/ft^2 total). During anthesis, heads were kept wet using overhead, impulse sprinklers applying water 3 min. per hour from 10:00 pm until 5:00 am. For each plot, heading date (50% headed) was determined and visual estimations of percent symptomatic spikelets (FHB index) for the entire plot were taken on 17 May, 20 May, 23 May, 27 May, 31 May, and 3 Jun. Plots were harvested with a combine on 21 Jun and grain sub-samples were visually rated for percentage *Fusarium*-damaged kernels (FDK). Ground grain samples from all plots were sent to the North Dakota State University Toxicology Lab for determination of deoxynivalenol (DON) concentrations. Data for heading date, FHB index ratings for each date, mean FHB index (ratings 1-5), FDK, and DON concentrations in the grain were subjected to analysis of variance followed by Fisher's protected least significant differences (LSD, $P = 0.05$). Correlations among parameters were also calculated.

Low to moderately severe FHB developed in this experiment. It is possible that prolonged cool temperatures during and after anthesis slowed disease development. By 3 Jun FHB development had progressed normally, but accessions were maturing (FHB6). Overley had the greatest mean FHB index (18.9). All entries had significantly lower mean index values than Overley. The moderately-resistant check, Everest, had a mean FHB index of 4.6 which was about 24% of Overley. There were 4 entries with average index values significantly lower than Everest. However, these entries were 13-16 days later than Everest. There was a significant negative correlation between heading date and mean FHB index ($n = 130$, $r = -0.5947$, $P < 0.0001$). Therefore, direct comparisons among entries with different heading dates are not valid. Everest was in the group with the lowest FDK ratings, although 33 other entries were statistically similar. Everest also had a relatively low DON level (2.4 ppm) although 8 other entries were statistically similar. The susceptible check Overley had high DON levels (10.7 ppm). One entry (NE05548) was statistically higher than Overley, and all other entries were statistically similar. There were significant correlations between heading and FDK, and heading and DON ($n = 143$, $r = 0.2753$, $P < 0.001$ and $n = 143$, $r = 0.54321$, $P < 0.0001$, respectively). There was a significant negative correlation between mean FHB index and DON levels ($n = 143$, $r = -0.18957$, $P = 0.0308$), but a positive correlation between FDK and DON ($n = 144$, $r = 0.5837$, $P < 0.0001$). There was no significant correlation between mean FHB index and FDK ($n = 130$, $r = 0.0.0607$, $P = 0.4926$).

		FHB index (%)								
Entry[z]	Heading date (Julian)[y]	FHB1 17 May	FHB2 20 May	FHB3 23 May	FHB4 27 May	FHB5 31 May	FHB6 3 June	FHB Mean[x]	FDK (%)[w]	DON (ppm)[v]
LCH13NEDH-11-24	128.3	0.0	0.0	0.3	0.5	3.0	14.3	0.8	4.8	11.8
NE14696	126.0	0.8	0.0	0.8	1.5	3.8	21.8	1.4	4.5	8.7
NE13625	124.8	0.5	0.3	0.5	4.3	4.8	15.3	2.1	2.5	8.6
NE14557	125.0	1.0	0.0	1.3	3.8	4.5	17.3	2.1	4.3	12.6
NI12702W	126.0	0.8	0.0	1.0	3.8	5.5	24.3	2.2	5.5	16.4
NE14569	120.3	0.5	0.3	1.0	2.8	7.3	27.3	2.4	6.5	12.4
KS080315-K-5	122.8	1.0	0.0	1.3	3.8	6.0	26.5	2.4	5.8	14.0
NE14538	123.0	0.5	0.3	1.5	4.3	7.5	23.8	2.8	5.8	11.6
NE13604	126.8	0.8	0.0	0.8	3.3	11.3	24.5	3.2	8.5	15.1

Entry[z]	Heading date (Julian)[y]	FHB index (%) FHB1 17 May	FHB2 20 May	FHB3 23 May	FHB4 27 May	FHB5 31 May	FHB6 3 June	FHB Mean[x]	FDK (%)[w]	DON (ppm)[v]
KS10DH0003-102	122.8	0.5	0.0	1.5	5.5	8.5	27.8	3.2	6.5	11.4
NE05548	124.3	0.8	0.0	0.8	5.3	10.5	40.8	3.5	10.5	23.2
KS080053-M-5	118.3	1.0	0.3	1.5	5.3	9.5	28.0	3.5	5.8	10.6
KS080736-M-2	113.5	1.3	1.0	2.5	6.0	8.0	25.3	3.8	1.3	6.6
NE14494	126.0	1.0	0.0	1.3	6.0	11.3	26.0	3.9	9.8	10.3
KS10DH0003-111	115.8	1.8	1.0	2.5	6.3	10.0	27.0	4.3	2.5	6.2
NE13515	124.3	0.5	0.0	1.5	6.5	13.8	30.8	4.5	7.5	14.6
NW13570	124.8	0.5	0.0	2.3	7.0	13.0	30.8	4.6	2.8	11.4
Everest	112.0	0.3	3.3	2.3	6.0	11.0	.	4.6	2.8	2.4
TA 5093 (Friebe)	115.8	3.0	1.8	4.0	9.5	13.0	27.7	4.9	5.5	8.1
NE10478-1	116.5	1.8	0.8	2.8	6.0	14.5	38.0	5.2	5.5	12.1
KS080624-M-3	115.0	2.3	0.5	3.3	6.5	17.3	35.3	6.0	5.3	10.8
LCS Mint	116.5	1.0	0.5	3.3	9.3	19.0	44.3	6.6	4.0	12.0
NE12589	120.3	1.0	0.5	2.0	10.0	20.0	48.0	6.7	10.8	11.6
KS080336-M-23	113.0	1.8	2.0	3.8	14.0	13.0	.	6.9	2.0	2.0
Karl 92	113.5	3.0	1.3	4.5	11.0	14.8	36.0	6.9	2.3	10.7
KS080468-M-1	115.0	2.3	2.5	3.3	11.0	17.3	45.0	7.3	3.5	10.7
KS081067-M-15	114.0	2.3	1.8	4.3	10.5	18.0	34.0	7.4	2.5	8.1
KS080242-K-4	116.8	4.0	3.0	5.5	11.3	14.3	38.3	7.6	3.5	9.9
NE10478	115.5	2.0	2.5	5.0	11.8	20.5	42.5	8.4	5.0	7.5
Brawl CL	116.8	6.3	1.5	3.5	14.3	21.0	38.8	9.3	6.5	15.8
KS080144-M-14	112.3	3.3	2.8	7.3	15.3	23.8	51.7	10.5	6.5	5.6
KS10DH0003-139	110.5	6.8	4.0	11.0	18.5	20.0	.	11.4	2.5	4.0
KS10DH0003-73	113.5	7.0	4.3	10.0	16.5	23.3	.	12.2	5.5	4.7
Overley	114.8	10.3	5.5	14.8	19.5	44.3	76.3	18.9	7.5	10.7
KS10DH0003-80	113.8	4.8	2.5	6.0	9.0	.	.	.	2.3	11.4
KS10DH0003-113	111.0	7.0	5.3	10.5	24.3	.	.	.	2.5	2.3
Average	118.5	2.3	1.4	3.6	8.6	13.5	31.9	5.5	5.0	10.1
P for entry effect	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0042	<0.0001
LSD (P = 0.05)	2.05	3.25	1.42	2.88	3.92	7.53	10.16	2.55	4.83	5.31

[z]Sorted by data in FHB index "Mean" column. Everest (MR) and Overley (S) were used as the moderately resistant and susceptible checks, respectively.
[y]Days from January 1
[x]Mean of all rating dates, except FHB6.
[w]*Fusarium*-damaged kernels.
[v]Deoxynivalenol concentration in ground grain samples.

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