Northern Uniform Winter Wheat Scab Nursery
(NUWWSN)

Report on 2002-2003 Nursery

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This report is a compilation and analysis of data from the cooperative assessment of resistance to Fusarium Head Blight (scab) (causal agent *Fusarium graminearum* (teleomorph: *Gibberella zeae* Schwabe.)) in winter wheat germplasm adapted to the northern regions of North America. Funding for the evaluation comes from the U.S. Wheat and Barely Scab Initiative, state and provincial agricultural experiment stations, USDA-ARS, and private companies.

This report contains preliminary data that has not been confirmed and thus is not suitable for general release to the public. Interpretation of the presented results may be modified with additional research. Confirmed results should be published through established channels. This report is to be used as a tool for the cooperators in the NUWWSN, their staff, and persons having direct interest in the development of wheat germplasm and agricultural research programs.

This report and data is not intended for unrestricted publication or distribution and should not be used in or referred to in publicity or advertising. Use of this data may be granted for certain purposes upon written request to the agency or agencies involved.

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MATERIALS AND METHODS

Entries:

There were 51 lines and three checks in the 2003 trial (Table 1). The lines were from 10 breeding programs. Four entries (MO980829, MO981020, IL97-6755, NY89064sp-7139*) besides the three checks were also in the 2001 NUWWSN. There were 46 entries in the 2002 nursery, 49 entries in the 2001 nursery, 29 entries in the 2000 nursery, and 28 in the 1999 nursery.

Tests:

The entries were successfully evaluated in nine field tests (locations) and five greenhouse tests (Table 2). Data was obtained from 11 cooperators while seed was sent to 13 cooperators. Three field evaluations failed for various reasons.

Traits:

Data was collected on heading date (HD), height (HGT), disease severity (SEV), disease incidence (INC), disease index (IND), kernel rating (KR), percent scabby seed (%SS), and DON (Table 3). Severity was also assessed in the greenhouse assays (SEV-GH). Data was not collected on all traits in all tests (Table 3). Some groups collected additional data that are summarized and described in Table 16.

Data Analyses:

Most cooperators sent entry means (not raw data) with some summary statistics from their trials. These means and statistics are presented in the appropriate tables and no additional within test analyses were performed. The entry means from individual tests were used to analyze results over tests. We used the LSMEANS option in PROC GLM to calculate the means over tests even though the data was quite balanced. ANOVAs (model: trait = genotype + environment) were conducted for each trait and the genotype x environment mean square (residual or error in this model) was used as the error term to calculate a LSD (0.05) for entry means over environment. R^2 values in the table indicate the proportion of total sum of squares accounted for by genotype and environment effects while $1\text{-}R^2$ is the proportion of total sum of squares due to the genotype x environment interaction (GEI) effect. There was no test for significance for this interaction.

Based on $1\text{-}R^2$, the GEI appeared quite large for disease index, severity from field and greenhouse trials, DON, and kernel rating so multivariate statistics (Yan et al., 2000 Crop Science 40:597-605) were used to analyze the GEI and group those environments that produced similar results for each trait. Genotype means were then calculated (LSMEANS again) over the environments that produced similar rankings. A group of environments that produced similar genotype rankings and results is called a megaenvironment. Among the environments within a megaenvironment there is generally little GEI, and the means from environments within a megaenvironment are generally correlated. This suggests that the environments within a megaenvironment form a setthat provide similar information.

Correlations were calculated between all traits using entry means averaged over all appropriate environments.

RESULTS

All Traits

Genotype was a significant source of variance for all traits. There was little GEI for heading date, height, disease incidence, or % scabby seed as genotype + environment effects accounted for more than 75% of the treatment sum of squares for these traits. Thus, genotype means over all environments are appropriate estimators of genetic value.

GEI seemed to be an important source of variation of disease severity from field and greenhouse trials, disease index, DON, and kernel rating as GEI accounted for more than 25% of the treatment sum of squares. Each is discussed below.

Disease Index (IND):

As in 2001 and 2002, the GEI pattern for IND was complex, accounting for 24% of the treatment sum of squares. The ARF+ARK+KY+OH+IL environments appeared to group together to form a megaenvironment as all correlations among these environments exceeded 0.44. The VA location was also placed in this megaenvironment, though its association with the other sites was not as great. The MO and ONT environments were somewhat correlated to the OH and IL environments ($r \approx 0.45$), but not the other environments in the megaenvironment, nor to each other ($r = 0.27$). The NE environment was clearly an outlier, showing non-significant negative correlations with all other environments.

The ETI would affect selection. On average, only 14% of the best lines (top 10%) or worst lines (bottom 10%) from the megaenvironment would be similarly classified in the other environments.

Disease Severity in the Field (SEV):

The GEI for SEV accounted for 40% of the treatment sum of squares. The analysis revealed a complex GxE pattern for SEV that was related to the pattern found for IND. This result is quite similar to that found in 2001 and 2002. The multivariate analyses and inspection of correlations suggested that IL+OH+ONT formed a megaenvironment with correlation among these environments exceeding 0.49. All other sites were outliers. The VA, KY, and MO environments were each correlated ($r \approx 0.45$) to one of the megaenvironment environments, but not the others. The NE environment was a clear outlier as it was for IND, with all correlations with other environments being negative.

The ETI would affect selection. On average, only 23% of the best lines (top 10%) or worst lines (bottom 10%) from the megaenvironment would be similarly classified in the other environments. Two of the best lines from the megaenvironment would be considered among the worst in NE and VA.

DON: The GEI for DON accounted for 25% of the treatment sum of squares. The GEI was important for DON in 2001, but not 2002. The 2003 GEI analysis grouped the OH+VA environments as their correlation was 0.60. NE was a clear outlier with

correlations less than 0.14 with the other environments. KY was somewhat associated (r = 0.42) with the OH+VA group.

The ETI would affect selection. On average, only 13% of the best lines (top 10%) or worst lines (bottom 10%) from the megaenvironment would be similarly classified in the other environments, including KY.

Kernel Rating:

GEI accounted for 37% of the treatment sum of squares in 2003, but did not appear important in the 2001 and 2002 NUWWSN. KR data was obtained from only two environments in 2003. The correlation between the two environments was 0.18. The GEI would affect selection. Only 33% of the best lines (top 10%) or worst lines (bottom 10%) from the IL would be similarly classified in KY.

Disease Severity in the Greenhouse (GH):

The GEI accounted for 22% of the treatment sum of squares, similar as in the 2002 NUWWSN. In 2001, the GEI did not appear important for GH. The 2003 analysis grouped AR+MI+MO as the lowest correlation between these three was 0.49: the correlation between MO and AR was 0.71. The VA data was loosely associated with the AR+MO+MI with an average correlation of 0.29. KY was a dramatic outlier, having an average correlation of less than 0.15 to AR+MI+MO or VA.

The GEI would affect selection. On average, only 17% of the best lines (top 10%) or worst lines (bottom 10%) from the megaenvironment would be similarly classified in the other sites, including KY.

Correlation Among Traits:

The correlation among all disease traits was positive and significant. INC, SEV, and IND were all highly correlated. As in 2001 and 2002, GH severity was highly correlated to SEV and IND from the filed, but not field INC. Also, the correlations involving kernel traits (KR, %SS, DON) tended to be lower than those among head traits

Most Resistant and Most Susceptible Genotypes:

The most resistant and susceptible, based on analysis of all disease traits is shown in Table 5 and their perigrees and possible sources of resistance are shown in Table 6. . Six of the genotypes in Table 6 have exotic sources of resistance (Ning 7840, Hupei, Frontana) while 10 do not appear to have exotic parentage.

Table 1. Entries in the 2003 Northern Uniform Winter Wheat Scab Nursery. Extended pedigrees are footnoted.

ENT.	SOURCE	NAME	PEDIGREE
1	Ohm	P.97397E1-11	96204//Gfd/INW9824
2	Ohm	P.981227A1-1	Gfd/9824//96204/3/x117/4/9853
3	Ohm	P.981233A1-10	Fdm//Gfd/X117
4	Ohm	P.981238A1-1	Ernie//91193D1/X117
5	Ohm	P.981359C1-4	Acc3130/Patterson
6	Ohm	P.99646C2-7	961331/9811//283-1/Fdm
7	Sorrells	NY89064SP-7139*	88029(84061(6120-15/F29-76)/Augusta)/Harus
8	Sorrells	NY89052SP-9232	88119(Geneva/84004/6-1MR)/Geneva
9	Sorrells	CALEDONIARESEL-VT	Caledonia offtype
10	Sorrells	NY88046-8138	Susquehanna/Harus
11	Sorrells	NY89052-7142	88119(Geneva/84004/6-1MR)/Geneva
12	Kolb	IL97-6755	IL90-4813//IL85-3132-1/Ning 7840
13	Kolb	IL99-13436	IL91-14163/IL93-1517
14	Kolb	IL99-27048	IL90-6364/Pioneer brand 2571
15	Kolb	IL97-4915	IL87-2834-1/OH470//MO9965-52/IL90-6364
16	Kolb	IL96-24851-1	IL90-6364//IL90-9464/Ning 7840
17	Baenziger	ARAPAHOE	BRULE/3/PKR4*/AGENT//BELOT198/LCR
18	Baenziger	NE97V121	N87V106/OK88767
19	Baenziger	NE99445	RAWHIDE/TOMAHAWK//KARL 92
20	Baenziger	NE98466	KS89H50-4/NE90518
21	Vansanford	KY94C-0094-11-2	L880119/2684//2510
22	Vansanford	KY93C-0403-23-1	VA88-52-69/KY83C-004//2510
23	Vansanford	KY93C-1238-34-1	VA87-54-558/ KY83C-004//2510
24	McKendry	MO980829	MO 11769/Madison
25	McKendry	MO981020	MO 11769/Madison
26	McKendry	MO011175	MO 91-19/Pioneer 2552
27	McKendry	MO011174	MO 980521 reselection. (MO 11769/Madison)
28	McKendry	MO010708	MO 94-182/VA 91-54-219
29	McKendry	MO010719	MO 12278/Pioneer 2552
30	Sneller	OH738	L890690/T814
31	Sneller	OH743	OH529/OH506
32	Sneller	OH750	OH536/OH506
33	Sneller	OH751	10584-0801/COKER 9663
34	Sneller	OH753	CATOCTIN/OH536
35	Sneller	OH736	OH462/COKER 9663
36	Schaafsma	RCATL33	R/FR#1/AC RON//25R18/ACRON
37	Schaafsma	RCATL10	BALKAN//AC RON/SUP72017-17-5-10-1
38	Schaafsma	RCATL13	2737W/25R57//R/FR#1/2737W
39	Schaafsma	RCATTF19/26	EX9806/AC RON
40	Schaafsma	RCATTF2/4	2737W/EX9806
41	Schaafsma	RCATTF17/34	2737W/25R57
42	Griffey	VA01W448	†PC-11/3/92-51-39//FFR555W/RCT/4/COKER9803
43	Griffey	VA02W694	†(CK9803/FREEDOM)/(CLARK*4/NING 7840)
44	Griffey	VA02W708	NING 7840/P.2684//96-54-244(CK9803/Fdm), F6
45	Griffey	VA02W709	NING 7840/P.2684//96-54-244(CK9803/Fdm), F6
46	Griffey	VA02W729	†PC-11/3/92-51-39//FFR555W/RCT/4/93-52-23&24
47	Griffey	VA02W734	†PC-7/3/92-51-39//CK9803/RCT/4/93-52-55
48	Ward	D6234	†X1291/3/(C5107,B2218/B2142//B5250)
49	Ward	E0009	NY82-105-2 / NY262-37-422
50	Ward	E0010	NY82-105-2 / NY262-37-422
51	Ward	F0008	†(D2217,C4680/AUG//AUG)/3/PIONEER-2555
52	check	ERNIE	
53	check	PIO.2545	
54	check	FREEDOM	

†VA01W448=PC-11(SHANGHAI4/CHILL"S":SCAB-RES)/3/92-51-39(IN71761A4-31-5-48//71-54-147/MCN1813)//FFR555W/RCT/4/COKER9803, F8; VA02W694=96-54-250(CK9803/FREEDOM) /P92823A1-1-2-3-5(CLARK*4/NING 7840), F6; VA02W709=PC-11(SHANGHAI4/CHILL"S":SCAB-RES)/3/92-51-39(IN71761A4-31-5-48//71-54-147/MCN1813)//FFR555W/RCT/4/93-52-23&24(MSY//HUNTER/WLR), F8; VA02W734=PC-7(CHILL"S"/YM16:SCAB-RES)/3/92-51-39(IN71761A4-31-4-48//71-54-147/MCN1813)//CK9803/RCT/4/93-52-55(MSY*3/BALKAN//SAL), F8 D6234=(X1291,I3118/FRANKENMUTH//FRANKENMUTH)/3/(C5107,B2218/B2142//B5250); F008 =(D2217,C4680/AUG//AUG)/3/(PIONEER_2555,PNR_W3017/PNR_W521)

Table 2. Summary of testing information for the 2002-03 NUWWSN

INSTITUTE:	**University of Arkansas (ARF, ARK)**
COOPERATOR(S):	Milus, Rohman, Markell
TEST LOCATION:	Fayetteville (F) and Kibler (K), AR
PLOT SIZE:	2 rows (F), 3 rows (K), each 5 feet long
REPS:	4 in field, 3 in greenhouse
SEEDING DATE:	10/15/2002 (F), 10/23/2002 (K)
HARVEST DATE:	6/9/2003 (K), Fayetteville not harvested
FERTILIZER:	100 lbs. N (F), 80 lbs. N (K), split application
IRR./MISTING METHOD:	8 mist periods of 10 min. each between midnight and 8AM on 9 nights between 29 April and 13 May (F) 2 hour sprinkling periods 3 days per week for six weeks from early April to mid-May (K)
INOCULATION METHOD:	Corn inoculum applied 4-04-03 and 4-14-03 (F), 3-26-03 and 4-07-03 (K). Total: 6 kernels/sq. ft. each location
PRECIP DURING GRAIN FILL:	2.47" in April, 5.90" in May. Most came after irrigation ceased (F). 2.60" in April, 2.40" in May (K)
DATE/FEEKES WHEN RATED:	5/27/2003, Feekes 11.2 (F), 5/19/2003, Feekes 11.2 (K)
COMMENTS:	Three weeks of rainy weather after irrigation stopped led to severe FHB. No samples sent for DON
INSTITUTE:	**Cornell University (NY)**
COOPERATOR(S):	Sorrells, Bergstrom
TEST LOCATION:	Ithaca
PLOT SIZE:	1M x .35M
REPS:	6
SEEDING DATE:	9/30/2002
FERTILIZER:	100 lb/a 10-20-20
IRR./MISTING METHOD:	Overhead mist.
INOCULATION METHOD:	Corn Kernels in alley
PRECIP DURING GRAIN FILL:	9.2 inches.
AVG. TEMP. DURING GRAIN FILL:	66 F
DATE/FEEKES WHEN RATED:	1 week post heading
INSTITUTE:	**University of Illinois (IL)**
COOPERATOR(S):	Kolb, Boze
TEST LOCATION:	Urbana
PLOT SIZE:	1 row x 3 ft.
REPS:	4
SEEDING DATE:	9/27/2002
HARVEST DATE:	7/7/2003
FERTILIZER:	40 lbs N/A preplant, P and K ok, no spring topdress
IRR./MISTING METHOD:	Misted daily early morning and late evening
INOCULATION METHOD:	Wheat grain spawn, and corn fodder scattered in field and sprayed with inoculum
DATE/FEEKES WHEN RATED:	Feekes 10.5 + approx.29 days (longer than normal due to cool temps.)
COMMENTS:	Cool weather delayed onset of symptoms

Table 2. (continued)

INSTITUTE:	**University of Kentucky (KY)**
COOPERATOR(S):	Stewart, Van Sanford
TEST LOCATION:	Lexington
PLOT SIZE:	2 rows, 4 ft long
REPS:	2
SEEDING DATE:	8/22/2002
HARVEST DATE:	6/29/2003
FERTILIZER:	P, K acc. To soil tests; 110# N, split appl.
IRR./MISTING METHOD:	Evening/Early morning irrigation
INOCULATION METHOD:	Scabby corn
PRECIP DURING GRAIN FILL:	8.59 inches
AVG. TEMP. DURING GRAIN FILL:	61.7 F
DATE/FEEKES WHEN RATED:	Feekes 10.5 + approx.21
INSTITUTE:	**University of Missouri (MO)**
COOPERATOR(S):	McKendery; Tremain
TEST LOCATION:	Columbia
PLOT SIZE:	4 rows x 3 ft. long
REPS:	4
SEEDING DATE:	10/2/2002
HARVEST DATE:	7/7/2003
IRR./MISTING METHOD:	FIELD:overhead mist
	GH:plants were misted for 72 hours
INOCULATION METHOD:	FIELD:50,00 spores/ml conidial suspension sprayed on the plots at 75% anthesis
	GH:Point inoculation of a single central floret at anthesis with 10 micro litres of 50,000 spores/ml suspension
DATE/FEEKES WHEN RATED:	FIELD:rated at 28 days, which was later than usual due to cool temperatures
	GH:rated at 21 days post inoculation
COMMENTS	Field conditions were cooler than usual this spring and so we didn't get our
INSTITUTE:	**University of Nebraska (NE)**
COOPERATOR(S):	Baenziger, Watkins, Schimelfenig
TEST LOCATION:	Mead
PLOT SIZE:	Total of 10 ft2 (1 row x 10 ft. long)
REPS:	1
SEEDING DATE:	9/30/2002
HARVEST DATE:	7/11/2003
IRR./MISTING METHOD:	Misting from overhead risers
INOCULATION METHOD:	Spray 70 000 conidia/ml – 5/16, 18, 20, 22, 25, 27 and 29 in 2003
AVG. TEMP. DURING GRAIN FILL:	90-98 F
DATE/FEEKES WHEN RATED:	Feekes 11.2 : date – 6/20/2002
COMMENTS:	Ideal conditions – excellent infection in 2003

Table 2. (continued)

INSTITUTE:	**Virginia Tech Univiversity (VA)**
COOPERATOR(S):	Griffey, Wilson, Nabati
TEST LOCATION:	Blacksburg
PLOT SIZE:	20 ft^2
REPS:	3
SEEDING DATE:	10/9/2002
HARVEST DATE:	7/15/2003
FERTILIZER:	25-70-60 app. 10/8/02; 80-0-0 app. 3/23/2003
IRR./MISTING METHOD:	FIELD: Overhead mist irrigation; only turned on twice due to wet conditions
INOCULATION METHOD:	GH: Mist irrigation set on timer; 45 sec misting every 30 mins for 5 days Sprayed conidial suspension of approx. 5 x 10^4 concentration
PRECIP DURING GRAIN FILL:	14.14 inches
AVG. TEMP. DURING GRAIN FILL:	62.7 F
DATE/FEEKES WHEN RATED:	FIELD: 6/9 and 6/10/2003; GH: various dates in March 2003
INSTITUTE:	Ridgetown College, University of Guelph (ONT)
COOPERATOR(S):	Lily Tamburic-Ilincic, Art Schaafsma, Arend Smith
TEST LOCATION:	Ridgetown, Ontario
IRR./MISTING METHOD:	Yes
INOCULATION METHOD:	Spray inoculation at flowering
INSTITUTE:	The Ohio State University, OARDC (OH)
COOPERATOR(S):	C. Sneller, P. Lipps, L. Herald
TEST LOCATION:	Wooster, OH
PLOT SIZE:	Single row, 3' long
REPS:	3
IRR./MISTING METHOD:	Mist irrigation
INOCULATION METHOD:	Spread corn seed infested with pathogen
COMMENTS	May was very cool and wet which delayed and extended the heading period. After heading, the temperature again turned cool which delayed disease development. Plots were rated 20-37 days after heading, depending on variety. Heading date, rating date, or time from heading to rating were not correlated to disease rating.
INSTITUTE:	Michigan State University (MI)
COOPERATOR(S):	R. Ward, L. Siler
TEST LOCATION:	E. Lansing, MI

Table 3. Description of traits.

Code	Trait	Description	Tests where data was collected
HD	Heading date	Days from Jan 1st when 50% of heads have emerged	IL, IN, KY, MO, NY, OH, VA
HGT	Plant height	Height in inches from ground to top of spike at maturity	
SEV	Disease severity from field tests	% of infected spikelets in an infected head. Generally visually rated according to Stack & McMullen, 'A Visual scale to estimate severity of Fusarium Head Blight in Wheat', NDES. PP-1095	IL, KY, MO, NE, OH, ONT, VA
INC	Disease incidence	% of heads with at least one infected spikelets	IL, IN, KY, MO, NE, NY, OH, ONT, VA
IND	Disease index	IND = (SEVxINC)/100	ARF, ARK, KY, IL, OH, VA, MO, NE, ONT
KR	Kernel rating	A visual assessment of the percent infected kernels	IL, KY
%SS	Percent scabby seed	Percent of scabby seed by weight	ARK, KY, MO, VA
DON	DON (vomitoxin)	PPM of vomitoxin in grain sample as assayed by Pat Hart, Michigan State University	KY, NE, OH, VA
GH	Disease severity from greenhouse tests	Same as SEV except using greenhouse data	ARF, KY, MI, MO, VA

Table 4a. Entry means for 2003 NUWWSN (see Table 3 for information on traits and tests). Each entry was compared to the lowest (l) and highest (h) means in each column using $LSD_{(0.05)}$. "# low" is the number of disease traits for which an entry received a low score, "# high" is the times it received a high score. The traits HD, HGT, and KR are presented in Table 4b.

		SEV	INC	IND	%SS	DON	GH	#	#
		n=7	9	9	4	4	5	LOW	HIGH
1	P.97397E1-11	21.1 l	49.7 l	20.5	45.5	11.5 l	23.4 l	4	0
2	P.981227A1-1	27.5 h	56.5	27.6	47.1	11.6 l	43.9	1	1
3	P.981233A1-10	22.9 l	57.8	20.4	50.5 h	18.1	21.9 l	2	1
4	P.981238A1-1	17.4 l	49.0 l	18.0 l	49.5	11.7 l	35.0 l	5	0
5	P.981359C1-4	16.5 l	49.3 l	10.7 l	23.0 l	12.7 l	34.7 l	6	0
6	P.99646C2-7	29.5 h	62.7 h	28.1	46.0	16.5	64.1 h	0	3
7	NY89064SP-7139*	22.1 l	55.6	18.7 l	49.8	17.1	39.2 l	3	0
8	NY89052SP-9232	22.2 l	53.5	20.6	39.6	25.5 h	59.1 h	1	2
9	CALED-RESEL-VT	23.4 l	47.1 l	18.9 l	52.3 h	18.9 h	58.8 h	3	3
10	NY88046-8138	26.6	54.9	29.7	43.1	13.9 l	43.0	1	0
11	NY89052-7142	29.8 h	57.0	25.5	39.7	15.5	57.9 h	0	2
12	IL97-6755	15.7 l	43.3 l	13.1 l	30.7 l	6.3 l	30.4 l	6	0
13	IL99-13436	27.8 h	58.2	25.5	48.5	18.2	49.8	0	1
14	IL99-27048	14.4 l	42.8 l	13.1 l	28.2 l	7.9 l	37.2 l	6	0
15	IL97-4915	28.5 h	52.5 l	20.7	39.3	7.6 l	47.0	2	1
16	IL96-24851-1	16.3 l	47.7 l	12.8 l	43.0	8.3 l	27.1 l	5	0
17	ARAPAHOE	19.9 l	55.1	18.7 l	42.9	9.5 l	53.4 h	3	1
18	NE97V121	33.1 h	66.0 h	32.0	59.1 h	13.6 l	49.7	1	3
19	NE99445	38.4 h	57.8	36.3 h	49.7	10.2 l	59.7 h	1	3
20	NE98466	29.9 h	54.5	22.8	41.9	10.5 l	47.7	1	1
21	KY94C-0094-11-2	21.1 l	57.3	23.5	43.7	8.4 l	43.0	2	0
22	KY93C-0403-23-1	26.5	59.4 h	31.3	63.6 h	11.4 l	71.4 h	1	3
23	KY93C-1238-34-1	36.2 h	64.7 h	34.4 h	52.0 h	6.7 l	46.8	1	4
24	MO980829	21.6 l	41.9 l	11.4 l	35.7 l	8.4 l	24.9 l	6	0
25	MO981020	17.9 l	45.1 l	15.5 l	34.3 l	6.6 l	26.1 l	6	0
26	MO011175	21.4 l	46.1 l	15.8 l	32.2 l	10.7 l	41.6	5	0
27	MO011174	16.0 l	43.0 l	11.8 l	32.3 l	9.3 l	24.3 l	6	0
28	MO010708	20.7 l	55.7	18.0 l	33.4 l	11.7 l	34.6 l	5	0
29	MO010719	22.9 l	48.1 l	18.0 l	37.5	12.5 l	41.1	4	0
30	OH738	31.8 h	66.9 h	37.3 h	57.2 h	13.4 l	45.3	1	4
31	OH743	22.2 l	57.2	24.8	48.0	9.1 l	33.8 l	3	0
32	OH750	23.5 l	56.8	21.2	50.7 h	11.6 l	51.2	2	1
33	OH751	21.9 l	55.7	22.5	41.2	12.7 l	37.0 l	3	0
34	OH753	23.1 l	56.0	24.7	48.6	9.3 l	48.6	2	0
35	OH736	26.0	57.2	22.0	43.4	15.0	50.4	0	0
36	RCATL33	15.3 l	39.9 l	14.6 l	39.3	13.2 l	46.2	4	0
37	RCATL10	29.8 h	61.5 h	27.6	48.9	16.3	34.7 l	1	2
38	RCATL13	31.1 h	65.3 h	36.0 h	51.5 h	29.6 h	65.9 h	0	6
39	RCATTF19/26	27.2 h	56.2	25.4	50.4 h	8.9 l	51.9	1	2
40	RCATTF2/4	22.3 l	48.9 l	19.3 l	49.1	14.1 l	56.2 h	4	1
41	RCATTF17/34	36.6 h	60.8 h	39.3 h	53.8 h	28.3 h	61.2 h	0	6
42	VA01W448	30.8 h	57.3	35.1 h	55.3 h	14.4	47.9	0	3
43	VA02W694	22.5 l	45.6 l	25.2	40.0	3.3 l	61.5 h	3	1
44	VA02W708	15.0 l	44.3 l	11.9 l	25.7 l	7.4 l	31.5 l	6	0
45	VA02W709	16.5 l	49.3 l	16.6 l	52.9 h	11.4 l	29.8 l	5	1
46	VA02W729	22.2 l	58.0	22.0	43.8	10.6 l	44.9	2	0
47	VA02W734	36.1 h	64.7 h	41.3 h	49.0	13.6 l	55.0 h	1	4
48	D6234	24.8 l	57.2	27.1	41.2	18.2	45.8	1	0
49	E0009	20.9 l	52.7 l	18.0 l	36.2 l	8.4 l	36.6 l	6	0
50	E0010	26.0	61.1 h	26.2	48.4	16.0	36.8 l	1	1
51	F0008	27.5 h	66.3 h	34.6 h	55.3 h	24.5 h	50.5	0	5
52	ERNIE	17.0 l	45.7 l	19.0 l	36.3 l	17.3	27.6 l	5	0
53	PIO. 2545	30.7 h	71.4 h	34.4 h	58.6 h	21.2 h	43.5	0	5
54	FREEDOM	21.5 l	58.0	21.6	49.9 h	14.6	37.8 l	2	1
	AVERAGE	24.3	54.6	23.4	44.6	13.4	43.9		
	R2	0.6	0.8	0.8	1.0	0.8	0.8		
	CV	45.1	25.4	41.5	22.0	57.3	34.3		
	LSD	11.5	12.8	9.0	13.7	10.8	18.7		

† Indicates a mean that is not different from the lowest (l) or highest (h) mean in the column based on $LSD_{(0.05)}$

Table 4b. Entry means for 2003 NUWWSN (see Table 3 for information on traits and tests). Each entry was compared to the lowest (l) and highest (h) means in each column using $LSD_{(0.05)}$.. The traits INC, SEV, IND, %SS, DON, and GH are presented in Table 4a.

		KR	HD	HGT
		2.0	7	3
1	P.97397E1-11	4.2 l†	136.0	32.6 l
2	P.981227A1-1	7.7 l	136.4	35.8
3	P.981233A1-10	6.0 l	134.8 l	33.0 l
4	P.981238A1-1	7.6 l	133.9 l	33.8 l
5	P.981359C1-4	5.5 l	136.0	39.2 h
6	P.99646C2-7	7.0 l	134.7 l	34.6 l
7	NY89064SP-7139*	8.0 l	145.0	36.3
8	NY89052SP-9232	13.7 l	144.9	38.1 h
9	CALEDONIARESEL-VT	22.3 h	141.8	41.0 h
10	NY88046-8138	8.4 l	144.3	38.1 h
11	NY89052-7142	6.3 l	140.8	40.6 h
12	IL97-6755	2.5 l	135.5 l	40.7 h
13	IL99-13436	7.5 l	134.1 l	32.1 l
14	IL99-27048	7.1 l	134.6 l	34.2 l
15	IL97-4915	4.2 l	135.1 l	35.5
16	IL96-24851-1	13.5 l	137.5	35.3
17	ARAPAHOE	11.6 l	141.0	38.5 h
18	NE97V121	17.4	138.4	35.7
19	NE99445	7.9 l	135.1 l	34.9 l
20	NE98466	5.2 l	139.4	37.6
21	KY94C-0094-11-2	5.9 l	138.4	34.6 l
22	KY93C-0403-23-1	13.9 l	136.7	31.6 l
23	KY93C-1238-34-1	6.7 l	136.5	33.1 l
24	MO980829	8.9 l	142.4	39.0 h
25	MO981020	3.3 l	137.1	34.9 l
26	MO011175	7.2 l	137.2	41.2 h
27	MO011174	3.5 l	141.3	37.8
28	MO010708	6.4 l	138.3	36.4
29	MO010719	6.7 l	137.9	41.2 h
30	OH738	14.5 l	137.9	36.0
31	OH743	9.0 l	138.1	36.3
32	OH750	15.3 l	138.5	37.7
33	OH751	8.1 l	137.1	36.9
34	OH753	8.4 l	135.4 l	35.5
35	OH736	4.7 l	137.8	35.5
36	RCATL33	3.8 l	135.9	40.4 h
37	RCATL10	8.4 l	143.5	39.3 h
38	RCATL13	12.4 l	137.5	35.0
39	RCATTF19/26	5.7 l	136.6	34.1 l
40	RCATTF2/4	9.1 l	138.9	36.3
41	RCATTF17/34	8.7 l	137.5	32.9 l
42	VA01W448	16.7	139.7	32.7 l
43	VA02W694	4.7 l	135.7 l	32.5 l
44	VA02W708	3.0 l	136.8	34.6 l
45	VA02W709	6.0 l	137.0	31.7 l
46	VA02W729	7.6 l	137.4	33.1 l
47	VA02W734	13.1 l	135.7 l	34.6 l
48	D6234	5.5 l	138.8	36.1
49	E0009	5.5 l	145.9 h	37.6
50	E0010	9.5 l	145.8 h	37.4
51	F0008	16.9	140.5	35.8
52	ERNIE	5.2 l	134.7 l	33.0 l
53	PIONEER 2545	32.0 h	137.8	34.6 l
54	FREEDOM	7.0 l	137.9	37.5
	AVERAGE	8.8	43.9	36.0
	R2	0.63	0.78	0.72
	CV	79	34.3	5.6
	LSD	14	1.8	3.3

† Indicates a mean that is not different from the lowest (l) or highest (h) mean in the column based on $LSD_{(0.05)}$

Table 5. Entry means for the most tolerant (top) and susceptible (bottom) entries in the 2003 NUWWSN based on SEV, INC, IND, %SS, DON, and GH. The check Freedom (entry 54) was not one of the most tolerant entries but is presented in the table only as a check.

		SEV	INC	IND	%SS	DON	GH	#	#		KR	HD	HGT
		n=7	9	9	4	4	5	LOW	HIGH		2	7	3
5	P.981359C1-4	16.5 l†	49.3 l	10.7 l	23.0 l	12.7 l	34.7 l	6	0		5.5 l	136.0	39.2 h
12	IL97-6755	15.7 l	43.3 l	13.1 l	30.7 l	6.3 l	30.4 l	6	0		2.5 l	135.5 l	40.7 h
14	IL99-27048	14.4 l	42.8 l	13.1 l	28.2 l	7.9 l	37.2 l	6	0		7.1 l	134.6 l	34.2 l
24	MO980829	21.6 l	41.9 l	11.4 l	35.7 l	8.4 l	24.9 l	6	0		8.9 l	142.4	39.0 h
25	MO981020	17.9 l	45.1 l	15.5 l	34.3 l	6.6 l	26.1 l	6	0		3.3 l	137.1	34.9 l
27	MO011174	16.0 l	43.0 l	11.8 l	32.3 l	9.3 l	24.3 l	6	0		3.5 l	141.3	37.8
44	VA02W708	15.0 l	44.3 l	11.9 l	25.7 l	7.4 l	31.5 l	6	0		3.0 l	136.8	34.6 l
49	E0009	20.9 l	52.7 l	18.0 l	36.2 l	8.4 l	36.6 l	6	0		5.5 l	145.9 h	37.6
4	P.981238A1-1	17.4 l	49.0 l	18.0 l	49.5	11.7 l	35.0 l	5	0		7.6 l	133.9 l	33.8 l
16	IL96-24851-1	16.3 l	47.7 l	12.8 l	43.0	8.3 l	27.1 l	5	0		13.5 l	137.5	35.3
26	MO011175	21.4 l	46.1 l	15.8 l	32.2 l	10.7 l	41.6	5	0		7.2 l	137.2	41.2 h
28	MO010708	20.7 l	55.7	18.0 l	33.4 l	11.7 l	34.6 l	5	0		6.4 l	138.3	36.4
45	VA02W709	16.5 l	49.3 l	16.6 l	52.9 h	11.4 l	29.8 l	5	1		6.0 l	137.0	31.7 l
52	ERNIE	17.0 l	45.7 l	19.0 l	36.3 l	17.3	27.6 l	5	0		5.2 l	134.7 l	33.0 l
1	P.97397E1-11	21.1 l	49.7 l	20.5	45.5	11.5 l	23.4 l	4	0		4.2 l	136.0	32.6 l
29	MO010719	22.9 l	48.1 l	18.0 l	37.5	12.5 l	41.1	4	0		6.7 l	137.9	41.2 h
36	RCATL33	15.3 l	39.9 l	14.6 l	39.3	13.2 l	46.2	4	0		3.8 l	135.9	40.4 h
54	FREEDOM	21.5 l	58.0	21.6	49.9 h	14.6	37.8 l	2	1		7.0 l	137.9	37.5
23	KY93C-1238-34-1	36.2 h	64.7 h	34.4 h	52.0 h	6.7 l	46.8	1	4		6.7 l	136.5	33.1 l
30	OH738	31.8 h	66.9 h	37.3 h	57.2 h	13.4 l	45.3	1	4		14.5 l	137.9	36.0
47	VA02W734	36.1 h	64.7 h	41.3 h	49.0	13.6 l	55.0 h	1	4		13.1 l	135.7 l	34.6 l
51	F0008	27.5 h	66.3 h	34.6 h	55.3 h	24.5 h	50.5	0	5		16.9	140.5	35.8
53	PIONEER 2545	30.7 h	71.4 h	34.4 h	58.6 h	21.2 h	43.5	0	5		32.0 h	137.8	34.6 l
38	RCATL13	31.1 h	65.3 h	36.0 h	51.5 h	29.6 h	65.9 h	0	6		12.4 l	137.5	35.0
41	RCATTF17/34	36.6 h	60.8 h	39.3 h	53.8 h	28.3 h	61.2 h	0	6		8.7 l	137.5	32.9 l
	AVERAGE	24.3	54.6	23.4	44.6	13.4	43.9				8.8	43.9	36.0
	R2	0.6	0.8	0.8	1.0	0.8	0.8				0.6	0.78	0.72
	CV	45.1	25.4	41.5	22.0	57.3	34.3				79	34.3	5.6
	LSD	11.5	12.8	9.0	13.7	10.8	18.7				14	1.8	3.3

† Indicates a mean that is not different from the lowest (l) or highest (h) mean in the column based on $LSD_{(0.05)}$

Table 6. Possible sources of resistance for the most resistant entries in Table 5.

NAME	PEDIGREE	POSSIBLE SOURCE(S) OF RESISTANCE (note: parents in the pedigree with known resistance are listed. Resistance alleles may be contributed from other parents as well)
E0009	NY82-105-2 / NY262-37-422	Unknown
IL96-24851-1	IL90-6364//IL90-9464/Ning 7840	Ning 7840
IL97-6755	IL90-4813//IL85-3132-1/Ning 7840	Ning 7840
IL99-27048	IL90-6364/Pioneer brand 2571	Unknown
MO010708	MO 94-182/VA 91-54-219	Unknown, not Ernie or Truman
MO010719	MO 12278/Pioneer 2552	Unknown, not Ernie or Truman
MO011174	MO 980521 reselection. (MO 11769/Madison)	Full sib of Truman. Source unknown, not Ernie
MO011175	MO 91-19/Pioneer 2552	Unknown, not Ernie or Truman
MO980829	MO 11769/Madison	Full sib of Truman. Source unknown, not Ernie
MO981020	MO 11769/Madison	Full sib of Truman. Source unknown, not Ernie
P.97397E1-11	96204//Gfd/INW9824	Goldfield (Gfd)
P.981238A1-1	Ernie//91193D1/X117	Ernie
P.981359C1-4	Acc3130/Patterson	Acc3130 is the Chinese line Huapei 57-2
RCATL33	R/FR#1/AC RON//Pio. 25R18/ACRON	Frontana (FR) and Pio. 25R18
VA02W708	NING 7840/PION2684//96-54-244(CK9803/FREEDOM), F6	Ning 7840, Freedom
VA02W709	NING 7840/PION2684//96-54-244(CK9803/FREEDOM), F6	Ning 7840, Freedom

Table 7. Heading date (julian days) for entries in 2003 NUWWSN

		AVG	IL	IN	KY	MO	NY	OH	VA
1	P.97397E1-11	136	134	132	127	132	155	142	130
2	P.981227A1-1	136.4	136	133	131	133	151	141	130
3	P.981233A1-10	134.8 l†	133	130	129	132	151	141	128
4	P.981238A1-1	133.9 l	133	129	127	130	151	141	127
5	P.981359C1-4	136	136	133	127	133	152	141	130
6	P.99646C2-7	134.7 l	134	130	127	131	152	141	128
7	NY89064SP-7139*	145	144	141	137	143	159	154	138
8	NY89052SP-9232	144.9	144	141	136	140	159	156	139
9	CALEDONIARESEL-VT	141.8	142	139	131	136	159	150	136
10	NY88046-8138	144.3	145	141	137	142	161	155	129
11	NY89052-7142	140.8	140	138	133	136	158	146	135
12	IL97-6755	135.5 l	136	132	126	132	152	141	129
13	IL99-13436	134.1 l	132	129	126	129	155	141	127
14	IL99-27048	134.6 l	133	129	131	129	151	142	128
15	IL97-4915	135.1 l	135	130	128	131	151	142	129
16	IL96-24851-1	137.5	139	135	129	134	152	142	131
17	ARAPAHOE	141	139	138	132	137	156	151	134
18	NE97V121	138.4	137	135	130	134	155	145	133
19	NE99445	135.1 l	134	133	125	133	151	141	129
20	NE98466	139.4	138	135	133	136	155	147	132
21	KY94C-0094-11-2	138.4	137	134	131	134	157	144	132
22	KY93C-0403-23-1	136.7	135	134	129	133	152	143	131
23	KY93C-1238-34-1	136.5	135	133	129	133	155	141	130
24	MO980829	142.4	141	137	134	139	157	154	136
25	MO981020	137.1	135	133	127	133	154	146	132
26	MO011175	137.2	136	133	130	133	156	143	130
27	MO011174	141.3	140	139	130	138	159	146	137
28	MO010708	138.3	137	135	129	133	155	148	131
29	MO010719	137.9	136	134	133	132	155	146	129
30	OH738	137.9	137	136	127	134	155	145	132
31	OH743	138.1	137	136	128	133	155	145	133
32	OH750	138.5	138	137	128	133	155	146	133
33	OH751	137.1	136	135	128	133	152	145	131
34	OH753	135.4 l	133	133	126	132	152	142	130
35	OH736	137.8	136	135	128	133	156	144	132
36	RCATL33	135.9	135	132	129	133	154	141	128
37	RCATL10	143.5	143	142	128	140	159	156	137
38	RCATL13	137.5	137	136	126	132	157	143	132
39	RCATTF19/26	136.6	135	133	133	131	152	143	130
40	RCATTF2/4	138.9	139	137	126	133	157	146	135
41	RCATTF17/34	137.5	136	135	128	132	157	144	130
42	VA01W448	139.7	139	137	130	134	158	148	133
43	VA02W694	135.7 l	135	133	127	131	152	143	129
44	VA02W708	136.8	134	133	133	133	154	141	130
45	VA02W709	137	136	134	128	133	155	143	130
46	VA02W729	137.4	135	134	133	133	154	143	130
47	VA02W734	135.7 l	135	133	129	132	152	142	127
48	D6234	138.8	139	137	128	134	157	144	133
49	E0009	145.9 h	146	144	135	141	161	156	138
50	E0010	145.8 h	145	143	135	143	161	156	138
51	F0008	140.5	139	138	134	133	157	148	134
52	ERNIE	134.7 l	133	131	128	129	152	140	130
53	PIONEER 2545	137.8	137	136	130	133	156	142	131
54	FREEDOM	137.9	137	136	132	133	155	143	129
	AVERAGE	43.9	137	135	129.8	134	155	145.2	131.6
	R2	0.78							
	CV	34.3			0.55	0.8			0.99
	LSD	18.7	1.2		1.5	1.4			1.76

† Indicates a mean that is not different from the lowest (l) or highest (h) mean in the column based on $LSD_{(0.05)}$

Table 8. Disease incidence (% heads with infected spikelets) for entries in 2003 NUWWSN

		AVG	IL	IN	KY	MO	NE	NY	OH	ONT	VA
1	P.97397E1-11	49.7 l†	73.8	22	39.4	90	15	11.1	100	52.5	43.3
2	P.981227A1-1	56.5	88.3	18	59.8	95	10	13.8	100	83.8	40.0
3	P.981233A1-10	57.8	62.5	28	64.6	90	25	8.9	100	47.5	93.3
4	P.981238A1-1	49.0 l	62.5	4	64.5	76	15	17.0	100	50.0	51.7
5	P.981359C1-4	49.3 l	30.0	6	41.3	95	65	7.9	100	70.0	28.3
6	P.99646C2-7	62.7 h	84.5	38	58.3	84	40	13.2	100	80.0	66.7
7	NY89064SP-7139*	55.6	94.8	20	61.5	99	5	1.6	100	78.8	40.0
8	NY89052SP-9232	53.5	94.8	18	49.5	89	5	2.9	100	77.5	45.0
9	CALEDONIARESEL-VT	47.1 l	77.5	16	29.4	81	5	2.1	100	51.4	61.7
10	NY88046-8138	54.9	98.8	26	57.1	100	0	2.7	100	83.2	26.7
11	NY89052-7142	57.0	87.0	24	49.7	88	30	6.4	100	71.3	56.7
12	IL97-6755	43.3 l	23.8	14	42.3	63	55	3.2	100	66.3	21.7
13	IL99-13436	58.2	75.0	34	73.7	70	25	9.2	100	63.8	73.3
14	IL99-27048	42.8 l	42.5	8	50.8	66	35	11.0	100	45.0	26.7
15	IL97-4915	52.5 l	60.0	24	45.4	71	30	16.9	100	73.8	51.7
16	IL96-24851-1	47.7 l	40.0	20	58.6	71	15	14.1	100	78.8	31.7
17	ARAPAHOE	55.1	84.3	22	52.3	84	60	5.1	100	45.0	43.3
18	NE97V121	66.0 h	97.5	46	65.6	89	30	24.2	100	68.8	73.3
19	NE99445	57.8	76.3	30	81.4	83	5	15.5	100	68.8	60.0
20	NE98466	54.5	78.8	26	57.0	94	5	10.2	100	67.5	51.7
21	KY94C-0094-11-2	57.3	77.0	22	62.2	94	45	11.4	100	58.8	45.0
22	KY93C-0403-23-1	59.4 h	87.5	20	70.7	93	25	13.4	100	56.3	68.3
23	KY93C-1238-34-1	64.7 h	95.8	70	43.0	99	15	21.8	100	73.0	65.0
24	MO980829	41.9 l	33.8	12	44.4	93	5	2.0	100	53.8	33.3
25	MO981020	45.1 l	40.0	18	60.3	83	0	4.6	98.3	68.8	33.3
26	MO011175	46.1 l	66.3	18	56.4	80	10	9.7	100	42.5	31.7
27	MO011174	43.0 l	26.3	22	40.3	88	30	3.9	100	50.0	26.7
28	MO010708	55.7	87.2	30	58.3	88	40	9.3	100	58.8	30.0
29	MO010719	48.1 l	66.3	18	52.9	86	5	9.9	100	46.3	48.3
30	OH738	66.9 h	98.0	86	61.4	96	0	16.2	100	82.5	61.7
31	OH743	57.2	89.8	20	50.0	98	0	12.2	100	81.3	63.3
32	OH750	56.8	85.8	30	57.7	80	25	11.6	100	71.3	50.0
33	OH751	55.7	82.3	22	62.8	99	5	12.2	100	61.3	56.7
34	OH753	56.0	43.8	22	61.7	76	70	8.4	100	55.0	66.7
35	OH736	57.2	83.8	20	56.1	95	15	7.2	100	86.3	51.7
36	RCATL33	39.9 l	23.8	8	44.5	65	0	6.8	100	46.3	65.0
37	RCATL10	61.5 h	96.3	42	63.2	76	25	2.5	100	73.8	75.0
38	RCATL13	65.3 h	93.8	34	68.0	90	35	17.3	100	71.3	78.3
39	RCATTF19/26	56.2	66.3	18	62.6	89	60	4.3	100	78.8	26.7
40	RCATTF2/4	48.9 l	48.8	20	57.1	75	25	4.3	98.3	70.0	41.7
41	RCATTF17/34	60.8 h	94.3	26	54.6	94	5	18.9	100	66.3	88.3
42	VA01W448	57.3	94.0	28	54.5	95	0	7.3	100	75.0	61.7
43	VA02W694	45.6 l	78.0	30	46.3	89	0	10.0	100	17.5	40.0
44	VA02W708	44.3 l	23.8	12	49.4	96	15	8.4	100	43.8	50.0
45	VA02W709	49.3 l	43.6	6	63.3	94	20	12.6	100	63.8	40.0
46	VA02W729	58.0	85.0	20	68.4	93	50	7.0	100	70.0	28.3
47	VA02W734	64.7 h	96.5	18	68.1	85	35	24.7	100	90.0	65.0
48	D6234	57.2	93.8	36	55.3	90	5	5.4	100	81.3	48.3
49	E0009	52.7 l	42.5	10	31.6	94	80	1.2	100	76.8	38.3
50	E0010	61.1 h	96.8	20	52.0	95	70	2.6	100	75.0	38.3
51	F0008	66.3 h	80.0	46	78.7	93	25	21.7	100	73.8	78.3
52	ERNIE	45.7 l	70.0	30	60.5	61	15	12.8	98.3	33.8	30.0
53	PIO. 2545	71.4 h	95.5	32	91.5	100	40	18.2	100	82.5	83.3
54	FREEDOM	58.0	82.8	18	60.7	98	30	8.0	100	57.5	66.7
	AVERAGE	54.6	72.3	25	56.9	87.0	24.1	10.1	99.9	65.1	51.1
	R2	0.8		0.5					0.33		
	CV	25.4	12.1	72	21.8	12			68	21.5	35.9
	LSD	12.8	12.1	14.3	25.1	15			0.14	19.6	24.9

† Indicates a mean that is not different from the lowest (l) or highest (h) mean in the column based on $LSD_{(0.05)}$

Table 9. Field disease severity (% infected spikelets) for entries in 2003 NUWWSN

		AVG		IL+OH +ONT		IL	OH	ONT	KY	MO	NE	VA
1	P.97397E1-11	21.1	l†	26.5	l	23.4	43.1	13.1	18.7	11	22	16.1
2	P.981227A1-1	27.5	h	45.5	h	47.3	57.0	32.3	19.7	14	7	15.4
3	P.981233A1-10	22.9	l	13.8	l	14.9	17.6	8.9	17.7	11	56	34.3
4	P.981238A1-1	17.4	l	23.1	l	15.3	47.7	6.3	16.7	10	7	18.6
5	P.981359C1-4	16.5	l	15.4	l	17.4	20.6	8.3	19.9	15	18	16.1
6	P.99646C2-7	29.5	h	39.3		61.3	36.9	19.8	27.6	23	13	25.2
7	NY89064SP-7139*	22.1	l	28.8	l	41.9	29.3	15.3	22.8	23	7	15.4
8	NY89052SP-9232	22.2	l	34.5		38.7	49.6	15.1	16.2	11	7	17.5
9	CALEDONIARESEL-VT	23.4	l	26.9	l	43.0	27.4	10.2	19.5	10	33	20.9
10	NY88046-8138	26.6		41.7	h	57.1	50.0	17.9	29.5	20	0	11.9
11	NY89052-7142	29.8	h	33.9		39.2	46.7	15.8	22.9	15	46	22.8
12	IL97-6755	15.7	l	19.6	l	23.8	17.9	17.0	20.1	7	12	12.4
13	IL99-13436	27.8	h	32.9		22.7	59.1	17.0	22.0	10	37	27.0
14	IL99-27048	14.4	l	14.4	l	13.8	18.8	10.5	18.2	10	17	12.4
15	IL97-4915	28.5	h	35.3		51.2	34.9	19.9	14.6	10	48	21.1
16	IL96-24851-1	16.3	l	20.8	l	15.5	20.0	27.0	23.2	10	7	11.6
17	ARAPAHOE	19.9	l	24.8	l	32.2	37.2	5.1	16.8	13	16	18.8
18	NE97V121	33.1	h	35.3		43.9	51.0	10.9	20.3	12	68	25.6
19	NE99445	38.4	h	43.5	h	58.8	53.3	18.3	34.1	13	60	31.6
20	NE98466	29.9	h	31.6		37.8	43.9	13.0	20.1	11	60	23.3
21	KY94C-0094-11-2	21.1	l	28.6	l	39.3	37.5	9.1	17.1	13	8	23.9
22	KY93C-0403-23-1	26.5		35.6		53.4	42.3	11.1	17.3	17	21	23.5
23	KY93C-1238-34-1	36.2	h	53.6	h	64.6	71.9	24.3	17.7	14	36	24.9
24	MO980829	21.6	l	18.8	l	17.9	30.4	8.0	12.8	10	60	12.1
25	MO981020	17.9	l	25.0	l	27.7	35.9	11.5	17.8	15	0	17.5
26	MO011175	21.4	l	24.3	l	39.7	28.8	4.4	24.7	8	29	15.3
27	MO011174	16.0	l	20.0	l	20.6	33.8	5.5	15.3	14	12	10.8
28	MO010708	20.7	l	25.6	l	35.3	32.8	8.8	20.1	7	28	13.0
29	MO010719	22.9	l	25.7	l	32.9	38.8	5.4	17.8	17	30	18.5
30	OH738	31.8	h	49.7	h	66.6	65.9	16.7	30.2	15	0	27.9
31	OH743	22.2	l	34.0		32.1	54.3	15.7	17.5	11	0	24.8
32	OH750	23.5	l	33.3		41.9	42.5	15.6	24.0	14	8	18.2
33	OH751	21.9	l	29.8		43.7	36.7	9.0	14.9	19	7	23.1
34	OH753	23.1	l	21.6	l	21.7	34.0	9.2	31.0	9	38	19.0
35	OH736	26.0		32.6		37.3	41.7	18.8	17.0	14	33	20.5
36	RCATL33	15.3	l	14.8	l	21.1	16.2	7.0	14.4	17	0	31.2
37	RCATL10	29.8	h	41.2	h	60.4	49.4	13.9	40.1	9	8	27.9
38	RCATL13	31.1	h	51.7	h	54.2	79.4	21.4	13.4	13	7	29.5
39	RCATTF19/26	27.2	h	42.4	h	42.4	57.5	27.3	29.6	14	7	12.8
40	RCATTF2/4	22.3	l	30.5		42.0	30.1	19.4	18.5	12	16	18.2
41	RCATTF17/34	36.6	h	54.7	h	66.9	74.8	22.3	30.1	20	7	35.2
42	VA01W448	30.8	h	47.8	h	48.9	78.0	16.6	29.8	19	0	23.0
43	VA02W694	22.5	l	36.1		49.7	56.4	2.1	20.3	10	0	19.2
44	VA02W708	15.0	l	15.6	l	15.3	25.8	5.6	14.5	13	9	21.7
45	VA02W709	16.5	l	20.4	l	24.2	21.9	15.1	21.6	9	7	16.5
46	VA02W729	22.2	l	27.6	l	30.0	42.2	10.6	30.3	13	14	15.1
47	VA02W734	36.1	h	56.3	h	63.4	79.0	26.4	30.5	15	13	25.1
48	D6234	24.8	l	33.4		41.4	39.7	19.1	29.3	15	7	21.9
49	E0009	20.9	l	22.0	l	24.3	31.2	10.4	17.0	10	40	13.4
50	E0010	26.0		35.5		50.1	45.7	10.8	25.7	15	18	16.4
51	F0008	27.5	h	37.7		35.5	66.9	10.7	24.5	19	7	29.0
52	ERNIE	17.0	l	24.3	l	24.2	43.1	5.7	17.7	9	7	12.1
53	PIO. 2545	30.7	h	42.9	h	43.6	61.7	23.3	28.2	15	8	35.4
54	FREEDOM	21.5	l	25.8	l	37.4	30.5	9.5	20.9	12	14	26.1
	AVERAGE	24.3		31.6		37.9	42.9	13.9	21.7	13.2	19.3	20.8
	R2	0.6		0.82			0.73					
	CV	45.1		31		22.2	29	39.1	33.5	45		34.4
	LSD	11.5		15.7		11.5	20.6	7.6	15.1	8		9.7

† Indicates a mean that is not different from the lowest (l) or highest (h) mean in the column based on $LSD_{(0.05)}$

Table 10. Disease index ([severity% x incidence%]/100) for entries in 2003 NUWWSN

		AVG	ME	ARF	ARK	KY	IL	OH	VA	MO	NE	ONT
1	P.97397E1-11	20.5	26.9 l	50	34	9.3	17.3	43.1	7.7	9.9	3	10.6
2	P.981227A1-1	27.6	34.4	46	39	14.8	41.7	57.0	8.0	13.3	1	27.3
3	P.981233A1-10	20.4	25.7 l	50	30	14.7	9.4	17.6	32.2	9.9	14	5.4
4	P.981238A1-1	18.0 l†	24.9 l	35	33	12.8	9.6	47.7	11.3	7.6	1	4.4
5	P.981359C1-4	10.7 l	10.6 l	13	10	9.9	5.7	20.6	4.6	14.3	12	6.2
6	P.99646C2-7	28.1	35.5	45	35	22.7	52.5	36.9	20.8	19.3	5	15.6
7	NY89064SP-7139*	18.7 l	22.0 l	15	24	17.9	39.5	29.3	6.2	22.8	0	13.6
8	NY89052SP-9232	20.6	27.2 l	23	36	10.1	36.4	49.6	8.0	9.8	0	12.4
9	CALEDONIARESEL-VT	18.9 l	25.8 l	42	31	7.2	33.8	27.4	13.2	8.1	2	5.6
10	NY88046-8138	29.7	38.6	47	51	23.4	56.5	50.0	3.8	20.0	0	15.5
11	NY89052-7142	25.5	31.8 l	48	35	14.2	33.7	46.7	13.2	13.2	14	11.8
12	IL97-6755	13.1 l	15.9 l	42	16	10.5	6.0	17.9	2.7	4.4	7	11.4
13	IL99-13436	25.5	33.7	52	34	20.2	17.0	59.1	19.9	7.0	9	11.4
14	IL99-27048	13.1 l	16.5 l	38	21	11.4	5.8	18.8	3.8	6.6	6	6.2
15	IL97-4915	20.7	25.0 l	37	26	8.7	31.3	34.9	12.2	7.1	14	14.9
16	IL96-24851-1	12.8 l	14.3 l	20	18	18.2	6.2	20.0	3.6	7.1	1	21.4
17	ARAPAHOE	18.7 l	24.1 l	32	29	11.0	27.3	37.2	8.2	10.9	10	2.4
18	NE97V121	32.0	41.6	57	63	16.5	42.9	51.0	19.3	10.7	20	7.8
19	NE99445	36.3 h	50.0 h	82	66	34.7	45.3	53.3	18.8	10.8	3	12.8
20	NE98466	22.8	30.4 l	43	40	14.1	29.6	43.9	11.9	10.3	3	9.0
21	KY94C-0094-11-2	23.5	31.6 l	43	55	13.5	30.0	37.5	10.7	12.2	4	5.3
22	KY93C-0403-23-1	31.3	42.5	63	70	15.4	47.2	42.3	16.9	15.8	5	6.1
23	KY93C-1238-34-1	34.4 h	45.4 h	68	45	9.4	61.8	71.9	16.2	13.9	5	18.2
24	MO980829	11.4 l	14.3 l	15	23	7.3	6.1	30.4	4.1	9.3	3	4.8
25	MO981020	15.5 l	19.8 l	28	24	13.7	11.2	35.7	6.2	12.5	0	8.2
26	MO011175	15.8 l	21.8 l	30	23	17.0	26.7	28.8	5.1	6.4	3	2.1
27	MO011174	11.8 l	14.6 l	17	20	7.7	5.3	33.8	3.5	12.3	4	3.0
28	MO010708	18.0 l	23.3 l	28	28	14.3	32.4	32.8	4.1	6.2	11	5.2
29	MO010719	18.0 l	23.7 l	35	25	12.0	22.4	38.8	9.2	14.6	2	2.6
30	OH738	37.3 h	51.2 h	70	65	24.1	65.2	65.9	17.2	14.4	0	14.0
31	OH743	24.8	33.2	43	44	10.9	29.0	54.3	17.9	10.8	0	13.0
32	OH750	21.2	27.7 l	29	33	16.1	35.8	42.5	9.8	11.2	2	11.8
33	OH751	22.5	29.7 l	40	40	11.7	36.3	36.7	13.3	18.8	0	5.4
34	OH753	24.7	30.6 l	51	53	22.8	9.6	34.0	13.0	6.8	27	5.0
35	OH736	22.0	27.3 l	33	34	11.8	31.7	41.7	11.7	13.3	5	16.1
36	RCATL33	14.6 l	19.4 l	31	33	8.0	5.5	16.2	22.8	11.1	0	3.9
37	RCATL10	27.6	38.3	41	29	31.2	58.0	49.4	21.3	6.8	2	10.1
38	RCATL13	36.0 h	49.2 h	79	50	11.4	51.5	79.4	23.8	11.7	2	15.2
39	RCATTF19/26	25.4	32.3	40	40	24.0	28.2	57.5	3.9	12.5	1	21.7
40	RCATTF2/4	19.3 l	24.4 l	39	35	13.1	21.2	29.8	8.1	9.0	4	14.3
41	RCATTF17/34	39.3 h	53.2 h	70	58	22.1	63.1	74.8	31.3	18.8	0	15.2
42	VA01W448	35.1 h	47.6 h	70	56	21.0	46.2	78.0	14.1	18.1	0	12.4
43	VA02W694	25.2	36.2	50	51	12.3	38.9	56.4	8.5	8.9	0	0.4
44	VA02W708	11.9 l	15.3 l	20	19	9.0	3.7	25.8	14.0	12.5	1	2.5
45	VA02W709	16.6 l	21.7 l	31	43	17.1	10.7	21.9	6.6	8.5	1	9.9
46	VA02W729	22.0	28.5 l	31	41	26.7	25.6	42.2	4.7	12.1	7	7.9
47	VA02W734	41.3 h	55.0 h	78	66	26.7	61.4	79.0	18.7	12.8	5	23.7
48	D6234	27.1	35.8	44	59	21.8	38.8	39.7	11.2	13.5	0	15.5
49	E0009	18.0 l	18.7 l	19	38	7.5	10.7	31.2	5.8	9.4	32	8.2
50	E0010	26.2	33.4	38	44	16.8	48.6	45.7	7.3	14.3	13	8.4
51	F0008	34.6 h	47.2 h	69	70	25.8	29.0	66.9	22.5	17.7	2	8.1
52	ERNIE	19.0 l	27.0 l	50	34	13.3	17.2	42.4	5.3	5.5	1	2.5
53	PIO.2545	34.4 h	45.4 h	59	48	32.3	41.7	61.7	29.9	15.0	3	18.7
54	FREEDOM	21.6	28.8 l	43	35	15.9	30.8	30.5	17.5	11.8	4	6.1
	AVERAGE	23.4	30.5	42.8	38.9	16.0	30.2	42.9	12.3	11.7	5.1	10.2
	R2	0.77	0.78					0.73				
	CV	41.5	31			47.9	27.1	29	61.5	46.6		47.6
	LSD	9	10.9	15	13	12.5	11.2	20.6	10.3	7.7		6.8

ME = Mean of the sites included in the megaenvironment (ARF, ARK, KY, IL, OH, VA)

† Indicates a mean that is not different from the lowest (l) or highest (h) mean in the column based on $LSD_{(0.05)}$

Table 11. Kernel rating (visual rating of % infected seeds) for entries in 2003 NUWWSN

		AVG	IL	KY			AVG	IL	KY
1	P.97397E1-11	4.2 l†	3.3	5.0	30	OH738	14.5 l	9.0	20.0
2	P.981227A1-1	7.7 l	6.3	9.0	31	OH743	9.0 l	6.0	12.0
3	P.981233A1-10	6.0 l	7.0	5.0	32	OH750	15.3 l	5.5	25.0
4	P.981238A1-1	7.6 l	5.3	10.0	33	OH751	8.1 l	4.3	12.0
5	P.981359C1-4	5.5 l	1.0	10.0	34	OH753	8.4 l	4.8	12.0
6	P.99646C2-7	7.0 l	6.0	8.0	35	OH736	4.7 l	4.5	5.0
7	NY89064SP-7139*	8.0 l	6.0	10.0	36	RCATL33	3.8 l	3.5	4.0
8	NY89052SP-9232	13.7 l	3.3	24.0	37	RCATL10	8.4 l	5.8	11.0
9	CALEDONIARESEL-VT	22.3 h	4.5	40.0	38	RCATL13	12.4 l	4.8	20.0
10	NY88046-8138	8.4 l	8.8	8.0	39	RCATTF19/26	5.7 l	6.5	5.0
11	NY89052-7142	6.3 l	3.5	9.0	40	RCATTF2/4	9.1 l	5.3	13.0
12	IL97-6755	2.5 l	1.0	4.0	41	RCATTF17/34	8.7 l	5.5	12.0
13	IL99-13436	7.5 l	5.0	10.0	42	VA01W448	16.7	8.5	25.0
14	IL99-27048	7.1 l	4.3	10.0	43	VA02W694	4.7 l	5.3	4.0
15	IL97-4915	4.2 l	3.5	5.0	44	VA02W708	3.0 l	2.0	4.0
16	IL96-24851-1	13.5 l	2.0	25.0	45	VA02W709	6.0 l	5.0	7.0
17	ARAPAHOE	11.6 l	6.3	17.0	46	VA02W729	7.6 l	7.3	8.0
18	NE97V121	17.4	7.8	27.0	47	VA02W734	13.1 l	7.3	19.0
19	NE99445	7.9 l	7.8	8.0	48	D6234	5.5 l	5.0	6.0
20	NE98466	5.2 l	5.3	5.0	49	E0009	5.5 l	4.0	7.0
21	KY94C-0094-11-2	5.9 l	6.8	5.0	50	E0010	9.5 l	5.0	14.0
22	KY93C-0403-23-1	13.9 l	7.8	20.0	51	F0008	16.9	3.8	30.0
23	KY93C-1238-34-1	6.7 l	8.5	5.0	52	ERNIE	5.2 l	5.3	5.0
24	MO980829	8.9 l	1.8	16.0	53	PIONEER 2545	32.0 h	7.0	57.0
25	MO981020	3.3 l	2.5	4.0	54	FREEDOM	7.0 l	5.0	9.0
26	MO011175	7.2 l	3.5	11.0		AVERAGE	8.8	5.1	12.5
27	MO011174	3.5 l	3.0	4.0		R2	0.63		
28	MO010708	6.4 l	3.8	9.0		CV	79	21.6	22.2
29	MO010719	6.7 l	5.5	8.0		LSD	14	1.5	6.8

† Indicates a mean that is not different from the lowest (l) or highest (h) mean in the column based on $LSD_{(0.05)}$

Table 12. % scabby seed (% scabby seed based on weight) for entries in 2003 NUWWSN

		AVG	ARK	KY	MO	VA
1	P.97397E1-11	45.5	90	3.6	4.3	84.0
2	P.981227A1-1	47.1	90	6.8	8.3	83.3
3	P.981233A1-10	50.5 h†	78	17.2	8.3	98.3
4	P.981238A1-1	49.5	93	6.3	2.3	96.3
5	P.981359C1-4	23.0 l	39	7.6	6.5	39.0
6	P.99646C2-7	46.0	75	6.0	9.5	93.3
7	NY89064SP-7139*	49.8	98	8.0	5.0	88.0
8	NY89052SP-9232	39.6	75	14.7	3.5	65.3
9	CALEDONIARESEL-VT	52.3 h	98	25.0	4.0	82.0
10	NY88046-8138	43.1	100	6.4	6.8	59.0
11	NY89052-7142	39.7	65	7.3	4.8	81.7
12	IL97-6755	30.7 l	53	3.4	1.5	65.0
13	IL99-13436	48.5	88	7.6	4.8	93.7
14	IL99-27048	28.2 l	53	7.1	2.0	50.7
15	IL97-4915	39.3	75	3.3	2.0	76.7
16	IL96-24851-1	43.0	85	12.9	2.0	72.0
17	ARAPAHOE	42.9	85	12.9	3.8	70.0
18	NE97V121	59.1 h	100	17.3	24.5	94.7
19	NE99445	49.7	93	5.7	9.5	90.7
20	NE98466	41.9	88	3.9	6.0	69.7
21	KY94C-0094-11-2	43.7	90	10.1	11.0	63.7
22	KY93C-0403-23-1	63.6 h	95	12.5	54.5	92.3
23	KY93C-1238-34-1	52.0 h	95	4.0	16.3	92.7
24	MO980829	35.7 l	85	9.8	2.5	45.3
25	MO981020	34.3 l	64	4.6	3.3	65.3
26	MO011175	32.2 l	64	8.0	3.5	53.3
27	MO011174	32.3 l	75	3.2	2.8	48.3
28	MO010708	33.4 l	66	7.3	2.5	57.7
29	MO010719	37.5	75	6.3	2.8	65.7
30	OH738	57.2 h	100	12.5	22.5	93.7
31	OH743	48.0	88	8.7	19.5	75.7
32	OH750	50.7 h	88	16.2	9.0	89.7
33	OH751	41.2	83	8.6	5.0	68.0
34	OH753	48.6	88	9.4	5.8	91.0
35	OH736	43.4	78	9.1	13.3	73.3
36	RCATL33	39.3	68	3.1	3.3	82.7
37	RCATL10	48.9	90	8.7	6.0	90.7
38	RCATL13	51.5 h	85	11.3	13.8	96.0
39	RCATTF19/26	50.4 h	93	3.3	11.3	94.0
40	RCATTF2/4	49.1	85	10.0	4.8	96.7
41	RCATTF17/34	53.8 h	88	9.7	19.0	98.3
42	VA01W448	55.3 h	100	13.3	25.8	82.0
43	VA02W694	40.0	85	2.7	5.0	67.3
44	VA02W708	25.7 l	53	3.0	3.8	43.0
45	VA02W709	52.9 h	98	4.9	25.0	83.7
46	VA02W729	43.8	93	6.0	9.8	66.3
47	VA02W734	49.0	98	12.9	6.5	78.7
48	D6234	41.2	80	5.1	4.8	74.7
49	E0009	36.2 l	95	5.5	5.8	38.3
50	E0010	48.4	95	11.9	3.8	83.0
51	F0008	55.3 h	88	20.0	25.5	87.7
52	ERNIE	36.3 l	75	7.4	1.3	61.3
53	PIONEER 2545	58.6 h	90	32.0	14.5	98.0
54	FREEDOM	49.9 h	83	6.6	18.8	91.3
	AVERAGE	44.6	83.3	9.1	9.3	76.7
	R2	0.95				
	CV	22		24.6	103	15.6
	LSD	13.7	17	5.6	13.1	16.3

† Indicates a mean that is not different from the lowest (l) or highest (h) mean in the column based on $LSD_{(0.05)}$

Table 13. DON (vomitoxin in ppm) for entries in 2003 NUWWSN. The scores of "<0.5" from NE were assumed to be 0.25 when calculating the mean.

		AVG	OH+VA	OH	VA	KY	NE
1	P.97397E1-11	11.5 l†	17.6 l	30	5.1	8.7	2.2
2	P.981227A1-1	11.6 l	16.3 l	30	2.6	13.0	0.7
3	P.981233A1-10	18.1	28.5	40	17.0	14.0	1.2
4	P.981238A1-1	11.7 l	17.9 l	32	3.7	9.0	2.0
5	P.981359C1-4	12.7 l	21.0 l	36	6.0	8.7	0.3
6	P.99646C2-7	16.5	23.2 l	40	6.4	17.3	2.2
7	NY89064SP-7139*	17.1	27.1	36	18.2	12.3	1.8
8	NY89052SP-9232	25.5 h	40.0 h	72	8.0	17.3	4.8
9	CALEDONIARESEL-VT	18.9 h	29.5	46	13.0	16.0	0.7
10	NY88046-8138	13.9 l	21.0 l	38	3.9	12.7	1.0
11	NY89052-7142	15.5	20.9 l	32	9.7	16.7	3.4
12	IL97-6755	6.3 l	8.9 l	14	3.7	5.7	1.6
13	IL99-13436	18.2	27.4	38	16.7	15.3	2.6
14	IL99-27048	7.9 l	7.4 l	12	2.8	14.7	2.0
15	IL97-4915	7.6 l	9.2 l	10	8.3	7.7	4.5
16	IL96-24851-1	8.3 l	11.2 l	20	2.3	10.7	0.3
17	ARAPAHOE	9.5 l	11.4 l	16	6.7	12.0	3.3
18	NE97V121	13.6 l	18.2 l	24	12.3	14.0	4.1
19	NE99445	10.2 l	11.4 l	14	8.7	15.0	2.9
20	NE98466	10.5 l	12.5 l	16	9.0	15.7	1.2
21	KY94C-0094-11-2	8.4 l	9.9 l	14	5.7	13.3	0.5
22	KY93C-0403-23-1	11.4 l	12.4 l	18	6.7	19.3	1.6
23	KY93C-1238-34-1	6.7 l	11.9 l	16	7.7	8.7	
24	MO980829	8.4 l	12.2 l	20	4.3	9.0	0.3
25	MO981020	6.6 l	8.4 l	10	6.7	9.3	0.3
26	MO011175	10.7 l	13.9 l	20	7.7	13.3	2.0
27	MO011174	9.3 l	12.4 l	20	4.7	12.3	0.3
28	MO010708	11.7 l	15.2 l	26	4.3	15.0	1.4
29	MO010719	12.5 l	16.0 l	22	10.0	17.7	0.3
30	OH738	13.4 l	15.0 l	22	8.0	23.3	0.3
31	OH743	9.1 l	10.5 l	12	9.0	15.3	0.3
32	OH750	11.6 l	17.7 l	28	7.3	10.7	0.3
33	OH751	12.7 l	18.2 l	30	6.3	14.0	0.5
34	OH753	9.3 l	13.0 l	20	6.0	9.3	2.0
35	OH736	15	19.2 l	28	10.3	20.5	1.0
36	RCATL33	13.2 l	20.5 l	30	11.0	11.7	0.3
37	RCATL10	16.3	23.5 l	32	15.0	17.7	0.6
38	RCATL13	29.6 h	51.0 h	84	18.0	14.7	1.5
39	RCATTF19/26	8.9 l	11.7 l	20	3.3	10.7	1.4
40	RCATTF2/4	14.1 l	17.9 l	26	9.7	20.3	0.6
41	RCATTF17/34	28.3 h	48.1 h	72	24.2	16.0	1.0
42	VA01W448	14.4	20.9 l	34	7.7	15.7	0.3
43	VA02W694	3.3 l	5.7 l	6	5.4	10.7	.
44	VA02W708	7.4 l	10.5 l	18	3.0	8.3	0.3
45	VA02W709	11.4 l	16.6 l	28	5.2	12.0	0.3
46	VA02W729	10.6 l	13.4 l	20	6.7	14.7	1.1
47	VA02W734	13.6 l	19.9 l	32	7.8	14.3	0.3
48	D6234	18.2	27.2	44	10.3	18.1	0.3
49	E0009	8.4 l	11.7 l	16	7.3	10.0	0.3
50	E0010	16	24.0 l	36	12.0	15.7	0.3
51	F0008	24.5 h	37.6 h	52	23.2	19.7	3.0
52	ERNIE	17.3	26.2	46	6.3	15.3	1.7
53	PIONEER 2545	21.2 h	29.2	46	12.3	26.0	0.6
54	FREEDOM	14.6	22.4 l	36	8.7	13.3	0.6
	AVERAGE	13.4	18.9	29.3	8.6	13.9	1.3
	R2	0.76	0.81				
	CV	57.3	50.0		36.7	19.2	
	LSD	10.8	19.0		4.3	6.9	

† Indicates a mean that is not different from the lowest (l) or highest (h) mean in the column based on $LSD_{(0.05)}$

Table 14. Greenhouse disease severity (% infected spikelets) for entries in 2003 NUWWSN.

		AVG		AR+MI +MO		ARF	MI	MO	KY	VA
1	P.97397E1-11	23.4	l†	22.1	l	7	53.3	6.0	36.1	14.7
2	P.981227A1-1	43.9		47.5		26	95.5	20.9	55.7	21.3
3	P.981233A1-10	21.9	l	23.0	l	7	52.5	9.4	30.1	10.7
4	P.981238A1-1	35.0	l	33.0	l	10	72.5	16.5	65.7	10.1
5	P.981359C1-4	34.7	l	42.3		15	94.1	17.7	27.0	19.5
6	P.99646C2-7	64.1	h	59.6		37	99.3	42.5	84.3	57.4
7	NY89064SP-7139*	39.2	l	37.1		9	92.7	9.6	62.0	22.6
8	NY89052SP-9232	59.1	h	48.6		20	98.4	27.4	81.3	68.2
9	CALEDONIARESEL-VT	58.8	h	54.2		28	86.1	48.6	61.1	70.1
10	NY88046-8138	43.0		45.2		10	90.9	34.8	60.8	18.4
11	NY89052-7142	57.9	h	51.1		37	96.5	19.8	60.5	75.7
12	IL97-6755	30.4	l	33.5	l	9	67.9	23.6	30.8	20.5
13	IL99-13436	49.8		61.9		23	100.0	62.8	29.0	34.3
14	IL99-27048	37.2	l	38.9		14	75.6	27.1	50.7	18.5
15	IL97-4915	47.0		38.2		16	83.0	15.7	74.0	46.5
16	IL96-24851-1	27.1	l	23.2	l	10	54.5	5.2	51.0	14.9
17	ARAPAHOE	53.4	h	40.1		19	57.0	44.2	93.8	52.8
18	NE97V121	49.7		53.5		25	96.0	39.4	77.4	10.7
19	NE99445	59.7	h	63.3	h	45	93.4	51.6	53.2	55.3
20	NE98466	47.7		49.6		21	88.4	39.5	73.5	16.1
21	KY94C-0094-11-2	43.0		45.5		15	93.4	28.2	50.3	27.9
22	KY93C-0403-23-1	71.4	h	82.3	h	79	94.6	73.2	69.0	41.2
23	KY93C-1238-34-1	46.8		41.5		35	78.6	10.9	90.1	19.4
24	MO980829	24.9	l	23.4	l	12	51.3	6.9	38.3	15.8
25	MO981020	26.1	l	18.0	l	12	37.6	4.4	61.0	15.5
26	MO011175	41.6		43.8		15	83.8	32.5	69.4	7.5
27	MO011174	24.3	l	15.2	l	14	20.3	11.3	64.0	12.1
28	MO010708	34.6	l	37.3		12	89.8	10.2	43.2	17.9
29	MO010719	41.1		34.7	l	9	86.4	8.6	75.7	26.0
30	OH738	45.3		51.6		34	98.8	21.9	40.2	31.8
31	OH743	33.8	l	38.2		22	78.5	14.2	42.4	11.9
32	OH750	51.2		50.4		11	86.4	53.9	75.6	29.3
33	OH751	37.0	l	34.3	l	13	76.5	13.5	56.3	25.6
34	OH753	48.6		48.9		30	79.8	36.9	72.4	24.1
35	OH736	50.4		58.9		41	93.6	42.0	59.5	16.0
36	RCATL33	46.2		43.6		27	81.4	22.5	35.1	65.1
37	RCATL10	34.7	l	43.2		20	86.6	23.1	24.3	19.3
38	RCATL13	65.9	h	75.6	h	72	85.0	69.7	76.8	26.2
39	RCATTF19/26	51.9		48.2		21	93.9	29.8	76.2	38.6
40	RCATTF2/4	56.2	h	62.1		28	91.9	66.5	54.8	39.8
41	RCATTF17/34	61.2	h	65.1	h	37	90.8	67.4	76.2	34.5
42	VA01W448	47.9		53.5		39	89.1	32.4	62.6	16.4
43	VA02W694	61.5	h	72.7	h	51	96.3	70.7	66.8	22.7
44	VA02W708	31.5	l	30.3	l	8	48.6	34.4	60.0	6.7
45	VA02W709	29.8	l	16.1	l	7	39.3	1.9	90.8	10.2
46	VA02W729	44.9		50.9		22	100.0	30.6	60.9	11.0
47	VA02W734	55.0	h	72.0	h	57	98.3	60.7	48.4	10.5
48	D6234	45.8		50.9		29	92.0	31.6	54.6	21.8
49	E0009	36.6	l	28.7	l	16	60.0	10.1	69.3	27.6
50	E0010	36.8	l	40.4		19	94.1	8.0	50.9	12.2
51	F0008	50.5		59.8		36	100.0	43.3	34.5	38.5
52	ERNIE	27.6	l	30.6	l	9	71.7	11.0	26.7	19.4
53	PIONEER 2545	43.5		53.4		34	99.4	26.8	37.1	20.0
54	FREEDOM	37.8	l	37.1		15	81.2	15.2	31.7	45.7
	AVERAGE	43.9		44.9		23.9	81.4	29.4	57.5	27.2
	R2	0.78		0.90						
	CV	34.3		27.1					31.1	
	LSD	18.7		19.7		23			41.2	

† Indicates a mean that is not different from the lowest (l) or highest (h) mean in the column based on $LSD_{(0.05)}$

Table 15. Correlations among entry means for traits, as averaged over appropriate 2003 NUWWSN tests. See Table 3 for explanation of the trait codes.

	INC	SEV	IND	KR	PSS	DON	GH	HD	HGT
INC	1.00	0.78 **	0.84 **	0.52 **	0.71 **	0.50**	0.44 **	0.09	-0.28
SEV	0.78 **	1.00	0.90 **	0.37 *	0.62 **	0.40 **	0.60 **	0.03	-0.20
IND	0.84 **	0.90 **	1.00	0.46 **	0.73 **	0.48 **	0.60 **	-0.03	-0.36
KR	0.52 **	0.37 *	0.46 **	1.00	0.61 **	0.40 **	0.34 *	0.21	-0.01
PSS	0.71 **	0.62 **	0.73 **	0.61 **	1.00	0.42 **	0.45 **	0.03	-0.40
DON	0.50 **	0.40 **	0.48 **	0.44 **	0.42 **	1.00	0.39 **	0.21	-0.05
GH	0.44 **	0.60 **	0.60 **	0.34 *	0.45 **	0.39 **	1.00	-0.02	-0.08
HD	0.09	0.03	-0.03	0.21	0.03	0.21	-0.02	1.00	0.46
HGT	-0.28	-0.20	-0.36	-0.01	-0.40	-0.05	-0.08	0.46	1.00

*, ** indicate significance at the 0.05, and 0.01 probability levels, respectively.

Table 16. Height and other traits for entries in 2003 NUWWSN

		AVG HGT (in.)	KY HGT (in.)	MO HGT (in.)	VA HGT (in.)	IN # Diseased Spikelets	NY % Heads with ≥1/2 infected spikelets	AR % SR[1]	AR % SLB[2]	AR % GR LVS[3]
1	P.97397E1-11	32.6 l[†]	34	33.1	30.7	0.9	0.1	0	64	41
2	P.981227A1-1	35.8	37	36.2	34.3	1.5	0.7	4	55	58
3	P.981233A1-10	33.0 l	33	32.3	33.7	1.5	0.7	14	54	48
4	P.981238A1-1	33.8 l	36	33.1	32.3	3.4	0.7	17	45	39
5	P.981359C1-4	39.2 l	39	37.8	40.7	1.1	0.2	0	2	80
6	P.99646C2-7	34.6 l	37	34.7	32.0	8.5	0.7	0	37	78
7	NY89064SP-7139*	36.3	39	33.9	36.0	3.6	0.3	50	22	36
8	NY89052SP-9232	38.1 l	36	41.4	37.0	3.6	0.5	30	10	41
9	CALEDONIARESEL-VT	41.0 l	42	39.4	41.7	7.3	0.2	20	8	69
10	NY88046-8138	38.1 l	38	34.7	41.7	5.2	0.4	75	11	15
11	NY89052-7142	40.6 l	42	38.2	41.7	2.1	0.3	22	30	60
12	IL97-6755	40.7 l	41	39.0	42.0	1.3	0.7	2	20	69
13	IL99-13436	32.1 l	33	33.1	30.3	3.3	0.4	0	43	73
14	IL99-27048	34.2 l	33	36.2	33.3	1.7	0.7	0	25	78
15	IL97-4915	35.5	36	36.6	34.0	8.8	1.4	7	50	45
16	IL96-24851-1	35.3	39	33.9	33.0	1.4	0.2	38	29	31
17	ARAPAHOE	38.5 l	38	39.4	38.0	4.1	0.5	1	20	64
18	NE97V121	35.7	35	37.4	34.7	1.5	3.1	0	63	45
19	NE99445	34.9 l	34	36.6	34.0	11.7	3.2	0	68	10
20	NE98466	37.6	38	38.2	36.7	1.9	0.7	8	20	60
21	KY94C-0094-11-2	34.6 l	37	35.1	31.7	2.3	0.3	1	32	14
22	KY93C-0403-23-1	31.6 l	32	30.7	32.0	5.4	2.3	38	50	2
23	KY93C-1238-34-1	33.1 l	33	33.1	33.3	3.1	2.9	7	37	45
24	MO980829	39.0 l	39	39.0	39.0	1.9	0.1	0	4	78
25	MO981020	34.9 l	35	35.5	34.3	0.9	0.0	0	15	77
26	MO011175	41.2 l	37	43.3	43.3	2.3	1.4	2	20	75
27	MO011174	37.8	35	41.4	37.0	1.4	0.5	0	8	87
28	MO010708	36.4	38	36.6	34.7	0.8	0.4	1	12	87
29	MO010719	41.2 l	40	40.2	43.3	0.8	0.4	0	17	71
30	OH738	36.0	35	37.0	36.0	1.9	2.3	0	29	83
31	OH743	36.3	35	37.0	37.0	1.5	0.4	0	24	78
32	OH750	37.7	36	38.2	39.0	2.2	0.3	15	6	73
33	OH751	36.9	35	36.6	39.0	1.9	0.4	60	40	14
34	OH753	35.5	35	37.4	34.0	5.1	0.3	83	50	5
35	OH736	35.5	33	34.3	39.3	1.8	0.2	15	6	66
36	RCATL33	40.4 l	37	41.0	43.3	3.7	0.1	12	41	59
37	RCATL10	39.3 l	38	38.6	41.3	2.6	0.1	65	14	73
38	RCATL13	35.0	39	34.3	31.7	3.4	3.1	13	45	59
39	RCATTF19/26	34.1 l	35	34.7	32.7	4.5	0.3	65	55	20
40	RCATTF2/4	36.3	35	37.8	36.0	4.4	0.6	81	23	36
41	RCATTF17/34	32.9 l	33	33.1	32.7	5.5	2.9	13	36	46
42	VA01W448	32.7 l	36	30.7	31.3	0.7	0.7	1	29	78
43	VA02W694	32.5 l	32	33.5	32.0	4.5	0.5	50	68	1
44	VA02W708	34.6 l	37	33.9	33.0	1	0.3	0	40	74
45	VA02W709	31.7 l	34	31.1	30.0	0.8	0.3	25	71	50
46	VA02W729	33.1 l	35	33.5	30.7	1	0.2	0	15	55
47	VA02W734	34.6 l	36	34.7	33.0	4.3	5.1	0	69	76
48	D6234	36.1	35	37.0	36.3	2	0.3	60	40	50
49	E0009	37.6	40	36.6	36.3	1.6	0.1	8	3	81
50	E0010	37.4	39	35.1	38.0	2.7	0.2	8	5	74
51	F0008	35.8	39	36.6	31.7	2.5	3.4	73	36	8
52	ERNIE	33.0 l	34	33.9	31.0	3.4	1.3	38	55	13
53	PIO. 2545	34.6 l	35	35.1	33.7	2	3.1	17	40	73
54	FREEDOM	37.5	39.0	35.5	38.0	0.8	0.0	25	56	46
	AVERAGE	36.0	36.4	36.1	35.6	2.95				
	R2	0.72				0.49				
	CV	5.6	4.9	3.3	4.4	79.4				
	LSD	3.3	5.2	4.2	2.1	1.99		4	17	22

[†] Indicates a mean that is not different from the lowest (l) or highest (h) mean in the column based on $LSD_{(0.05)}$

1, SR = Stripe rust from Fayetteville; 2, SLB = Septoria Leaf Blotch from Fayetteville,; 3 = Green leaf area where most discoloration was due to Septoria, Kibler