

GREENHOUSE AND FIELD EVALUATION OF RESISTANCE TO FUSARIUM HEAD BLIGHT IN SOFT RED WINTER WHEAT

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OBJECTIVES:

- To identify resistance to FHB in greenhouse and field screening trials.
- To evaluate apparent vs. actual FHB infection by plating out seeds on selective media.

MATERIALS AND METHODS:

Entries in the 1999 Uniform Winter Scab Nursery along with a number of advanced breeding lines were planted in the field in a randomized complete block design with four replications on 29 October 1998. Each plot consisted of a single 4ft. row. The previous crop was corn and the seedbed had been chisel plowed and disked. Entries in the greenhouse were planted in a completely randomized design with a variable number of replications.

Field Inoculation

Mason jars containing approximately 500 g of autoclaved corn seed were inoculated with the head scab fungus *F. graminearum* on April 5, 1999. On April 27, wheat plots were inoculated just prior to heading by spreading 35-40g of the inoculated corn mixture per plot. Plots were mist irrigated daily beginning May 7 for approximately one hour during the early part of the morning, mid-day, and late evening throughout anthesis into early grain fill. Because of extremely dry weather and a delay in irrigation, wheat plots were inoculated a second time with more corn inoculum on May 17. Incidence of scab was reported as the percentage of scab-infected heads per total number of heads per row. Severity was determined by counting the number of infected spikelets and dividing by the total number of spikelets on diseased heads only.

Greenhouse Inoculations

Several advanced breeding lines were evaluated in the greenhouse for Type I (preventing initial infection) and Type II (reducing spread within the head) resistance.

To measure Type II resistance, at flowering, 3 l containing approximately 1,200 spores was injected into a single floret in the middle of the head. After inoculation, plants were placed directly into humidity chambers for three consecutive nights. The final percentage of infected spikelets per spike was recorded on day 21. Type I resistance was measured by spraying a spore suspension onto heads at flowering, and placing the pot in a humidity chamber for 3 nights. Twenty-one days after inoculation plants were rated for disease development using a 0-4 scale: 0 = no disease, 1 = 1-25%, 2 = 26-50%, 3 = 51-75%, and 4 = 76-100% of spikelets infected.

Seed Assessment

Wheat seed was collected from both injection and spray test entries. Total seed number plus the number of visually scabby seed were recorded for each seed lot. Plates were incubated for 7-10 days at 20 C. Each plate was visually inspected for *F. graminearum* contaminated seed. Seed from the injection test was also assessed for the presence of *F. graminearum*. In this particular test, seed was visually inspected and placed in the following three categories according to appearance: 1) normal, 2) small, wrinkled and 3) tombstone. The location and category of each seed was recorded on the top of each petri plate. After incubation, those seed that were positive for the presence of *F. graminearum* were recorded.

RESULTS AND DISCUSSION:

Field Screening

For the first time in three years of field screening, incidence and severity in our inoculated, irrigated nursery were rather low (Table 1). Nonetheless, the resistant checks, Ernie and Freedom actually showed some signs of resistance in our nursery, which was not the case in the previous two years. Thus, the scab pressure that we observed this year may have been closer to what would be expected under a natural infection.

Greenhouse Screening

Even with a large number of replications (15 plants), repeatability of assessment of type II resistance was low (Table 2). The most promising entry, KY 91C-022-36, ranged from 6 to 26% scabby spikelets. With only three plants, however, it is difficult to have confidence in this estimate.

Selective Media

We tend to regard an evaluation of scabby seed after harvest as a confirmation of our assessment of scab on the intact spike. Although visual assessment of seed seems straightforward, plating out the seed on a selective medium revealed some surprises (Tables 3, 4). Seed of Freedom, for example, was visually rated at 17 % scabby, yet plating the seed revealed that 82% was actually infected with *F. graminearum*.

TABLE 1. UNIFORM WINTER WHEAT SCAB SCREENING NURSERY,

Cultivar	LEXINGTON, KY						
	Average Severity %	Average Incidence %	FHB Index	Height (in)	Yield (bu/a)	Heading Date (Julian)	DON Levels (ppm)
NY87048-7387	1.75	0.65	0.46	40	61.25	134	0.60
Ernie	3.50	1.34	0.09	32	57.82	125	0.78
IL94-1909	4.38	0.68	0.06	41	89.05	129	0.55
OH 544	6.42	1.10	0.10	41	93.68	134	0.55
NY86003-106	8.50	1.75	0.19	37	71.89	133	0.80
M94-1069	11.13	5.63	0.91	35	75.49	128	0.20
Freedom	15.95	4.11	0.72	35	77.90	129	0.63
Geneva	17.08	5.02	1.71	36	56.62	131	0.93
OH 522	17.19	9.92	1.88	35	93.51	127	0.80
NY6003-27	18.79	4.50	2.23	41	68.29	132	1.88
Foster	19.25	2.18	0.93	36	77.90	128	0.50
2545	22.95	9.02	2.00	35	57.99	132	1.70
OH 657	23.38	3.55	1.03	41	80.64	132	0.65
IL96-24078	27.08	1.73	0.49	34	63.48	126	0.75
NY87048W-7405	27.08	8.16	0.98	34	66.23	129	1.00
P92823A1	27.50	5.39	2.58	35	91.28	128	0.55
VA96-54-216	29.45	8.63	2.68	33	102.60	126	0.45

Goldfield	30.21	2.36	0.88	38	107.75	129	0.33
OH 609	30.40	4.98	1.63	36	97.11	127	0.33
Cayuga	31.48	3.97	1.72	42	78.75	135	1.00
Patterson	33.25	5.92	2.15	38	82.36	126	0.88
P88288C1	34.49	7.57	2.94	34	72.23	129	0.55
VA96W-348	38.71	15.27	5.75	32	71.72	127	0.90
M95-3349	43.13	3.15	1.11	37	109.12	128	0.53
IL95-4162	47.50	2.74	1.26	37	101.06	127	0.48
P86958RC2	47.54	3.92	2.35	36	81.33	129	0.95
KY89-895-14	51.20	11.51	5.78	34	88.88	129	0.58
Roane	53.45	18.44	10.06	33	81.84	126	2.38
Location Mean	16.68	4.27	1.06	37	82.29	130	0.80
L.S.D.	21.90	4.24	2.06	2.00	23.63	1.35	0.62
C.V.	71.90	65.99	89.81	4.69	24.91	0.89	59.20

TABLE 2. EVALUATION OF FOURTEEN ADVANCED BREEDING LINES IN THE GREENHOUSE FOR TYPE II^A RESISTANCE TO SCAB.

Entry	N	AUDPC ^b			% Diseased spikelets ^c		
		Min	Max	Mean	Min	Max	Mean
91C-092-3	5	0.7	2.3	1.7	6	32	22
91C-092-5	12	0.5	6.5	1.6	5	100	18
91C-092-7	3	0.7	2.8	1.9	6	36	16
91C-092-72	14	0.1	9.1	3.9	5	100	53
91C-092-105	6	0.7	8.2	3.9	7	100	37
91C-092-111	3	1.2	5.3	4.5	17	94	48
91C-019-17	4	0.6	3.2	2.9	5	39	24
91C-022-34	4	0.7	3.2	2.1	6	41	16
91C-022-36	3	0.3	2.5	2.2	6	26	17
91C-022-42	4	0.3	5.0	4.2	6	100	53
91C-046-2	4	0.9	4.9	4.4	7	64	43
91C-261-13	6	0.2	3.4	2.6	5	100	35
91C-261-24	15	0.7	8.8	3.3	6	100	46
92C-432-62	14	0.7	7.4	3.3	6	100	46

^aReduction of spread within the spike.

^bArea under the disease progress curve.

^cPercent of infected spikelets per spike recorded 21 days after injection.

TABLE 3. MEAN NUMBER OF SEED COLLECTED AND PERCENT OF SEED INFECTED WITH *F.graminearum* FROM FOURTEEN ADVANCED BREEDING LINES SCREENED IN THE GREENHOUSE FOR TYPE II RESISTANCE TO SCAB.

Entry	Mean number of seed ^a			Percentage of infected seed		
	Normal	Small/ Wrinkled	Tombstone	Normal	Small/ Wrinkled	Tombstone
91C-092-3	32.8	3.8	4.2	5.7	7.7	41.7
91C-092-5	26.6	3.6	1.5	0.3	1.6	33.3
91C-092-7	18.3	0	0	0	0	0
91C-092-72	15.2	15.4	5.5	5.2	14.8	26.1
91C-092-105	15.8	5.5	2.8	5.7	12.2	47.0
91C-092-111	1.0	24.3	7.3	0	3.0	34.2
91C-019-17	24.5	0	4.3	1.8	0	61.9
91C-022-34	12.5	14.3	0.3	4.4	0	0
91C-022-36	8.8	19.6	4.4	2.3	1.0	30.5
91C-022-42	18.8	3.0	3.0	1.0	0	12.5
91C-046-2	12.8	9.0	1.8	0	7.4	11.1
91C-261-13	15.2	5.0	3.1	15.4	7.2	48.4
91C-261-24	10.2	8.3	9.2	9.2	10.2	33.4
92C-432-62	12.0	5.4	2.9	5.1	13.9	50.3

^a Visual assessment of seed by appearance.

^b Percent of *F. graminearum* contaminated seed per total number of seed by category, recorded 7-10 days after plating on selective media.

TABLE 4. EVALUATION OF FIFTEEN ADVANCED BREEDING LINES SCREENED IN THE GREENHOUSE FOR TYPE I RESISTANCE TO SCAB.

Entry	N	Disease Score ^a	Total Seed	Percent Visual scabby seed ^b	Percent of seed infected with <i>F. graminearum</i> ^c
Glory	3	2.7	19	77	87
KAS EX 108	1	4	6	100	83
FFR 555	5	3.6	21.2	66	70
Foster+Gaucho	4	2.8	16.3	40	92
2552	3	1.7	13.3	34	76
KY 89C-744-44	3	2.3	19.3	37	60
92C-432-62	3	0.3	13	30	18
92C-433-77	1	1	32	19	72
91C-261-3	5	1.2	38.2	15	43

91C-261-3	3	2.7	3	99	100
90C-383-18	1	1	27	100	81
91C-260-6	3	0.7	34.6	6	15
91C271-74	3	1.7	18	51	53
Freedom	2	2	29	17	82
Ernie	3	1	13.4	25	17

^aTwenty-one days after inoculation plants were rated for disease development using a 0-4 scale:
0 = no disease, 1 = 0-25%, 2 = 26-50%, 3 = 51-75%, and 4 = 76-100% of spikelets infected.

^bVisual assessment of seed by appearance.

^cPercent of *F. graminearum* contaminated seed per total number of seed, recorded 7-10 days after plating on selective media.