

Report on the 2015-2016 Northern Uniform Winter Wheat Scab Nurseries (NUWWSN and PNUWWSN)

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INTRODUCTION

The objective of the Northern Uniform Winter Wheat Scab Nursery (NUWWSN) and the Preliminary Northern Uniform Winter Wheat Scab Nursery (PNUWWSN) is to screen winter wheat genotypes adapted to the northern portion of the eastern US for scab resistance. Breeders submit entries each also conducts the trial in inoculated and misted FHB nurseries within their programs. Data is then sent to the coordinator for summation and distribution. Public and private breeders submit lines using their own criteria for inclusion though all must be adapted. Entries vary in the degree of pretesting and selection and their purpose (germplasm, cultivars). Most of the entries have only native resistance though some have undergone MAS for *Fhb1* and other QTL.

MATERIAL AND METHODS

The locations that reported data and the traits assessed are listed in Tables 1, 2 and 3. The NUWWSN had 50 entries (46 lines & four checks, Table 4) from 12 programs and we obtained phenotypic data on seven traits from 14 locations. The PNUWWSN had 42 entries (38 lines & four checks, Table 5) from 10 programs and we obtained phenotypic data from 12 locations. Cooperators collect replicated data and submit means to the coordinator. The means from individual locations are used in an analysis over locations. The genotype x environment interaction (GEI) term is the error and is used to calculate an LSD (0.05). The LSD value is used to determine if a particular entry mean is statistically equal to the lowest entry mean (such values are designated with an "l") or the highest entry mean (such values are designated with an "h") for each trait. Variance components were estimated using PROC MIXED from SAS considering entries and locations to be random.

RESULTS

The mean for each entry over all environments for all FHB traits are shown in tables 10 and 11. The entry mean heritability was moderate for all FHB traits though the ratio of genetic variance to error variance was < 0.50 for most traits (Table 7). We observed good levels of FHB resistance in the 2016 uniform tests, though perhaps not as quite as good as in the 2015 and 2014 tests.

- 58.7% of the entries in the PNUWWSN and the NUWWSN had an FHB index < that of Freedom (this was 68% in 2015, 69% in 2014, and 90% in 2013)
- Only 2.2% of the PNUWWSN and the NUWWSN entries had an FHB index < that of Truman (vs 23% in 2015, 4% in 2015 and 24% in 2013)
- 40.2% of the PNUWWSN and NUWWSN entries had less DON than Freedom (vs 83% in 2015, 90% in 2014, and 65% in 2014)
- 19.6% of the PNUWWSN and the NUWWSN entries had less DON than Truman (vs 63% and 35% in 2015 and 2014)
- In the NUWWSN, 7 of 50 entries (14%) were not significantly different than the most resistant entry for all six FHB traits with an LSD while 8 of 42 entries (19.0%) in the PNUWWSN were not different than the most resistant entry for all six FHB traits (Tables 10 & 11).

While the percentage of line < Freedom of Truman were somewhat lower than in recent years, there were very few entries placed in the “worst” category in either test (Tables 8 and 9) (“worst” is defined as being not significantly different from worst entry for five or more of the six FHB traits where an LSD was calculated).

Most of the entries have only native resistance (e.g. not from Asia, or South America) though the frequency of the resistant alleles at *Fhb1* was 0.208 among all 84 breeding lines in the P+NUWWSN tests (Tables 30 and 31).

Most of FHB traits were positively correlated in the NUWWSN and PNUWWSN where the correlations among INC, SEV, IND, FDK, ISK, and DON all exceeded 0.49 in both tests. Of the 30 possible correlations among INC, SEV, IND, FDK, ISK, and DON, 25 exceeded 0.60 (Tables 6a and b). This is reflected in the PC analysis of the data FHB traits (INC, SEV, IND, FDK, ISK, DON, GH) where the first PC accounted for > 70% of the variation in both tests (Figs. 1 & 2). Heading date and height were not highly correlated to any FHB traits in either test: the only significant correlations were DON/HD (0.29) and INC/HGT (-0.35) in the NUWWSN.

The tables in this report are created from excel files that are available from Clay Sneller (sneller.5@osu.edu).

Table 1. Fusarium Head Blight and other traits assessed in 2015-16 P+NUWWSN

Code	Trait	Description
INC	Disease incidence	% of heads with at least one infected spikelets
SEV	Disease severity from field tests	% of infected spikelets in an infected head.
IND	Disease index	$IND = (SEV \times INC) / 100$
FDK	Fusarium damaged kernels	Either a visual assessment of the percent infected kernels, or a percent of scabby seed by weight
ISK	Composite of head and kernel traits	$ISK \text{ Index} = .3 (\text{Severity}) + .3 (\text{Incidence}) + .4 (\text{FDK})$
DON	DON (vomitoxin)	PPM of vomitoxin in grain
GH	Greenhouse severity	Same as SEV except from greenhouse
HD	Heading Date	Julian date when 50% of spikes have emerged from the boot
HGT	Plant Height	Height in inches from soil to top of spike of a typical plant

Table 2. Cooperators in the 2015-2016 P+NUWWSN

ENV CODE	LOCATION	NUWWSN	PNUWWSN	COOPERATORS	INSTITUTE	CODE
ILCHA	Champaign, IL	yes	yes	Jana Murche	KWS Cereals	KWS
ILURB	Urbana, IL	yes	yes	Fred Kolb, Eric Brucker	University of Illinois	UIL
ILHIG	Highland Bottom	yes	no	Jennifer Vonderwall	Syngenta	SYN
INLAF	Lafayette, IN	yes	yes	Don Obert	Limagrain	LIM
INWLA	W. Lafayette, IN	yes	yes	Mohsen Mohammadi	Purdue University	PUR
KYLEX	Lexington, KY	yes	yes	David Van Sanford	University of Kentucky	UKY
MIELA	East Lansing, MI	yes	yes	Eric Olson, Lee Siler	Michigan State University	MSU
MOCOL	Columbia, MO	yes	yes	Anne McKendry,	University of Missouri	UMO
NEMEA	Mead, NE	yes	no	Stephen Baenziger, S Wegulo	University of Nebraska	UNE
NYITH	Ithaca, NY	yes	no	Mark Sorrells, Gary Bergstrom	Cornell University	COR
OHNAP	Napoleon, OH	yes	yes	Don Obert	Limagrain	LIM
OHWOO	Wooster, Ohio	yes	yes	Clay Sneller, Pierce Paul	The Ohio State University	OSU
VABLA	Blacksburg, VA	yes	yes	Carl Griffey	Virginia Tech	VAT
VAWAR	Warsaw, VA	yes	yes	Carl Griffey	Virginia Tech	VAT

Table 3. Means for each trait and each location for the 2015-2016 P+NUWWSN. PM=powdery mildew, LR = leaf rust, YR = yellow rust

NUWWSN	INC	SEV	IND	FDK	ISK	DON	HD	HGT	Yield	Test Wgt	PM	LR	YR	Foliar Rating
	%	%	%	%	%	ppm	days	inches	bu/ac	lbs/bu	0-9	0-9	0-9	0-9
ILCHA	46.8	34.6	16.6				130.7						4.1	
ILHIG	56.1	28.0	17.5										5.1	
ILURB	56.9	45.0	30.4	25.9	41.0	1.7								
INWLA		20.5					137.6	39.9					5.1	
KYLEX	55.2	20.0	11.8	7.0	25.4	16.2	124.4	33.5						
MIELA	17.5	37.9	8.4				148.0							
MOCOL	67.0	15.7	11.2	31.6	37.5		129.4							
NEMEA	97.9	18.0	17.7	17.1	41.6	-2.5								
NYITH	25.0	4.8	2.6	21.3	17.5		148.3							
OHWOO			34.3	26.1	31.0	21.6	138.9							3.3
VABLA	55.9	15.0	9.4	38.2	36.5	5.8	116.2	30.1						
VAWAR									60.4	57.7	3.5	3.9		

PNUWWSN	INC	SEV	IND	FDK	ISK	DON	HD	HGT	Yield	Test Wgt	PM	LR	YR	Foliar Rating
	%	%	%	%	%	ppm	days	inches	bu/ac	lbs/bu	0-9	0-9	0-9	0-9
ILCHA	49.4	37.6	20.2				131.0						4.2	
INLAF							129.5						5.0	
ILHIG	67.4	32.1	24.1										5.0	
ILURB	59.8	48.5	31.4	33.8	46.0	1.9								
INWLA		25.8					137.3	39.9						
KYLEX	61.9	22.9	15.0	5.9	27.8	16.3	124.7	34.8						
MIELA	41.8	36.2	18.4				146.6							
MOCOL	72.1	16.9	12.7	28.9	38.2		129.7							
OHNAP							144.0	38.1	95.9					
OHWOO			36.2	24.8	31.6	21.9	139.5							5.9
VABLA	43.1	14.9	7.3	35.8	31.7	3.1	116.1	29.5						
VAWAR									61.6	57.5	3.4	4.0		

Table 4. Entries in the 2015-2016 NUWWSN

ENTRY	SOURCE	NAME	PEDIGREE
1	UMO	TRUMAN	
2	OSU	FREEDOM	
3	UMO	ERNIE	
4	PIO	PIONEER2545	
5	OSU	OH10-219-65	P.99608C1-1-3/BRANSON
6	OSU	OH09-207-68	M99*3098/OH743
7	OSU	OH08-206-69	P.92226E2-5-3/OH751
8	OSU	OH11-118-18	P.99840C4-8-3-6/(5x690=TRUMAN/IL00-8061)
9	KWS	KWS060	Branson/M05-1526
10	KWS	KWS072	IL00-8530/P99840C4-8-4//B030543/P99840C4-8-4
11	KWS	KWS074	USG3555/Shirley
12	KWS	KWS078	MO011126*/W06202B7202
13	UKY	KY09C-0052-26-12-3	USG 3350//IL02-19463/VA01-476
14	UKY	X08C-1070-73-18-1	KY97C-0519-04-07/P.03630A1-18
15	UKY	X09-0187-112-14-1	KY97C-0519-04-07//KY97C-0508-01-01A-1/M03-3616
16	UKY	KY09C-1024-96-1-3	SS MPV-57/KY02C-3007-41
17	UKY	KY09C-0601-39-8-1	KY97C-0519-04-07//MD01W233-06-1/0128A1-22
18	COR	NY05158-833	Va97w-375ws/NY87048W-7388
19	COR	NY05158-864	Va97w-375ws/NY87048W-7388
20	COR	NY05158-841	Va97w-375ws/NY87048W-7388
21	COR	NY05158-859	Va97w-375ws/NY87048W-7388
22	COR	NY99069-352	P25W33/Caledonia
23	VAT	VA14W-6	Jamestown (VA02W-370) / Shirley (VA03W-409) // SS8404† (Permission required for Parent Use)
24	VAT	VA10W-21BSR124	Z00-5018 (U90-1A//ZX90-2C1/P2580) / VA01W-158 (PION2643/VA94-54-331)
25	VAT	VA14FHB-22	VT-FHB Recurrent Seln: Developed using original population from Mary Guettieri
26	VAT	VA14FHB-31	VT-FHB Recurrent Seln: Developed using original population from Mary Guettieri
27	MSU	MI14R0233	E1009 / MO 050699
28	MSU	MI14R0082	Crystal / KY02C-3005-25
29	MSU	MI14W0217	E5011B // MO 050699 / Truman
30	MSU	MI14R0080	Crystal / VA06W-553
31	MSU	MI14R0109	Red Ruby / VA06W-553
32	PUR	0762A1-2-8	981129A1-45-3/99793RE2-3//INW0301/92145E8-7-7-3-57/3/981477A1/981312A1//INW0316
33	PUR	05247A1-7-3-108-2	99840C4/5/INW0315/3/INW0301MADSEN//INW0315/4/97395B1/6/99840C4//99794RA1
34	PUR	0566A1-3-1-52	INW0412/6/9017C1//92823A1/9218B4/3/P107/4/PATT/5/ACC3130/PATT/7/992060G1-1
35	PUR	05247A1-7-3-120	99840C4/5/INW0315/3/INW0301MADSEN//INW0315/4/97395B1/6/99840C4//99794RA1
36	PUR	04620A1-1-7-4-17	TRUMAN/9017C1//92823A1/9218B4/3/P107/4/PATT/5/INW9811/GLD//96204A1
37	LIM	ES14-0937	BWX5170/B030543
38	LIM	ES14-1398	SR7193J/Branson
39	LIM	ES14-1860	B980582/M98-2023
40	LIM	ES14-1847	X93-68B1/9823-h2
41	UIL	IL10-21934	IL97-1828 / IL03-18438 // IL00-8633
42	UIL	IL10-21937	IL97-1828 / IL03-18438 // IL00-8633
43	UIL	IL11-6543	IL97-1828 / IL02-18228
44	UIL	IL11-28222	IL02-18228 / IL01-16170 // M 03-3616
45	UIL	IL12-5110	IL97-1828 / IL06-13878
46	UNE	NE13625	
47	UNE	NE13515	
48	UNE	NE05548	
49	UNE	NE13604	
50	UNE	NI12702W	

Table 5. Entries in the 2015-2016 PNUWWSN

ENTRY	SOURCE	NAME	PEDIGREE
1	UMO	TRUMAN	
2	OSU	FREEDOM	
3	UMO	ERNIE	
4	PIO	PIONEER2545	
5	OSU	OH10-316-20	M99-2408/OH02-12686
6	OSU	OH12-263-1	M03-3616/MO050699
7	OSU	OH12-195-22	SHIRLEY/992178A3-1-1
8	OSU	OH12-223-12	MO011126/6x140,F2-M=PIO25R47/E1007,F2
9	OSU	OH12-319-13	SHIRLEY//PIO25R47/OH02-12686
10	OSU	OH12-140-13	SHIRLEY/6x136=PIO25R47//ILO1-16170F1
11	KWS	KWS081	Truman/SEMO9813-21
12	KWS	KWS083	Roane/Sunburst
13	KWS	KWS085	P99840C4-8-4/LA02*459
14	KWS	KWS087	Shirley/P992231A1-2-1
15	KWS	KWS086	D8006(P2555/Lowell)/Shirley(VA94-52-25/Coker9835//VA96-54-234)
16	UKY	KY09C-0128-72-2-1	SSMPV-57//ILO2-19463/0128A1-22
17	UKY	X08C-1232-30-6-3	KY97C-0574-01-04/MD01W233-06-1
18	UKY	X08C-1108-20-4-5	Pembroke08/P.0128A1-44-1-7
19	UKY	KY09C-1021-36-20-3	KY97C-0519-04-07/KY02C-3007-41
20	UKY	KY09C-1024-97-9-5	SS MPV-57/KY02C-3007-41
21	VAT	VA14W-41	VA06W-112 (VA97W-533 / VA98W-586) / VA06W-256 (McCORMICK"S" / VAN99W-97)
22	VAT	DH11SRW063-14	Yorktown (VA08W-294) / GA08279-G3-G1-G8 (991371-6E13*3 / 051710: Lr19/Sr25)
23	VAT	VA15FHB-11	VA07W-643 [COKER 9474(SCAB RES)/ McCormick"S" (VA98W-590)] / VA07W-568 [ROANE / ERNIE// McCORMICK], F6
24	VAT	VAMD10422-98	MD03-69-15 / Yorktown
25	VAT	13VA-FHB-DH131	MD03W61-09-7 / Jamestown // GA04570-10E46
26	VAT	13VA-FHB-DH192	MD03W61-09-7 / Jamestown // GA04570-10E46
27	MSU	MI14R0180	E5011B / VA05W-775
28	MSU	MI14R0235	E1009 / MO 050699
29	MSU	MI14W0447	FHB 12 X MSU Line E1007W
30	MSU	MI14W0604	Goldfield/CJ 9815//D6234/3/D6234/4/D6234
31	MSU	MI14R0112	Red Ruby / VA06W-553
32	MSU	MI14W0464	TEMPLE / MSU D6234
33	PUR	0527A1-9-14-4-3-1-1	99751D8-2-3/96169RE2-3-6-1-4/3/7D(E)//97462A1-21-1-5-1-15/INW0412
34	PUR	0566A1-3-1-6	INW0412/6/9017C1//92823A1/9218B4/3/P107/4/PATT/5/ACC3130/PATT/7/992060G1-1
35	PUR	05247A1-7-3-120	99840C4/5/INW0315/3/INW0301MADSEN//INW0315/4/97395B1/6/99840C4//99794RA1
36	PUR	0566A1-3-1-51	INW0412/6/9017C1//92823A1/9218B4/3/P107/4/PATT/5/ACC3130/PATT/7/992060G1-1
37	PUR	05247A1-7-3-114	99840C4/5/INW0315/3/INW0301MADSEN//INW0315/4/97395B1/6/99840C4//99794RA1
38	UIL	IL12-8545	ILO1-34159 / IL 02-18228
39	UIL	IL12-13746	ILO4-24668 / ILO1-16170
40	UIL	IL12-14179	ILO5-28110 / ILO2-18228
41	UIL	IL12-26448	ILO1-34159 / ILO4-10721 // ILO4-11003
42	UIL	IL12-30879	ILO5-38426 / VA-FE24-4-6 // ILO4-11003

Tables 6a and b. Correlation of traits in the 2015-2016 P+NUWWSN. Grey values are significant at $p < 0.05$. Bold values are > 0.59 .

a. NUWWSN

	INC	SEV	IND	FDK	ISK	DON	GHSEV	HD	HGT
INC		0.77	0.86	0.59	0.80	0.49	0.22	-0.12	-0.35
SEV	0.77		0.95	0.64	0.83	0.61	0.45	-0.09	-0.01
IND	0.86	0.95		0.66	0.87	0.62	0.37	0.03	-0.03
FDK	0.59	0.64	0.66		0.89	0.57	0.48	0.03	-0.14
ISK	0.80	0.83	0.87	0.89		0.70	0.50	0.11	-0.05
DON	0.49	0.61	0.62	0.57	0.70		0.39	0.29	0.24
GHSEV	0.22	0.45	0.37	0.48	0.50	0.39		0.07	0.09
HD	-0.12	-0.09	0.03	0.03	0.11	0.29	0.07		0.57
HGT	-0.35	-0.01	-0.03	-0.14	-0.05	0.24	0.09	0.57	

b. PNUWWSN

	INC	SEV	IND	FDK	ISK	DON	GHSEV	HD	HGT
INC		0.76	0.85	0.67	0.79	0.56	0.26	0.00	-0.21
SEV	0.76		0.96	0.78	0.90	0.71	0.36	0.12	0.03
IND	0.85	0.96		0.80	0.93	0.68	0.32	0.14	0.03
FDK	0.67	0.78	0.80		0.91	0.53	0.23	0.17	-0.07
ISK	0.79	0.90	0.93	0.91		0.69	0.30	0.22	0.03
DON	0.56	0.71	0.68	0.53	0.69		0.44	0.16	0.24
GHSEV	0.26	0.36	0.32	0.23	0.30	0.44		-0.20	0.00
HD	0.00	0.12	0.14	0.17	0.22	0.16	-0.20		0.54
HGT	-0.21	0.03	0.03	-0.07	0.03	0.24	0.00	0.54	

Table 7. Summary of variance components and their ratios from the 2015-2016 P+NUWWSN. Entry mean h^2 was calculated as $V_g/(V_g+(V_{error}/e))$ where e is the number of environments.

NUWWSN	INC	SEV	IND	FDK	ISK	DON	HD	HGT
Environment	537	147	95	99.6	77.3	92.5	25.5	24.5
Genotype	66.54	31	29.6	42.1	44.3	14.5	5.8	9.8
Error	228.7	118.5	88.9	141	81.4	44.2	3.9	1.6
# Envs	9	10	10	7	7	5	8	3
$V_g/(V_g+V_{error})$	0.23	0.21	0.25	0.23	0.35	0.25	0.60	0.86
V_g/V_{error}	0.29	0.26	0.33	0.30	0.54	0.33	1.49	6.13
"h2"	0.72	0.72	0.77	0.68	0.79	0.62	0.92	0.95
PNUWWSN	INC	SEV	IND	FDK	ISK	DON	HD	HGT
Environment	135.2	126.9	89.6	141	50	96.8	93.1	20.8
Genotype	105.7	53	54.1	38.4	51.4	18.4	3	4.4
Error	231.3	136.7	109	137.4	69.2	39.5	1.9	2.3
# Envs	7	8	8	5	5	4	7	3
$V_g/(V_g+V_{error})$	0.31	0.28	0.33	0.22	0.43	0.32	0.61	0.66
V_g/V_{error}	0.46	0.39	0.50	0.28	0.74	0.47	1.58	1.91
"h2"	0.76	0.76	0.80	0.58	0.79	0.65	0.92	0.85

Table 8. Best (top) and worst (bottom) entries in the 2015-2016 NUWWSN. Summary statistics are over all entries.

NAME	INC	SEV	IND	FDK	ISK	DON	GHSEV	PC1	#l	#h	Fhb1	HD	HGT
OH11-118-18	33.2 |	13.1 |	4.7 |	18.5 |	20.5 |	2.3 |	4.2	-3.81	6	0	Fhb1	138.1	36.7
TRUMAN	34.4 |	15.4 |	7.7 |	16.0 |	23.0 |	5.6 |	4.5	-3.35	6	0	no	139.3 h	38.4
IL11-28222	40.7 |	14.1 |	9.1 |	12.9 |	22.1 |	1.3 |	25.2	-3.14	6	0	no	132.7	34.7
IL10-21937	42.9 |	18.2 |	10.1 |	15.6 |	22.9 |	6.3 |	9.7	-2.38	6	0	no	129.7 |	34.1
ES14-1860	47.1 |	18.2 |	10.2 |	17.4 |	25.7 |	1.5 |	11.5	-2.30	6	0	no	133.5	33.0
MI14R0082	40.7 |	17.7 |	10.8 |	22.3 |	28.5 |	1.9 |	9.3	-2.14	6	0	Fhb1	137.0	36.7
IL11-6543	45.3 |	19.5 |	10.9 |	11.3 |	21.0 |	1.3 |	10.2	-2.84	6	0	no	134.2	36.7
0762A1-2-8	40.6 |	10.7 |	5.3 |	24.8	26.0 |	2.5 |	18.1	-2.83	5	0	Fhb1	133.0	29.2 |
OH09-207-68	44.8 |	19.1 |	8.7 |	25.1	28.2 |	5.7 |	30.6	-1.35	5	0	no	132.4	36.7
IL10-21934	39.6 |	21.4	10.3 |	13.4 |	23.4 |	4.1 |	12.3	-2.51	5	0	no	129.7 |	34.2
MI14R0109	49.3	19.4 |	11.2 |	20.1 |	29.6 |	6.7 |	25.5	-1.13	5	0	no	132.4	33.5
KY09C-0052-26-12-3	45.4 |	21.3	11.8 |	15.4 |	21.5 |	1.9 |	9.7	-2.41	5	0	no	132.0	33.2
IL12-5110	48.9	18.7 |	13.1 |	17.1 |	28.8 |	3.8 |	6.7	-1.72	5	0	no	134.9	35.5
VA10W-21BSR124	67.4 h	40.9 h	29.7 h	42.7 h	49.8 h	10.8	96.4	5.48	0	5	no	131.2 |	32.9
PIONEER2545	73.9 h	41.3 h	34.7 h	46.9 h	53.2 h	20.4 h	22.0	6.25	0	6	no	136.2	35.2
AVERAGE	53.2	23.9	16.0	23.9	32.9	8.6	19.7					134.3	34.5
MINIMUM	33.2	10.7	4.7	11.3	20.5	1.3						129.3	29.2
MAXIMUM	73.9	41.3	34.7	46.9	53.2	23.2						140.2	44.2
LSD(0.05)	14.3	9.7	8.4	12.7	9.6	8.4						2.0	2.0
# ENVIRONMENTS	9	10	10	7	7	5	1					8	3

Table 9. Best and worst entries in the 2015-2016 PNUWWSN. Summary statistics are over all entries.

NAME	INC	SEV	IND	FDK	ISK	DON	GHSEV	PC1	#l	#h	Fhb1	HD	HGT
TRUMAN	30.8 |	20.5 |	9.2 |	13.2 |	22.9 |	5.9 |	7.5	-3.60	6	0	no	136.4 h	38.0
IL12-30879	34.9 |	17.8 |	9.8 |	14.4 |	18.7 |	4.2 |	21.7	-3.63	6	0	Fhb1	131.6	34.4
IL12-8545	40.9 |	18.1 |	10.5 |	11.8 |	20.6 |	3.8 |	12.5	-3.58	6	0	Fhb1	131.9	36.0
KWS085	44.7 |	20.3 |	11.0 |	19.1 |	27.5 |	9.2 |	33.3	-1.94	6	0	no	132.4	38.3
0527A1-9-14-4-3-1-1	44.5 |	21.2 |	11.4 |	17.3 |	25.5 |	10.3 |	7.5	-2.38	6	0	no	134.7	37.3
05247A1-7-3-114	45.8 |	24.6 |	12.5 |	21.5 |	27.7 |	10.5 |	47.8	-1.18	6	0	no	128.9 |	30.5 |
IL12-14179	44.8 |	19.7 |	13.6 |	16.7 |	26.0 |	4.5 |	13.4	-2.64	6	0	no	129.3 |	35.3
IL12-26448	36.9 |	21.3 |	15.0 |	17.9 |	27.4 |	2.2 |	7.6	-2.85	6	0	Fhb1	129.1 |	33.2
MI14R0180	52.5	17.9 |	11.5 |	19.9 |	27.1 |	4.9 |	8.2	-2.43	5	0	no	131.9	34.8
MI14R0235	35.4 |	23.7 |	12.9 |	22.8 |	31.5	9.3 |	37.0	-1.51	5	0	no	132.6	36.1
IL12-13746	42.5 |	27.6 |	14.0 |	21.7 |	29.8	5.9 |	11.4	-1.79	5	0	no	129.1 |	32.2 |
OH12-263-1	66.3 h	41.3 h	33.2 h	41.9 h	46.7 h	9.6 |	22.6	2.93	1	5	no	133.6	35.4
MI14W0464	62.1	44.4 h	34.4 h	42.9 h	52.7 h	22.1 h	13.0	4.06	0	5	no	135.3 h	41.1 h
PIONEER2545	80.1 h	46.3 h	41.3 h	40.7 h	51.4 h	23.1 h	29.8	5.22	0	6	no	133.1	34.3
AVERAGE	56.5	29.4	20.7	25.8	35.1	10.8						132.1	34.7
MINIMUM	30.8	17.8	9.2	11.8	18.7	2.2						128.9	30.3
MAXIMUM	80.1	49.2	41.3	42.9	52.7	26.0						136.4	41.1
LSD(0.05)	16.3	11.7	10.4	14.8	10.5	8.9						1.6	2.2
# ENVIRONMENTS	7	8	8	5	5	4	1					7	3

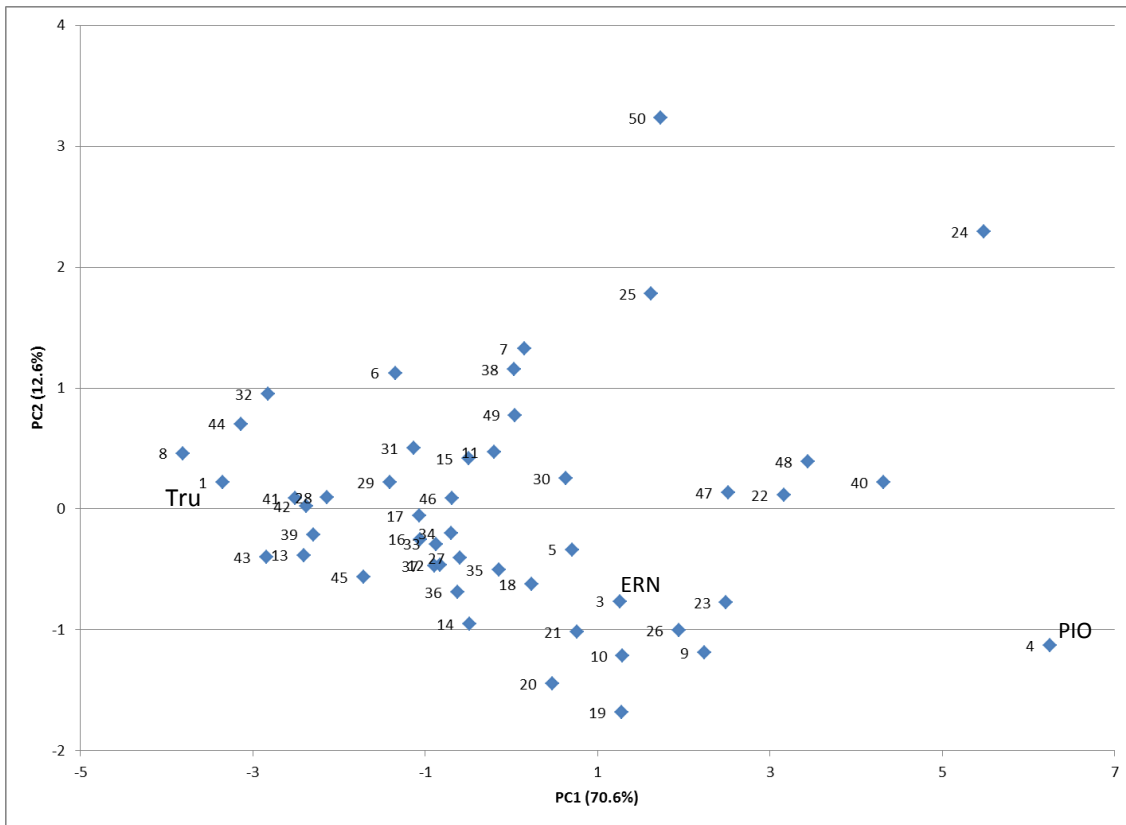


Figure 1. Graph of first two PC from the analysis of the seven FHB traits from the NUWWSN.

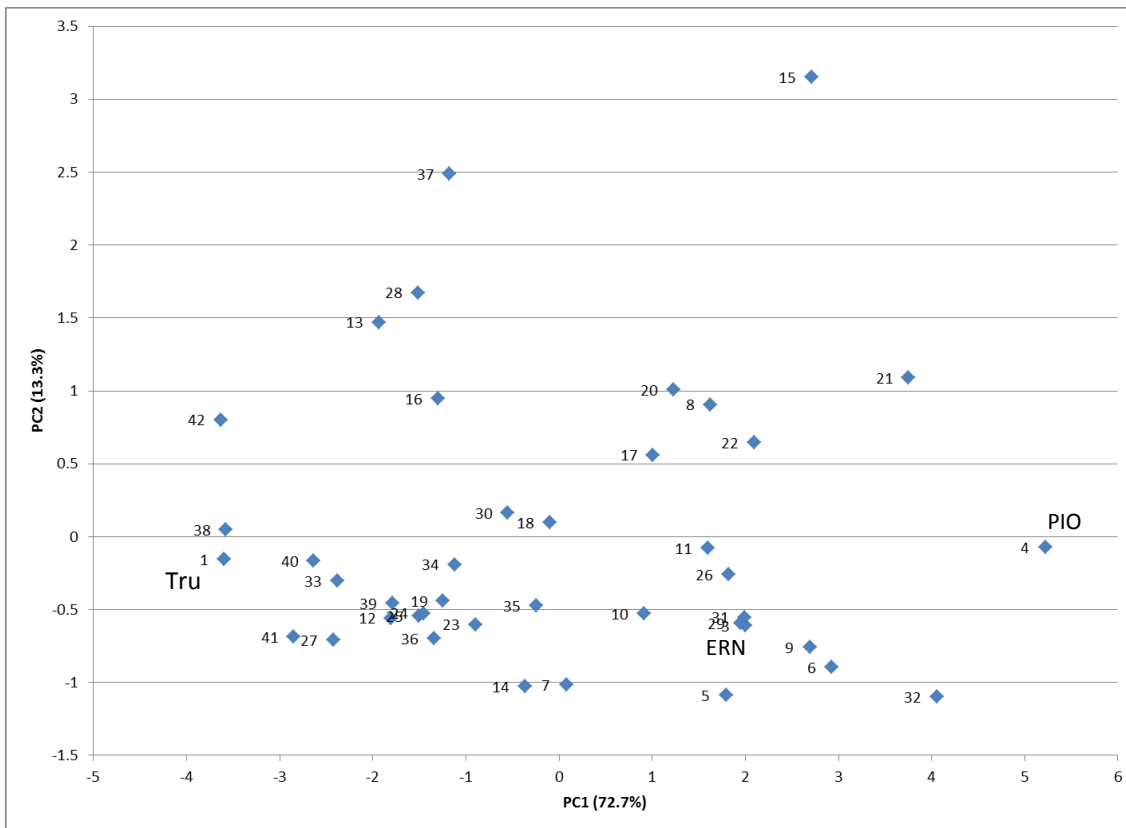


Figure 2. Graph of first two PC from the analysis of the seven FHB traits from the PNUWWSN.

Table 10. Summary of all FHB traits from the 2015-2016 NUWWSN: “ h” and “l” indicate means that are not significantly different from the highest (h) or lowest (l) mean in that column. Lower PC1 scores indicate more resistance.

NAME	INC	SEV	IND	FDK	ISK	DON	GHSEV	PC1	#	#h	Fhb1	HD	HGT
TRUMAN	34.4 |	15.4 |	7.7 |	16.0 |	23.0 |	5.6 |	4.5	-3.35	6	0	no	139.3 h	38.4
FREEDOM	58.3	19.3 |	16.2	34.1	38.5	8.3 |			2	0	no	135.6	36.3
ERNIE	58.4	28.8	21.6	27.3	36.5	11.5	14.5	1.26	0	0	no	132.1	35.1
PIONEER2545	73.9 h	41.3 h	34.7 h	46.9 h	53.2 h	20.4 h	22.0	6.25	0	6	no	136.2	35.2
OH10-219-65	55.5	25.3	18.5	29.2	36.6	9.6 |	17.1	0.71	1	0	no	133.6	35.8
OH09-207-68	44.8 |	19.1 |	8.7 |	25.1	28.2 |	5.7 |	30.6	-1.35	5	0	no	132.4	36.7
OH08-206-69	55.1	18.8 |	12.9 |	29.0	33.8	10.0	45.5	0.15	2	0	no	133.2	34.6
OH11-118-18	33.2 |	13.1 |	4.7 |	18.5 |	20.5 |	2.3 |	4.2	-3.81	6	0	Fhb1	138.1	36.7
KWS060	62.9 h	32.5 h	21.8	31.7	40.6	11.4	7.0	2.24	0	2	no	132.9	36.0
KWS072	64.4 h	31.6	22.1	23.5 |	35.1	6.5 |	16.1	1.29	2	1	no	129.3 |	31.3
KWS074	50.5	25.2	14.8	22.9 |	31.6	8.9 |	30.7	-0.20	2	0	no	133.5	34.0
KWS078	53.6	23.7	13.0 |	15.4 |	29.5 |	8.8 |	12.7	-0.83	4	0	no	133.9	36.5
KY09C-0052-26-12-3	45.4 |	21.3	11.8 |	15.4 |	21.5 |	1.9 |	9.7	-2.41	5	0	no	132.0	33.2
X08C-1070-73-18-1	54.4	26.5	18.8	17.4 |	24.6 |	8.3 |	9.0	-0.49	3	0	Fhb1	133.0	32.7
X09-0187-112-14-1	48.0	19.9 |	12.0 |	26.1	31.8	10.3	17.4	-0.50	2	0	no	133.0	33.6
KY09C-1024-96-1-3	50.5	20.1 |	13.7	19.1 |	31.2	5.7 |	13.7	-1.06	3	0	Fhb1	136.7	37.6
KY09C-0601-39-8-1	51.6	21.8	14.2	16.4 |	30.2	4.0 |	23.1	-1.07	2	0	Fhb1_het	135.9	37.3
NY05158-833	63.4 h	22.8	17.8	20.8 |	32.9	9.1 |	22.0	0.23	2	1	Fhb1	135.6	31.2 |
NY05158-864	73.4 h	26.0	23.1	17.9 |	36.1	11.2	14.5	1.27	1	1	Fhb1	135.5	31.0 |
NY05158-841	65.9 h	26.5	21.9	17.9 |	32.8	7.7 |	14.2	0.47	2	1	Fhb1	135.2	31.7
NY05158-859	63.8 h	25.7	18.6	23.6 |	36.1	7.4 |	13.3	0.76	2	1	Fhb1	135.5	30.6 |
NY99069-352	61.8 h	34.4 h	26.5 h	28.4	41.8	16.3 h	40.1	3.16	0	4	no	134.9	32.8
VA14W-6	69.7 h	29.7	21.1	33.2	42.1	12.1	21.9	2.49	0	1	no	133.3	30.5 |
VA10W-21BSR124	67.4 h	40.9 h	29.7 h	42.7 h	49.8 h	10.8	96.4	5.48	0	5	no	131.2 |	32.9
VA14FHB-22	53.7	30.1	18.9	26.5	38.4	9.8	66.2	1.62	0	0	no	134.0	33.7
VA14FHB-31	66.9 h	31.7 h	21.3	29.8	38.6	7.2 |	18.7	1.94	1	2	no	130.0 |	29.5 |
MI14R0233	50.0	23.4	14.5	20.9 |	33.0	9.7 |	10.1	-0.59	2	0	no	135.5	36.7
MI14R0082	40.7 |	17.7 |	10.8 |	22.3 |	28.5 |	1.9 |	9.3	-2.14	6	0	Fhb1	137.0	36.7
MI14W0217	44.6 |	21.8	11.9 |	14.3 |	26.8 |	10.1	16.7	-1.42	4	0	no	136.4	39.7
MI14R0080	51.8	28.2	16.7	28.1	36.4	5.8 |	27.7	0.63	1	0	no	135.1	34.2
MI14R0109	49.3	19.4 |	11.2 |	20.1 |	29.6 |	6.7 |	25.5	-1.13	5	0	no	132.4	33.5
0762A1-2-8	40.6 |	10.7 |	5.3 |	24.8	26.0 |	2.5 |	18.1	-2.83	5	0	Fhb1	133.0	29.2 |
05247A1-7-3-108-2	57.7	15.4 |	10.1 |	25.1	32.3	10.2	10.2	-0.88	2	0	no	132.3	29.4 |
0566A1-3-1-52	50.2	19.9 |	11.7 |	31.9	32.7	4.5 |	6.8	-0.70	3	0	no	132.5	29.4 |
05247A1-7-3-120	52.6	25.4	14.8	22.6 |	32.5	8.7 |	9.5	-0.15	2	0	no	132.1	29.9 |
04620A1-1-7-4-17	51.3	22.2	15.3	21.4 |	31.6	9.8	5.4	-0.63	1	0	no	133.7	31.0 |
ES14-0937	48.5	22.0	15.2	23.2 |	31.2	4.5 |	7.9	-0.89	2	0	no	132.9	35.9
ES14-1398	49.7	26.1	14.2	24.9	32.9	4.5 |	45.2	0.03	1	0	no	132.7	32.3
ES14-1860	47.1 |	18.2 |	10.2 |	17.4 |	25.7 |	1.5 |	11.5	-2.30	6	0	no	133.5	33.0
ES14-1847	66.5 h	31.5	23.3	43.9 h	49.2 h	17.4 h	31.6	4.31	0	4	no	134.5	33.9
IL10-21934	39.6 |	21.4	10.3 |	13.4 |	23.4 |	4.1 |	12.3	-2.51	5	0	no	129.7 |	34.2
IL10-21937	42.9 |	18.2 |	10.1 |	15.6 |	22.9 |	6.3 |	9.7	-2.38	6	0	no	129.7 |	34.1
IL11-6543	45.3 |	19.5 |	10.9 |	11.3 |	21.0 |	1.3 |	10.2	-2.84	6	0	no	134.2	36.7
IL11-28222	40.7 |	14.1 |	9.1 |	12.9 |	22.1 |	1.3 |	25.2	-3.14	6	0	no	132.7	34.7
IL12-5110	48.9	18.7 |	13.1 |	17.1 |	28.8 |	3.8 |	6.7	-1.72	5	0	no	134.9	35.5
NE13625	48.8	24.4	16.7	15.8 |	28.3 |	10.4	24.6	-0.69	2	0	no	136.8	40.3
NE13515	57.6	30.3	22.8	27.8	40.3	17.3 h	28.6	2.52	0	1	no	137.9	38.3
NE05548	55.8	33.5 h	26.9 h	33.9	45.8 h	17.6 h	36.1	3.44	0	4	no	138.1	44.2 h
NE13604	51.5	19.4 |	13.7	23.6 |	34.4	14.7	30.0	0.04	2	0	no	140.2 h	39.5
NI12702W	45.3 |	24.2	14.8	28.4	36.4	23.2 h	72.3	1.73	1	1	no	139.2 h	37.2
AVERAGE	53.2	23.9	16.0	23.9	32.9	8.6	22.0					134.3	34.5
MINIMUM	33.2	10.7	4.7	11.3	20.5	1.3						129.3	29.2
MAXIMUM	73.9	41.3	34.7	46.9	53.2	23.2						140.2	44.2
LSD(0.05)	14.3	9.7	8.4	12.7	9.6	8.4						2.0	2.0
# ENVIRONMENTS	9	10	10	7	7	5	1					8	3

Table 11. Summary of all FHB traits from the 2015-2016 PNUWWSN: “h” and “l” indicate means that are not significantly different from the highest (h) or lowest (l) mean in that column. Lower PC1 scores indicate more resistance.

NAME	INC	SEV	IND	FDK	ISK	DON	GHSEV	PC1	#l	#h	Fhb1	HD	HGT
TRUMAN	30.8 l	20.5 l	9.2 l	13.2 l	22.9 l	5.9 l	7.5	-3.60	6	0	no	136.4 h	38.0
FREEDOM	64.0 h	32.1	23.3	37.8 h	42.4 h	8.1 l			1	3	no	133.9	34.2
ERNIE	63.3	36.3	26.8	37.5 h	41.3	14.2	18.7	2.00	0	1	no	130.0 l	34.4
PIONEER2545	80.1 h	46.3 h	41.3 h	40.7 h	51.4 h	23.1 h	29.8	5.22	0	6	no	133.1	34.3
OH10-316-20	68.4 h	35.8	29.9	34.6 h	40.8	10.0 l	15.3	1.79	1	2	no	132.4	35.3
OH12-263-1	66.3 h	41.3 h	33.2 h	41.9 h	46.7 h	9.6 l	22.6	2.93	1	5	no	133.6	35.4
OH12-195-22	57.1	31.0	20.1	29.2 h	36.3	9.6 l	9.5	0.08	1	1	no	131.8	33.2
OH12-223-12	60.4	36.2	24.3	24.8 l	38.2	21.5 h	28.1	1.62	1	1	no	131.3	34.1
OH12-319-13	76.1 h	37.0	32.1 h	31.1 h	46.5 h	14.4	18.7	2.69	0	4	no	133.3	34.3
OH12-140-13	63.1	33.9	25.7	28.1	37.6	10.7 l	17.5	0.91	1	0	no	133.1	35.5
KWS081	56.7	38.2 h	27.2	29.7 h	39.4	16.5	20.1	1.59	0	2	no	132.7	37.5
KWS083	53.1	22.9 l	15.2 l	16.5 l	29.6	7.8 l	8.6	-1.80	4	0	no	133.9	33.8
KWS085	44.7 l	20.3 l	11.0 l	19.1 l	27.5 l	9.2 l	33.3	-1.94	6	0	no	132.4	38.3
KWS087	56.7	31.2	20.9	23.7 l	32.0	10.5 l	5.8	-0.36	2	0	no	131.8	34.2
KWS086	66.6 h	36.0	27.6	24.6 l	38.2	26.0 h	57.2	2.71	1	2	no	132.8	36.8
KY09C-0128-72-2-1	50.1	24.2 l	14.4 l	22.1 l	30.8	6.1 l	31.8	-1.30	4	0	Fhb1	132.1	38.7
X08C-1232-30-6-3	57.3	27.6 l	19.0 l	35.8 h	41.6	12.6	32.1	1.01	2	1	no	132.4	33.7
X08C-1108-20-4-5	50.3	31.7	19.1 l	23.8 l	36.1	12.3	19.4	-0.10	2	0	no	132.6	34.0
KY09C-1021-36-20-3	54.2	23.9 l	16.6 l	21.6 l	31.7	7.3 l	13.4	-1.24	4	0	Fhb1	132.9	34.7
KY09C-1024-97-9-5	64.0 h	30.4	23.6	28.3 h	40.2	12.3	37.5	1.23	0	2	Fhb1	132.2	35.3
VA14W-41	78.6 h	49.2 h	39.3 h	28.1	44.7 h	11.8	46.3	3.75	0	4	no	130.1 l	32.6
DH11SRW063-14	68.5 h	38.0 h	27.9	32.0 h	41.3	10.8 l	37.2	2.09	1	3	no	130.0 l	30.9 l
VA15FHB-11	67.0 h	25.6 l	18.5 l	18.8 l	31.0	6.2 l	13.5	-0.90	4	1	no	132.2	34.0
VAMD10422-98	60.8	18.1 l	13.6 l	24.9 l	30.5	6.0 l	14.4	-1.46	4	0	Fhb1	132.8	32.3 l
13VA-FHB-DH131	59.7	21.4 l	15.4 l	17.7 l	30.8	7.8 l	10.7	-1.51	4	0	no	131.1	32.0 l
13VA-FHB-DH192	68.3 h	38.6 h	26.5	29.4 h	40.9	13.0	22.2	1.82	0	3	no	129.6 l	34.2
MI14R0180	52.5	17.9 l	11.5 l	19.9 l	27.1 l	4.9 l	8.2	-2.43	5	0	no	131.9	34.8
MI14R0235	35.4 l	23.7 l	12.9 l	22.8 l	31.5	9.3 l	37.0	-1.51	5	0	no	132.6	36.1
MI14W0447	65.4 h	32.2	26.0	38.7 h	41.1	15.4	18.5	1.95	0	2	Fhb1	133.5	35.4
MI14W0604	48.0	29.0 l	18.2 l	19.4 l	34.1	14.7	15.9	-0.55	3	0	no	136.2 h	39.7 h
MI14R0112	59.7	35.1	26.5	35.2 h	46.8 h	14.1	19.1	1.99	0	2	no	133.9	35.5
MI14W0464	62.1	44.4 h	34.4 h	42.9 h	52.7 h	22.1 h	13.0	4.06	0	5	no	135.3 h	41.1 h
0527A1-9-14-4-3-1-1	44.5 l	21.2 l	11.4 l	17.3 l	25.5 l	10.3 l	7.5	-2.38	6	0	no	134.7	37.3
0566A1-3-1-6	55.5	20.9 l	15.0 l	25.1 l	32.5	7.9 l	17.6	-1.12	4	0	no	131.0	33.6
05247A1-7-3-120	62.7	30.1	19.0 l	21.7 l	31.6	12.1	12.1	-0.25	2	0	no	130.3 l	30.3 l
0566A1-3-1-51	54.6	22.5 l	15.6 l	23.9 l	29.4	8.7 l	9.1	-1.34	4	0	no	129.8 l	31.5 l
05247A1-7-3-114	45.8 l	24.6 l	12.5 l	21.5 l	27.7 l	10.5 l	47.8	-1.18	6	0	no	128.9 l	30.5 l
IL12-8545	40.9 l	18.1 l	10.5 l	11.8 l	20.6 l	3.8 l	12.5	-3.58	6	0	Fhb1	131.9	36.0
IL12-13746	42.5 l	27.6 l	14.0 l	21.7 l	29.8	5.9 l	11.4	-1.79	5	0	no	129.1 l	32.2 l
IL12-14179	44.8 l	19.7 l	13.6 l	16.7 l	26.0 l	4.5 l	13.4	-2.64	6	0	no	129.3 l	35.3
IL12-26448	36.9 l	21.3 l	15.0 l	17.9 l	27.4 l	2.2 l	7.6	-2.85	6	0	Fhb1	129.1 l	33.2
IL12-30879	34.9 l	17.8 l	9.8 l	14.4 l	18.7 l	4.2 l	21.7	-3.63	6	0	Fhb1	131.6	34.4
AVERAGE	56.5	29.4	20.7	25.8	35.1	10.8						132.1	34.7
MINIMUM	30.8	17.8	9.2	11.8	18.7	2.2						128.9	30.3
MAXIMUM	80.1	49.2	41.3	42.9	52.7	26.0						136.4	41.1
LSD(0.05)	16.3	11.7	10.4	14.8	10.5	8.9						1.6	2.2
# ENVIRONMENTS	7	8	8	5	5	4	1					7	3

Table 15. Summary of Fusarium Damaged Kernel (FDK, %) data from the 2015-2016 NUWWSN.

NAME	AVG	ILURB	KYLEX	MOCOL	NEMEA	NYITH	OHWOO	VABLA
TRUMAN	16.0 l	15.0	5.0	22.5	22.0	10.0	15.0	22.5
FREEDOM	34.1	50.0	24.0	25.0	40.0	40.5		
ERNIE	27.3	53.3	7.0	30.0	12.0	15.0	28.0	46.0
PIONEER2545	46.9 h	80.0	12.8	37.5	28.0	60.0	58.0	52.0
OH10-219-65	29.2	28.3	12.0	60.0	13.0	10.0	50.0	31.0
OH09-207-68	25.1	36.7	12.3	27.5	12.0	20.0	20.0	47.0
OH08-206-69	29.0	53.3	6.7	35.0	16.0	25.0	30.0	37.0
OH11-118-18	18.5 l	30.0	2.7	17.5	25.0	25.0	8.0	21.5
KWS060	31.7	33.3	4.6	37.5	15.0	25.0	55.0	51.5
KWS072	23.5 l	23.3	8.9	35.0	14.0	15.0	20.0	48.2
KWS074	22.9 l	23.3	11.2	30.0	15.0	25.0	25.0	31.0
KWS078	15.4 l	26.7	5.1	17.5	7.0	10.0	18.0	23.5
KY09C-0052-26-12-3	15.4 l	6.7	4.9	25.0	19.0	10.0	8.0	34.1
X08C-1070-73-18-1	17.4 l	11.7	3.0	25.0	14.0	20.0	25.0	23.0
X09-0187-112-14-1	26.1	40.0	7.7	22.5	24.0	25.0	25.0	38.5
KY09C-1024-96-1-3	19.1 l	26.7	2.7	47.5	10.0	10.0	10.0	27.0
KY09C-0601-39-8-1	16.4 l	38.3	3.5	30.0	5.0	15.0	8.0	15.3
NY05158-833	20.8 l	23.3	13.5	32.5	6.0	5.0	15.0	50.0
NY05158-864	17.9 l	23.3	7.7	35.0	8.0	10.0	10.0	31.3
NY05158-841	17.9 l	26.7	3.1	22.5	11.0	5.0	15.0	42.0
NY05158-859	23.6 l	30.0	5.6	50.0	12.0	10.0	10.0	47.5
NY99069-352	28.4	8.3	6.8	60.0	11.0	30.0	28.0	54.5
VA14W-6	33.2	23.3	5.6	52.5	12.0	40.0	55.0	44.0
VA10W-21BSR124	42.7 h	53.3	8.9	57.5	18.0	50.0	70.0	41.0
VA14FHB-22	26.5	16.7	5.6	40.0	14.0	25.0	50.0	34.0
VA14FHB-31	29.8	40.0	6.3	22.5	28.0	45.0	15.0	52.0
MI14R0233	20.9 l	10.0	9.6	32.5	22.0	15.0	18.0	39.0
MI14R0082	22.3 l	20.0	3.3	30.0	29.0	50.0	5.0	19.0
MI14W0217	14.3 l	6.7	4.3	12.5	12.0	10.0	20.0	34.4
MI14R0080	28.1	66.7	7.1	45.0	19.0	10.0	20.0	28.8
MI14R0109	20.1 l	20.0	6.3	37.5	17.0	10.0	18.0	32.0
0762A1-2-8	24.8	16.7	5.8	20.0	25.0	45.0	15.0	46.0
05247A1-7-3-108-2	25.1	20.0	5.2	15.0	20.0	50.0	20.0	45.4
0566A1-3-1-52	31.9	33.3	7.6	15.0	19.0	55.0	18.0	75.6
05247A1-7-3-120	22.6 l	16.7	4.3	20.0	21.0	40.0	15.0	41.0
04620A1-1-7-4-17	21.4 l	13.3	4.4	17.5	21.0	25.0	30.0	38.6
ES14-0937	23.2 l	30.0	3.2	25.0	40.0	15.0	15.0	34.0
ES14-1398	24.9	15.0	5.3	45.0	18.0	25.0	25.0	41.0
ES14-1860	17.4 l	6.7	2.5	37.5	26.0	10.0	15.0	24.3
ES14-1847	43.9 h	36.7	12.2	35.0	23.0	65.0	70.0	65.5
IL10-21934	13.4 l	5.0	4.5	15.0	18.0	5.0	15.0	31.4
IL10-21937	15.6 l	15.0	5.0	17.5	10.0	5.0	25.0	31.5
IL11-6543	11.3 l	20.0	3.2	7.5	19.0	5.0	5.0	19.5
IL11-28222	12.9 l	8.3	2.1	22.5	31.0	0.0	8.0	18.5
IL12-5110	17.1 l	15.0	2.6	37.5	26.0	5.0	8.0	25.5
NE13625	15.8 l	6.7	5.9	15.0	8.0	5.0	40.0	30.0
NE13515	27.8	36.7	16.1	35.0	8.0	10.0	35.0	53.5
NE05548	33.9	40.0	18.9	60.0	18.0	10.0	50.0	40.1
NE13604	23.6 l	10.0	10.3	25.0	10.0	20.0	40.0	50.0
NI12702W	28.4	6.7	8.6	45.0	2.0	10.0	65.0	61.5
AVERAGE	23.9	25.9	7.1	31.3	17.5	21.6	25.8	38.2
MINIMUM	11.3	5.0	2.1	7.5	2.0	0.0	5.0	15.3
MAXIMUM	46.9	80.0	24.0	60.0	40.0	65.0	70.0	75.6
LSD(0.05)	12.7							

Table 16. Summary of INC/SEV/FDK (ISK, %) data from the 2015-2016 NUWWSN

NAME	AVG	ILURB	KYLEX	MOCOL	NEMEA	NYITH	OHWO0	VABLA
TRUMAN	23.0 l	26.9	16.4	28.1	40.2	5.7	22.7	21.1
FREEDOM	38.5	52.3	43.3	14.2	44.0	41.5	.	.
ERNIE	36.5	61.6	21.7	42.8	40.7	12.7	36.2	39.7
PIONEER2545	53.2 h	81.4	39.5	50.8	49.3	37.5	56.2	57.7
OH10-219-65	36.6	39.1	25.7	57.0	38.7	8.4	52.3	35.1
OH09-207-68	28.2 l	30.5	22.6	30.1	38.0	15.7	21.0	39.6
OH08-206-69	33.8	49.3	22.1	43.6	40.3	19.2	28.3	33.9
OH11-118-18	20.5 l	26.0	14.4	22.9	40.7	10.4	9.9	19.0
KWS060	40.6	49.9	27.9	47.4	39.6	23.0	45.3	50.8
KWS072	35.1	45.6	26.4	51.3	43.6	16.7	28.0	34.3
KWS074	31.6	30.6	28.6	41.3	41.5	17.2	30.3	31.8
KWS078	29.5 l	41.1	23.4	34.4	33.0	16.2	24.2	33.9
KY09C-0052-26-12-3	21.5 l	16.4	16.5	30.0	43.5	8.6	12.7	22.7
X08C-1070-73-18-1	24.6 l	17.8	20.5	29.3	39.4	15.5	23.0	26.9
X09-0187-112-14-1	31.8	44.6	18.6	29.3	47.8	20.5	24.3	37.6
KY09C-1024-96-1-3	31.2	51.9	24.1	45.8	39.1	7.7	21.0	29.0
KY09C-0601-39-8-1	30.2	54.0	22.5	39.7	35.7	9.0	22.9	27.8
NY05158-833	32.9	32.2	39.2	34.7	37.8	9.9	31.0	45.6
NY05158-864	36.1	48.6	36.2	41.4	39.7	11.6	34.0	41.4
NY05158-841	32.8	49.0	31.9	27.8	43.2	7.9	30.0	39.7
NY05158-859	36.1	48.0	33.2	46.5	44.3	11.4	25.4	43.9
NY99069-352	41.8	49.7	26.3	52.2	40.4	22.8	46.5	54.8
VA14W-6	42.1	40.0	32.9	45.8	42.5	45.5	40.7	47.3
VA10W-21BSR124	49.8 h	67.0	31.3	58.3	43.5	52.5	55.4	40.5
VA14FHB-22	38.4	51.9	23.7	42.4	39.8	26.5	45.3	39.5
VA14FHB-31	38.6	47.2	29.6	28.5	43.6	50.0	20.3	50.7
MI14R0233	33.0	39.8	30.5	33.6	43.4	11.6	29.5	42.3
MI14R0082	28.5 l	54.1	20.8	31.6	46.0	20.3	10.3	16.5
MI14W0217	26.8 l	40.5	25.6	24.8	37.2	8.7	25.6	25.1
MI14R0080	36.4	68.1	24.0	49.2	42.7	12.1	29.0	29.4
MI14R0109	29.6 l	32.4	25.9	39.8	40.8	14.2	23.5	30.3
0762A1-2-8	26.0 l	14.2	16.4	34.3	44.2	24.7	12.7	35.3
05247A1-7-3-108-2	32.3	32.6	22.7	26.4	42.3	39.6	23.7	38.6
0566A1-3-1-52	32.7	35.8	26.4	25.6	41.2	29.0	21.2	49.4
05247A1-7-3-120	32.5	39.6	21.0	25.8	45.4	34.0	22.3	39.5
04620A1-1-7-4-17	31.6	43.0	25.4	23.6	44.0	18.1	29.3	37.6
ES14-0937	31.2	41.7	19.5	39.2	50.5	8.5	29.6	29.4
ES14-1398	32.9	33.8	25.7	51.4	41.4	18.6	27.3	32.1
ES14-1860	25.7 l	18.8	15.2	46.6	46.3	10.2	21.0	21.8
ES14-1847	49.2 h	56.2	34.4	41.6	45.7	51.9	52.0	62.7
IL10-21934	23.4 l	21.3	17.5	28.8	44.0	6.2	19.5	26.3
IL10-21937	22.9 l	20.1	20.4	17.6	38.1	8.8	26.0	29.2
IL11-6543	21.0 l	30.1	16.1	15.3	42.1	5.8	14.5	23.2
IL11-28222	22.1 l	14.7	11.0	42.3	48.5	4.2	18.2	15.5
IL12-5110	28.8 l	35.7	20.7	42.7	44.5	6.5	25.7	25.7
NE13625	28.3 l	39.1	25.7	25.7	32.8	6.8	38.0	29.9
NE13515	40.3	58.8	41.2	34.7	38.6	10.0	46.5	52.1
NE05548	45.8 h	67.5	37.8	50.6	42.0	7.2	71.0	44.5
NE13604	34.4	25.7	36.3	32.8	38.5	9.9	45.5	52.1
NI12702W	36.4	32.0	22.9	46.8	31.0	9.8	59.5	52.8
AVERAGE	32.9	41.0	25.6	36.9	41.6	18.0	30.8	36.4
MINIMUM	20.5	14.2	11.0	14.2	31.0	4.2	9.9	15.5
MAXIMUM	53.2	81.4	43.3	58.3	50.5	52.5	71.0	62.7
LSD(0.05)	9.6	.	.	.	.	.	.	.

Table 17. Summary of deoxynivalenol (DON, ppm) data from the 2015-2016 NUWWSN.

NAME	DON						NIV
	AVG	ILURB	KYLEX	OHWOO	VABLA	NEMEA	NEMEA
TRUMAN	5.6 l	0.8	10.1	11.9	4.8	0.5	<0.5
FREEDOM	8.3 l	1.9		12.8	9.5	1.3	<0.5
ERNIE	11.5	2.6	15.9	32.1	6.0	0.9	<0.5
PIONEER2545	20.4 h	7.1	26.8	53.7	13.0	1.3	<0.5
OH10-219-65	9.6 l	1.8	12.3	28.6	4.8	0.6	<0.5
OH09-207-68	5.7 l	1.4	15.9	11.7	4.8	<0.5	<0.5
OH08-206-69	10.0	1.2	16.3	25.2	6.8	0.5	<0.5
OH11-118-18	2.3 l	0.4	8.5	6.5	4.9	<0.5	<0.5
KWS060	11.4	2.0	12.3	39.3	3.0	<0.5	<0.5
KWS072	6.5 l	4.5	19.5	10.2	2.7	<0.5	<0.5
KWS074	8.9 l	0.8	18.5	16.6	7.8	0.7	<0.5
KWS078	8.8 l	1.1	19.9	21.1	4.0	<0.5	<0.5
KY09C-0052-26-12-3	1.9 l	0.8	6.7	10.1	1.2	<0.5	<0.5
X08C-1070-73-18-1	8.3 l	0.9	6.9	33.0	3.3	<0.5	<0.5
X09-0187-112-14-1	10.3	1.8	16.0	28.9	5.6	<0.5	<0.5
KY09C-1024-96-1-3	5.7 l	1.3	12.3	15.4	5.0	<0.5	<0.5
KY09C-0601-39-8-1	4.0 l	0.5	7.7	14.8	4.0	<0.5	<0.5
NY05158-833	9.1 l	1.2	17.9	20.5	5.6	0.5	<0.5
NY05158-864	11.2	1.9	18.1	27.0	8.4	0.6	<0.5
NY05158-841	7.7 l	1.4	17.1	16.6	3.0	0.6	<0.5
NY05158-859	7.4 l	1.5	16.5	15.0	7.6	<0.5	<0.5
NY99069-352	16.3 h	2.0	38.5	33.6	6.9	0.6	<0.5
VA14W-6	12.1	3.5	23.3	24.6	8.6	0.7	<0.5
VA10W-21BSR124	10.8	3.4	24.6	20.9	4.1	0.8	<0.5
VA14FHB-22	9.8	2.0	11.6	28.2	6.6	0.5	<0.5
VA14FHB-31	7.2 l	3.6	20.4	8.7	7.1	<0.5	<0.5
MI14R0233	9.7 l	1.2	18.7	19.3	8.6	0.5	<0.5
MI14R0082	1.9 l	0.2	7.5	8.0	2.9	<0.5	<0.5
MI14W0217	10.1	1.5	20.8	24.1	5.2	<0.5	<0.5
MI14R0080	5.8 l	2.3	15.7	13.5	2.8	<0.5	<0.5
MI14R0109	6.7 l	2.8	22.0	9.7	3.3	<0.5	<0.5
0762A1-2-8	2.5 l	1.3	6.5	9.7	3.4	<0.5	<0.5
05247A1-7-3-108-2	10.2	2.1	16.1	21.6	10.8	0.5	<0.5
0566A1-3-1-52	4.5 l	1.6	10.6	11.6	5.3	<0.5	<0.5
05247A1-7-3-120	8.7 l	1.9	13.3	23.5	7.3	<0.5	<0.5
04620A1-1-7-4-17	9.8	2.0	14.4	26.1	6.0	0.7	<0.5
ES14-0937	4.5 l	1.0	7.3	16.1	4.6	<0.5	<0.5
ES14-1398	4.5 l	1.3	9.5	15.0	3.3	<0.5	<0.5
ES14-1860	1.5 l	0.5	5.7	9.5	1.4	<0.5	<0.5
ES14-1847	17.4 h	3.4	21.3	43.2	12.7	<0.5	<0.5
IL10-21934	4.1 l	0.8	9.9	13.4	3.3	<0.5	<0.5
IL10-21937	6.3 l	1.0	13.7	17.3	4.4	<0.5	<0.5
IL11-6543	1.3 l	0.6	7.7	6.1	2.0	<0.5	<0.5
IL11-28222	1.3 l	0.7	5.6	8.3	1.7	<0.5	<0.5
IL12-5110	3.8 l	1.1	9.9	12.1	3.3	<0.5	<0.5
NE13625	10.4	1.6	16.3	27.5	6.3	0.5	<0.5
NE13515	17.3 h	3.1	40.8	28.8	7.7	<0.5	<0.5
NE05548	17.6 h	2.0	32.1	44.5	8.6	0.7	<0.5
NE13604	14.7	0.5	33.7	25.7	12.6	1.1	<0.5
NI12702W	23.2 h	0.9	21.1	78.6	14.2	1.0	<0.5
AVERAGE	8.6	1.7	15.9	14.4	7.7		
MINIMUM	1.3	0.2	1.3	1.2	3.0		
MAXIMUM	23.2	7.1	40.8	78.6	14.2		
LSD(0.05)	8.4	.	.	.	.

Table 18. Summary of greenhouse severity (GHSEV, %) data from the 2015-2016 NUWWSN.

ENTRY	NAME	GHSEV
1	TRUMAN	4.5
2	FREEDOM	
3	ERNIE	14.5
4	PIONEER2545	22.0
5	OH10-219-65	17.1
6	OH09-207-68	30.6
7	OH08-206-69	45.5
8	OH11-118-18	4.2
9	KWS060	7.0
10	KWS072	16.1
11	KWS074	30.7
12	KWS078	12.7
13	KY09C-0052-26-12-3	9.7
14	X08C-1070-73-18-1	9.0
15	X09-0187-112-14-1	17.4
16	KY09C-1024-96-1-3	13.7
17	KY09C-0601-39-8-1	23.1
18	NY05158-833	22.0
19	NY05158-864	14.5
20	NY05158-841	14.2
21	NY05158-859	13.3
22	NY99069-352	40.1
23	VA14W-6	21.9
24	VA10W-21BSR124	96.4
25	VA14FHB-22	66.2
26	VA14FHB-31	18.7
27	MI14R0233	10.1
28	MI14R0082	9.3
29	MI14W0217	16.7
30	MI14R0080	27.7
31	MI14R0109	25.5
32	0762A1-2-8	18.1
33	05247A1-7-3-108-2	10.2
34	0566A1-3-1-52	6.8
35	05247A1-7-3-120	9.5
36	04620A1-1-7-4-17	5.4
37	ES14-0937	7.9
38	ES14-1398	45.2
39	ES14-1860	11.5
40	ES14-1847	31.6
41	IL10-21934	12.3
42	IL10-21937	9.7
43	IL11-6543	10.2
44	IL11-28222	25.2
45	IL12-5110	6.7
46	NE13625	24.6
47	NE13515	28.6
48	NE05548	36.1
49	NE13604	30.0
50	NI12702W	72.3
100	AVERAGE	22.0

Table 19. Summary of heading date (HD, Julian days) height (HGT, inches), and lodging (LDG) data from the 2015-2016 NUWWSN

NAME	HD	ILCHA	INWLA	KYLEX	MIELA	MOCOL	NYITH	OHWOO	VAWAR	HGT	INWLA	KYLEX	VAWAR	LDG (0-10)
	AVG									AVG				VARWAR
TRUMAN	139.3 h	135	144	132	150	137	150	143	124	38.4	44.3	36.0	35	0
FREEDOM	135.6	132	137		150		150	140	119	36.3			32	1
ERNIE	132.1	130	137	121	147	127	148	138	109	35.1	41.8	33.5	30	1
PIONEER2545	136.2	132	143	127	149	130	149	140	120	35.2	39.7	34.8	31	0
OH10-219-65	133.6	130	137	124	147	129	147	137	118	35.8	40.3	35.3	32	0
OH09-207-68	132.4	130	136	120	148	130	146	137	113	36.7	43.4	34.8	32	0
OH08-206-69	133.2	130	142	125	148	127	147	138	110	34.6	39.8	33.0	31	0
OH11-118-18	138.1	135	136	131	149	137	150	143	124	36.7	41.7	36.3	32	0
KWS060	132.9	129	134	124	147	128	147	138	117	36.0	41.6	35.5	31	1
KWS072	129.3 l	126	137	122	145	119	145	135	106	31.3	36.3	29.5	28	0
KWS074	133.5	129	137	125	148	128	147	137	118	34.0	38.6	32.5	31	0
KWS078	133.9	131	135	124	148	128	149	138	118	36.5	41.7	35.8	32	0
KY09C-0052-26-12-3	132.0	129	136	121	147	125	147	137	114	33.2	38.1	31.5	30	1
X08C-1070-73-18-1	133.0	129	137	123	148	127	148	136	116	32.7	39.3	32.8	26	0
X09-0187-112-14-1	133.0	131	139	128	147	125	147	137	110	33.6	39.0	31.8	30	0
KY09C-1024-96-1-3	136.7	134	139	128	151	131	151	141	118	37.6	43.9	37.0	32	0
KY09C-0601-39-8-1	135.9	131	137	129	149	131	150	141	119	37.3	42.6	37.3	32	0
NY05158-833	135.6	131	138	127	148	132	150	140	119	31.2 l	36.0	29.5	28	0
NY05158-864	135.5	131	138	126	148	131	150	141	119	31.0 l	35.1	30.0	28	0
NY05158-841	135.2	131	137	126	149	131	149	140	119	31.7	37.0	30.0	28	0
NY05158-859	135.5	131	139	127	149	131	150	140	118	30.6 l	35.6	28.3	28	0
NY99069-352	134.9	133	137	125	149	130	149	140	117	32.8	37.9	31.5	29	1
VA14W-6	133.3	131	140	122	149	130	147	136	112	30.5 l	36.8	29.8	25	0
VA10W-21BSR124	131.2 l	129	137	119	147	127	146	135	110	32.9	39.4	31.3	28	0
VA14FHB-22	134.0	132	135	121	150	132	148	139	115	33.7	40.1	31.0	30	0
VA14FHB-31	130.0 l	128	139	117	147	125	146	135	103	29.5 l	33.6	29.0	26	0
MI14R0233	135.5	131	141	126	150	130	149	140	118	36.7	44.0	35.0	31	0
MI14R0082	137.0	133	139	129	151	132	150	142	120	36.7	43.0	36.0	31	0
MI14W0217	136.4	133	139	128	147	137	148	140	120	39.7	45.7	37.3	36	1
MI14R0080	135.1	131	136	127	149	130	149	141	119	34.2	39.7	32.8	30	0
MI14R0109	132.4	129	135	122	147	128	147	137	115	33.5	39.2	31.3	30	0
0762A1-2-8	133.0	130	135	122	148	128	149	138	115	29.2 l	34.9	27.8	25	0
05247A1-7-3-108-2	132.3	129	135	122	147	126	148	138	113	29.4 l	34.5	27.8	26	0
0566A1-3-1-52	132.5	129	135	122	148	128	148	138	113	29.4 l	34.7	29.5	24	0
05247A1-7-3-120	132.1	129	136	121	147	126	148	138	112	29.9 l	33.8	29.8	26	0
04620A1-1-7-4-17	133.7	130	136	123	148	130	150	138	116	31.0 l	35.8	31.3	26	0
ES14-0937	132.9	130	136	122	146	128	148	137	116	35.9	39.0	37.8	31	0
ES14-1398	132.7	129	137	121	147	130	149	136	113	32.3	39.3	30.5	27	0
ES14-1860	133.5	131	138	122	147	128	147	137	118	33.0	40.3	31.8	27	0
ES14-1847	134.5	131	136	125	148	131	149	138	118	33.9	39.7	31.0	31	0
IL10-21934	129.7 l	128	134	120	146	127	145	136	103	34.2	39.1	32.5	31	0
IL10-21937	129.7 l	128	135	120	146	125	146	135	103	34.1	39.1	33.3	30	0
IL11-6543	134.2	130	136	125	147	131	148	138	119	36.7	42.4	36.8	31	0
IL11-28222	132.7	129	136	121	146	128	148	138	116	34.7	40.0	36.0	28	1
IL12-5110	134.9	130	137	128	147	130	149	140	119	35.5	40.2	36.3	30	1
NE13625	136.8	134	141	126	149	131	149	142	123	40.3	47.2	38.8	35	1
NE13515	137.9	134	142	129	149	135	148	143	123	38.3	43.3	36.5	35	0
NE05548	138.1	135	143	128	149	133	151	143	123	44.2 h	47.9	42.8	42	3
NE13604	140.2 h	138	145	132	151	135	151	145	125	39.5	44.1	40.5	34	1
NI12702W	139.2 h	135	145	131	149	135	150	144	125	37.2	42.0	36.5	33	0
AVERAGE	134.3	131	138	125	148	130	148	139	117	34.5	39.7	33.4	30.1	0.26
MINIMUM	129.3	126	134	117	145	119	119	135	103	29.2	32.0	27.8	24	
MAXIMUM	140.2	138	145	150	151	140	151	145	138	44.2	47.9	42.8	42	
LSD(0.05)	2.0	.	.	.	.	.	.	.	.	2.0	.	.	.	

Table 20. Summary of other traits collected on the 2015-2016 NUWWSN including powdery mildew (PM), leaf rust (LR), yellow rust (YR) and foliar rating of general foliage health.

	VAWAR	VAWAR	VAWAR	VAWAR	VAWAR	VAWAR	VAWAR	VAWAR	VAWAR	ILHIG	ILCHA	INWLA	OHWOO
	YIELD	Yield % Mean	TEST WEIGHT	Spring Height (inches)	PM (0-9)	LR (0-9)	LR REACTION TYPE	LR REACTION TYPE: 0-3 (TCRK+MF QS)	YR AVG	YR (0-9)	YR (0-9)	YR (0-9)	Foliar Rating (0-9)
TRUMAN	61.3	102	57.6	15.0	1.0	7.0	3	3.0	5.5	6.0	4.5	6.0	6.7
FREEDOM	52.6	87	54.4	13.0	2.0	5.0	;1-	3;	7.2	8.0	5.5	8.0	8.3
ERNIE	59.8	99	57.0	17.0	3.0	5.0	3/Tr0;	3.0	6.7	7.5	5.0	7.5	7.3
PIONEER2545	57.3	95	55.4	12.0	4.0	6.0	3	3.0	6.3	6.5	6.0	6.5	8.0
OH10-219-65	68.7	114	57.5	13.0	6.0	4.0	3	3.0	7.3	8.0	6.0	8.0	7.3
OH09-207-68	72.8	121	58.0	15.0	2.0	5.0	3	3.0	1.5	1.5	1.5	1.5	2.7
OH08-206-69	56.7	94	57.0	17.0	5.0	4.0	3;	3.0	2.3	2.5	2.0	2.5	4.0
OH11-118-18	61.4	102	59.6	12.0	4.0	4.0	;1=	32;	2.2	2.0	2.5	2.0	6.0
KWS060	77.2	128	56.8	11.0	3.0	6.0	3	3.0	7.7	8.5	6.0	8.5	7.7
KWS072	63.8	106	58.8	18.0	4.0	3.0	0;/3	3.0	5.5	6.5	3.5	6.5	7.3
KWS074	62.6	104	57.8	12.0	2.0	3.0	3	3.0	4.3	4.5	4.0	4.5	5.3
KWS078	60.5	100	58.2	15.0	7.0	4.0	3	;3	1.3	1.0	2.0	1.0	6.0
KY09C-0052-26-12-3	62.9	104	59.8	13.0	3.0	6.0	3	3.0	8.8	9.0	8.5	9.0	8.3
X08C-1070-73-18-1	56.9	94	58.1	13.0	2.0	6.0	3;Tr0;	32.0	5.7	5.5	6.0	5.5	7.7
X09-0187-112-14-1	64.0	106	59.6	18.0	2.0	5.0	3	3.0	2.3	2.5	2.0	2.5	5.3
KY09C-1024-96-1-3	57.3	95	55.6	14.0	6.0	7.0	1;=/3	3.0	8.0	8.5	7.0	8.5	6.3
KY09C-0601-39-8-1	58.7	97	60.1	9.0	5.0	6.0	3;	3.0	6.7	7.0	6.0	7.0	6.0
NY05158-833	60.5	100	56.4	10.0	4.0	3.0	3	3.0	7.2	8.0	5.5	8.0	7.3
NY05158-864	61.0	101	56.8	10.0	4.0	4.0	3	3.0	7.7	9.0	5.0	9.0	6.3
NY05158-841	56.9	94	56.1	11.0	3.0	4.0	3	3.0	7.3	8.5	5.0	8.5	5.6
NY05158-859	60.5	100	56.6	12.0	3.0	4.0	23;	3.0	6.3	7.0	5.0	7.0	7.0
NY99069-352	63.3	105	56.1	13.0	3.0	6.0	3	3;	7.3	8.5	5.0	8.5	7.0
VA14W-6	50.5	84	56.3	15.0	4.0	1.0	0;	;1Tr3	7.2	7.5	6.5	7.5	7.0
VA10W-21BSR124	69.0	114	58.1	17.0	4.0	4.0	3	;12	4.8	6.0	2.5	6.0	8.3
VA14FHB-22	69.9	116	59.0	15.0	5.0	1.0	3	0;3	1.3	1.0	2.0	1.0	5.7
VA14FHB-31	57.8	96	59.2	20.0	2.0	4.0	23;	32.0	1.3	1.0	2.0	1.0	4.7
MI14R0233	59.9	99	57.1	14.0	1.0	5.0	3	;23	6.7	7.0	6.0	7.0	7.3
MI14R0082	48.1	80	57.4	11.0	2.0	4.0	3/Tr0;	3.0	7.2	8.0	5.5	8.0	5.0
MI14W0217	54.4	90	57.0	12.0	2.0	6.0	3	3.0	2.0	2.0	2.0	2.0	5.0
MI14R0080	60.8	101	56.5	10.0	0.0	6.0	3	3.0	6.7	7.0	6.0	7.0	6.7
MI14R0109	60.8	101	58.6	14.0	6.0	6.0	3	3.0	6.8	8.0	4.5	8.0	7.3
0762A1-2-8	70.5	117	56.5	13.0	4.0	4.0	3/Tr;1	3/1;	1.0	1.0	1.0	1.0	3.0
05247A1-7-3-108-2	59.1	98	58.5	14.0	3.0	1.0	;1=	3.0	1.0	1.0	1.0	1.0	2.0
0566A1-3-1-52	55.9	93	55.8	12.0	3.0	1.0	1-;	1-;Tr3	1.3	1.0	2.0	1.0	2.0
05247A1-7-3-120	62.1	103	58.4	12.0	3.0	1.0	;1=	3.0	3.3	4.5	1.0	4.5	2.0
04620A1-1-7-4-17	57.3	95	57.7	13.0	2.0	5.0	3/Tr;1	3.0	2.2	2.0	2.5	2.0	3.3
ES14-0937	63.2	105	57.5	11.0	3.0	2.0	3	23;	3.3	3.0	4.0	3.0	3.3
ES14-1398	74.3	123	58.7	15.0	3.0	6.0	3	3.0	3.7	3.5	4.0	3.5	4.7
ES14-1860	55.1	91	58.5	13.0	3.0	1.0	3	;23	6.3	7.0	5.0	7.0	6.3
ES14-1847	65.3	108	57.6	14.0	4.0	6.0	1-;	1;	2.7	2.5	3.0	2.5	7.0
IL10-21934	75.7	125	58.6	22.0	3.0	4.0	3	3.0	6.0	7.0	4.0	7.0	5.0
IL10-21937	67.3	111	58.2	23.0	3.0	4.0	3	3.0	5.2	6.0	3.5	6.0	6.7
IL11-6543	63.3	105	60.0	12.0	2.0	5.0	3	3.0	3.3	3.0	4.0	3.0	6.3
IL11-28222	57.4	95	59.0	11.0	6.0	2.0	3	;23	5.7	6.0	5.0	6.0	4.3
IL12-5110	64.7	107	58.5	10.0	3.0	2.0	3	3.0	4.2	4.5	3.5	4.5	6.0
NE13625	56.4	93	58.8	10.0	4.0	1.0	3	3.0	6.2	6.5	5.5	6.5	7.0
NE13515	43.2	71	57.4	15.0	6.0	2.0	;1-	3/Tr1;	1.7	1.5	2.0	1.5	6.3
NE05548	50.7	84	55.8	15.0	4.0	4.0	3	23;	5.3	5.5	5.0	5.5	6.3
NE13604	45.1	75	57.3	11.0	7.0	1.0	1;	1-;	3.5	3.0	4.5	3.0	7.3
NI12702W	47.1	78	60.2	15.0	6.0	1.0	3-	3.0	1.3	1.0	2.0	1.0	5.0
MEAN	60.4	100	57.7	13.6	3.5	3.9				5.1	4.1	5.1	3.3
LSD(0.05)										3.5	1.1		
CV										34.0	13.0		

Table 21. Summary of incidence (INC, %) from 2015-2016 PNUWWSN.

NAME	AVG	ILCHA	ILHIG	ILURB	KYLEX	MIELA	MOCOL	VABLA
TRUMAN	30.8 l	20.0	7.5	40.0	42.5	33.3	50.0	22.5
FREEDOM	64.0 h	70.0	75.0	60.0		26.7		67.5
ERNIE	63.3	55.0	62.5	65.0	75.0	73.3	80.0	32.5
PIONEER2545	80.1 h	75.0	100.0	75.0	80.0	53.3	97.5	80.0
OH10-316-20	68.4 h	75.0	80.0	67.0	70.0	76.7	80.0	30.0
OH12-263-1	66.3 h	65.0	100.0	73.0	67.5	43.3	85.0	30.0
OH12-195-22	57.1	55.0	75.0	40.0	70.0	40.0	75.0	45.0
OH12-223-12	60.4	55.0	75.0	43.0	57.5	30.0	92.5	70.0
OH12-319-13	76.1 h	75.0	62.5	80.0	87.5	60.0	90.0	77.5
OH12-140-13	63.1	85.0	72.5	57.0	55.0	60.0	52.5	60.0
KWS081	56.7	50.0	37.5	80.0	52.5	66.7	85.0	25.0
KWS083	53.1	55.0	62.5	50.0	47.5	26.7	77.5	52.5
KWS085	44.7 l	20.0	75.0	47.0	60.0	13.3	47.5	50.0
KWS087	56.7	65.0	57.5	60.0	47.5	56.7	85.0	25.0
KWS086	66.6 h	45.0	97.5	63.0	77.5	53.3	60.0	70.0
KY09C-0128-72-2-1	50.1	25.0	62.5	63.0	40.0	40.0	87.5	32.5
X08C-1232-30-6-3	57.3	30.0	52.5	65.0	72.5	43.3	77.5	60.0
X08C-1108-20-4-5	50.3	30.0	40.0	62.0	72.5	20.0	72.5	55.0
KY09C-1021-36-20-3	54.2	65.0	55.0	53.0	67.5	36.7	60.0	42.5
KY09C-1024-97-9-5	64.0 h	50.0	90.0	75.0	57.5	33.3	90.0	52.5
VA14W-41	78.6 h	85.0	99.5	78.0	90.0	40.0	95.0	62.5
DH11SRW063-14	68.5 h	60.0	90.0	90.0	50.0	36.7	82.5	70.0
VA15FHB-11	67.0 h	80.0	87.5	75.0	57.5	56.7	85.0	27.5
VAMD10422-98	60.8	80.0	82.5	68.0	62.5	40.0	50.0	42.5
13VA-FHB-DH131	59.7	70.0	87.5	42.0	85.0	23.3	60.0	50.0
13VA-FHB-DH192	68.3 h	40.0	97.5	70.0	80.0	63.3	57.5	70.0
MI14R0180	52.5	45.0	67.5	70.0	67.5	50.0	45.0	22.5
MI14R0235	35.4 l	15.0	35.0	33.0	52.5	10.0	60.0	42.5
MI14W0447	65.4 h	60.0	97.5	47.0	65.0	63.3	82.5	42.5
MI14W0604	48.0	20.0	70.0	63.0	70.0	13.3	45.0	55.0
MI14R0112	59.7	30.0	80.0	73.0	67.5	30.0	80.0	57.5
MI14W0464	62.1	30.0	77.5	72.0	62.5	60.0	90.0	42.5
0527A1-9-14-4-3-1-1	44.5 l	35.0	70.0	57.0	47.5	26.7	50.0	25.0
0566A1-3-1-6	55.5	40.0	57.5	70.0	80.0	43.3	75.0	22.5
05247A1-7-3-120	62.7	60.0	82.5	60.0	67.5	56.7	70.0	42.5
0566A1-3-1-51	54.6	55.0	75.0	57.0	42.5	50.0	67.5	35.0
05247A1-7-3-114	45.8 l	50.0	77.5	53.0	52.5	20.0	42.5	25.0
IL12-8545	40.9 l	25.0	35.0	33.0	50.0	53.3	70.0	20.0
IL12-13746	42.5 l	35.0	25.0	47.0	60.0	23.3	92.5	15.0
IL12-14179	44.8 l	55.0	20.0	50.0	47.5	43.3	72.5	25.0
IL12-26448	36.9 l	25.0	10.0	75.0	30.0	40.0	55.0	23.2
IL12-30879	34.9 l	15.0	65.0	10.0	42.5	26.7	75.0	10.0
AVERAGE	56.5	49.4	67.4	59.8	60.9	42.8	71.9	42.5
MINIMUM	30.8	15.0	7.5	10.0	26.7	10.0	42.5	10.0
MAXIMUM	80.1	85.0	100.0	90.0	90.0	76.7	97.5	80.0
LSD(0.05)	16.3	.	.	.	.	.	.	.

Table 24. Summary of Fusarium Damaged Kernel (FDK, %) data from the 2015-2016 PNUWWSN.

NAME	AVG	ILURB	KYLEX	MOCOL	OHWOO	VABLA
TRUMAN	13.2 l	18.3	3.7	15.0	8.0	21.0
FREEDOM	37.8 h	36.7			35.0	58.5
ERNIE	37.5 h	63.3	7.0	38.0	30.0	49.0
PIONEER2545	40.7 h	56.7	12.5	50.0	50.0	34.3
OH10-316-20	34.6 h	40.0	3.9	68.0	40.0	21.0
OH12-263-1	41.9 h	70.0	4.1	53.0	55.0	27.5
OH12-195-22	29.2 h	33.3	5.8	43.0	15.0	49.0
OH12-223-12	24.8 l	18.3	10.7	40.0	25.0	30.2
OH12-319-13	31.1 h	46.7	5.7	35.0	30.0	38.0
OH12-140-13	28.1	43.3	7.0	20.0	35.0	35.0
KWS081	29.7 h	26.7	4.3	25.0	55.0	37.5
KWS083	16.5 l	11.7	2.7	20.0	25.0	22.9
KWS085	19.1 l	15.0	6.5	18.0	30.0	26.0
KWS087	23.7 l	26.7	4.2	30.0	20.0	37.5
KWS086	24.6 l	25.0	4.8	30.0	30.0	33.0
KY09C-0128-72-2-1	22.1 l	53.3	3.5	15.0	10.0	28.5
X08C-1232-30-6-3	35.8 h	46.7	7.5	60.0	15.0	50.0
X08C-1108-20-4-5	23.8 l	23.3	6.5	40.0	18.0	31.0
KY09C-1021-36-20-3	21.6 l	30.0	5.9	33.0	15.0	24.0
KY09C-1024-97-9-5	28.3 h	43.3	7.6	53.0	10.0	27.5
VA14W-41	28.1	53.3	7.2	30.0	20.0	30.0
DH11SRW063-14	32.0 h	60.0	5.7	20.0	40.0	34.5
VA15FHB-11	18.8 l	15.0	3.9	28.0	20.0	27.0
VAMD10422-98	24.9 l	33.3	5.2	40.0	10.0	36.0
13VA-FHB-DH131	17.7 l	36.7	3.2	8.0	10.0	30.4
13VA-FHB-DH192	29.4 h	36.7	8.9	20.0	30.0	51.5
MI14R0180	19.9 l	36.7	4.1	25.0	8.0	25.6
MI14R0235	22.8 l	36.7	6.1	15.0	20.0	36.0
MI14W0447	38.7 h	40.0	4.8	78.0	30.0	40.5
MI14W0604	19.4 l	11.7	5.5	15.0	25.0	40.0
MI14R0112	35.2 h	50.0	9.9	43.0	30.0	43.1
MI14W0464	42.9 h	30.0	5.1	40.0	80.0	59.5
0527A1-9-14-4-3-1-1	17.3 l	30.0	3.6	8.0	10.0	35.0
0566A1-3-1-6	25.1 l	56.7	5.3	5.0	18.0	40.5
05247A1-7-3-120	21.7 l	13.3	9.6	23.0	28.0	34.5
0566A1-3-1-51	23.9 l	30.0	7.3	5.0	20.0	57.0
05247A1-7-3-114	21.5 l	20.0	7.0	18.0	25.0	37.4
IL12-8545	11.8 l	8.3	2.4	10.0	10.0	28.5
IL12-13746	21.7 l	23.3	3.8	20.0	20.0	41.5
IL12-14179	16.7 l	25.0	2.9	10.0	15.0	30.5
IL12-26448	17.9 l	30.0	2.4	20.0	8.0	29.0
IL12-30879	14.4 l	15.0	2.0	8.0	12.0	35.0
AVERAGE	25.8	33.8	6.3	29.4	24.5	35.3
MINIMUM	11.8	8.3	2.0	5.0	8.0	21.0
MAXIMUM	42.9	70.0	35.0	78.0	80.0	59.5
LSD(0.05)	14.8	.	.	.	.	.

Table 25. Summary of INC/SEV/FDK (ISK, %) data from the 2015-2016 PNUWWSN

NAME	AVG	ILURB	KYLEX	MOCOL	OHWOO	VABLA
TRUMAN	22.9 l	37.1	17.9	24.0	18.2	17.5
FREEDOM	42.4 h	44.8			37.5	48.9
ERNIE	41.3	63.8	33.0	45.3	32.0	32.6
PIONEER2545	51.4 h	61.1	38.1	59.7	48.0	50.0
OH10-316-20	40.8	53.8	27.8	56.7	45.5	20.0
OH12-263-1	46.7 h	70.6	27.0	52.0	59.0	25.0
OH12-195-22	36.3	39.5	29.7	42.5	30.0	39.6
OH12-223-12	38.2	32.8	31.0	51.1	37.0	38.9
OH12-319-13	46.5 h	58.7	39.7	46.3	44.0	43.8
OH12-140-13	37.6	48.0	26.8	28.7	45.5	39.0
KWS081	39.4	53.9	23.1	39.2	52.5	28.1
KWS083	29.6	29.9	20.0	34.4	34.0	29.6
KWS085	27.5 l	34.7	25.4	23.9	24.5	28.8
KWS087	32.0	45.1	21.4	42.0	25.5	26.2
KWS086	38.2	42.3	32.1	33.9	42.0	40.8
KY09C-0128-72-2-1	30.8	58.2	18.7	39.3	14.0	23.7
X08C-1232-30-6-3	41.6	50.7	33.5	54.3	25.5	44.1
X08C-1108-20-4-5	36.1	45.6	34.2	44.8	22.7	33.0
KY09C-1021-36-20-3	31.7	43.2	32.2	34.7	23.0	25.4
KY09C-1024-97-9-5	40.2	66.4	27.4	54.4	22.0	31.0
VA14W-41	44.7 h	68.8	42.8	45.2	29.0	37.9
DH11SRW063-14	41.3	63.7	26.9	40.2	36.0	39.6
VA15FHB-11	31.0	42.6	25.4	39.9	25.0	22.3
VAMD10422-98	30.5	40.5	27.3	36.0	19.0	29.6
13VA-FHB-DH131	30.8	40.9	36.7	24.2	21.5	30.5
13VA-FHB-DH192	40.9	50.1	38.4	32.0	35.0	49.2
MI14R0180	27.1 l	44.8	26.6	25.9	18.2	19.8
MI14R0235	31.5	37.9	25.8	32.4	30.5	30.7
MI14W0447	41.1	45.0	27.7	60.2	40.0	32.5
MI14W0604	34.1	42.3	29.7	23.9	38.5	36.0
MI14R0112	46.8 h	66.2	32.0	47.3	48.0	40.3
MI14W0464	52.7 h	59.9	26.0	51.4	82.5	43.7
0527A1-9-14-4-3-1-1	25.5 l	42.7	20.0	20.7	19.5	24.4
0566A1-3-1-6	32.5	52.1	32.6	30.3	22.2	25.5
05247A1-7-3-120	31.6	34.2	30.7	32.9	27.2	32.8
0566A1-3-1-51	29.4	36.2	23.8	25.2	25.5	36.1
05247A1-7-3-114	27.7 l	34.1	25.3	29.1	23.5	26.4
IL12-8545	20.6 l	18.8	19.4	28.4	16.0	20.3
IL12-13746	29.8	33.3	23.7	39.8	28.0	24.3
IL12-14179	26.0 l	35.1	19.7	28.9	24.0	22.3
IL12-26448	27.4 l	52.5	14.3	26.8	21.7	21.7
IL12-30879	18.7 l	11.3	18.4	30.4	13.8	19.5
AVERAGE	35.1	46.0	27.9	38.3	31.5	31.3
MINIMUM	18.7	11.3	14.3	20.7	13.8	17.5
MAXIMUM	52.7	70.6	42.8	60.2	82.5	50.0
LSD(0.05)	10.5	.	.	.	.	.

Table 26. Summary of deoxynivalenol (DON, ppm) data from the 2015-2016 PNUWWSN.

NAME	AVG	ILURB	KYLEX	OHWO0	VABLA
TRUMAN	5.9 l	0.2	9.4	12.0	1.9
FREEDOM	8.1 l	1.8		12.6	4.4
ERNIE	14.2	2.9	17.9	34.4	1.8
PIONEER2545	23.1 h	5.9	30.7	47.2	8.4
OH10-316-20	10.0 l	1.1	6.7	30.6	1.4
OH12-263-1	9.6 l	1.0	12.3	22.7	2.5
OH12-195-22	9.6 l	1.2	11.8	22.1	3.3
OH12-223-12	21.5 h	1.7	34.3	44.5	5.4
OH12-319-13	14.4	4.3	22.8	25.4	5.2
OH12-140-13	10.7 l	1.7	16.6	19.6	5.0
KWS081	16.5	1.8	12.6	49.3	2.1
KWS083	7.8 l	1.2	11.5	16.3	2.4
KWS085	9.2 l	1.5	12.2	20.0	2.9
KWS087	10.5 l	2.3	14.9	23.6	1.3
KWS086	26.0 h	2.7	42.7	49.7	8.9
KY09C-0128-72-2-1	6.1 l	1.3	8.7	13.1	1.4
X08C-1232-30-6-3	12.6	2.1	26.5	17.2	4.6
X08C-1108-20-4-5	12.3	1.4	21.5	22.9	3.3
KY09C-1021-36-20-3	7.3 l	1.6	12.2	14.2	1.4
KY09C-1024-97-9-5	12.3	3.1	23.4	20.4	2.5
VA14W-41	11.8	4.0	12.8	27.0	3.3
DH11SRW063-14	10.8 l	3.5	15.8	18.9	5.0
VA15FHB-11	6.2 l	1.1	8.4	14.3	1.1
VAMD10422-98	6.0 l	1.5	10.8	10.5	1.3
13VA-FHB-DH131	7.8 l	2.1	11.8	14.9	2.4
13VA-FHB-DH192	13.0	1.7	22.1	24.2	4.1
MI14R0180	4.9 l	1.1	10.0	7.8	0.7
MI14R0235	9.3 l	1.4	13.0	19.6	3.3
MI14W0447	15.4	1.9	26.4	30.2	3.2
MI14W0604	14.7	2.5	31.7	20.7	4.1
MI14R0112	14.1	3.2	24.1	24.3	5.0
MI14W0464	22.1 h	1.4	25.2	57.5	4.2
0527A1-9-14-4-3-1-1	10.3 l	1.9	11.0	22.5	5.9
0566A1-3-1-6	7.9 l	2.2	11.4	16.2	1.9
05247A1-7-3-120	12.1	3.7	22.1	17.7	4.9
0566A1-3-1-51	8.7 l	2.0	14.7	13.6	4.5
05247A1-7-3-114	10.5 l	1.9	21.6	15.9	2.5
IL12-8545	3.8 l	0.2	4.0	10.7	0.3
IL12-13746	5.9 l	0.9	8.6	13.6	0.4
IL12-14179	4.5 l	0.7	6.7	10.0	0.8
IL12-26448	2.2 l	0.7	4.8	3.3	0.0
IL12-30879	4.2 l	0.2	5.8	10.3	0.4
AVERAGE	10.8	1.9	16.3	21.7	3.0
MINIMUM	2.2	0.2	4.0	3.3	0.0
MAXIMUM	26.0	5.9	42.7	57.5	8.9
LSD(0.05)	8.9	.	.	.	.

Table 27. Summary of greenhouse severity (GHSEV, %) data from the 2015-2016 PNUWWSN.

		GHSEV
1	TRUMAN	7.5
2	FREEDOM	
3	ERNIE	18.7
4	PIONEER2545	29.8
5	OH10-316-20	15.3
6	OH12-263-1	22.6
7	OH12-195-22	9.5
8	OH12-223-12	28.1
9	OH12-319-13	18.7
10	OH12-140-13	17.5
11	KWS081	20.1
12	KWS083	8.6
13	KWS085	33.3
14	KWS087	5.8
15	KWS086	57.2
16	KY09C-0128-72-2-1	31.8
17	X08C-1232-30-6-3	32.1
18	X08C-1108-20-4-5	19.4
19	KY09C-1021-36-20-3	13.4
20	KY09C-1024-97-9-5	37.5
21	VA14W-41	46.3
22	DH11SRW063-14	37.2
23	VA15FHB-11	13.5
24	VAMD10422-98	14.4
25	13VA-FHB-DH131	10.7
26	13VA-FHB-DH192	22.2
27	MI14R0180	8.2
28	MI14R0235	37.0
29	MI14W0447	18.5
30	MI14W0604	15.9
31	MI14R0112	19.1
32	MI14W0464	13.0
33	0527A1-9-14-4-3-1-1	7.5
34	0566A1-3-1-6	17.6
35	05247A1-7-3-120	12.1
36	0566A1-3-1-51	9.1
37	05247A1-7-3-114	47.8
38	IL12-8545	12.5
39	IL12-13746	11.4
40	IL12-14179	13.4
41	IL12-26448	7.6
42	IL12-30879	21.7

Table 28. Summary of heading date (HD, Julian days) height (HGT, inches), and lodging (LDG) data from the 2015-2016 PNUWWN

ENTRY	NAME	HGT				LDG (0-10) VAWAR	HD AVG	ILCHA	INWLA	KYLEX	MIELA	MOCOL	OHWOO	VAWAR
		AVG	INWLA	KYLEX	VABLA									
1	TRUMAN	38.0	42.7	38.3	33.0	1	136.4 h	135	139	131	149	133	144	124
2	FREEDOM	34.2	29.0		29.0	0	133.9	132			148		141	119
3	ERNIE	34.4	38.6	36.5	28.0	0	130.0 l	129	137	120	146	131	137	110
4	PIONEER2545	34.3	38.6	37.3	27.0	0	133.1	132	138	128	146	130	141	118
5	OH10-316-20	35.3	42.2	33.8	30.0	0	132.4	130	138	126	146	130	140	118
6	OH12-263-1	35.4	39.8	35.5	31.0	0	133.6	132	137	129	148	131	141	118
7	OH12-195-22	33.2	38.1	32.5	29.0	0	131.8	130	138	124	146	128	140	116
8	OH12-223-12	34.1	39.8	32.5	30.0	0	131.3	129	136	125	146	130	138	116
9	OH12-319-13	34.3	39.1	33.8	30.0	0	133.3	131	138	128	148	131	139	118
10	OH12-140-13	35.5	39.6	36.0	31.0	1	133.1	131	138	126	147	132	141	117
11	KWS081	37.5	42.6	37.8	32.0	0	132.7	131	138	125	147	130	139	119
12	KWS083	33.8	38.8	34.8	28.0	1	133.9	132	139	127	147	132	141	119
13	KWS085	38.3	43.5	36.5	35.0	0	132.4	131	138	126	146	130	138	118
14	KWS087	34.2	41.0	31.8	30.0	0	131.8	131	136	126	146	128	139	117
15	KWS086	36.8	44.0	34.5	32.0	0	132.8	132	138	125	147	131	139	118
16	KY09C-0128-72-2-1	38.7	45.9	37.3	33.0	0	132.1	132	138	124	148	130	139	115
17	X08C-1232-30-6-3	33.7	38.8	32.3	30.0	0	132.4	131	137	126	147	130	139	118
18	X08C-1108-20-4-5	34.0	39.0	34.0	29.0	0	132.6	131	137	126	146	131	139	118
19	KY09C-1021-36-20-3	34.7	39.0	35.3	30.0	0	132.9	131	137	127	146	131	140	118
20	KY09C-1024-97-9-5	35.3	40.3	35.5	30.0	0	132.2	132	137	124	147	131	140	115
21	VA14W-41	32.6	37.9	33.0	27.0	0	130.1 l	130	135	122	146	128	138	112
22	DH11SRW063-14	30.9 l	36.8	30.0	26.0	0	130.0 l	133	138	120	148	128	139	105
23	VA15FHB-11	34.0	40.1	34.0	28.0	0	132.2	131	138	124	146	130	141	116
24	VAMD10422-98	32.3 l	39.2	30.8	27.0	0	132.8	133	138	123	148	132	141	115
25	13VA-FHB-DH131	32.0 l	37.4	31.8	27.0	0	131.1	130	136	124	146	128	139	115
26	13VA-FHB-DH192	34.2	39.0	33.8	30.0	1	129.6 l	129	135	121	145	128	137	112
27	MI14R0180	34.8	37.9	36.5	30.0	0	131.9	130	136	124	146	132	139	116
28	MI14R0235	36.1	43.6	35.8	29.0	0	132.6	131	139	125	148	130	139	117
29	MI14W0447	35.4	41.3	35.0	30.0	1	133.5	133	137	125	147	131	142	119
30	MI14W0604	39.7 h	43.9	40.3	35.0	1	136.2 h	135	141	131	149	133	145	120
31	MI14R0112	35.5	40.7	35.8	30.0	0	133.9	132	139	129	148	131	142	117
32	MI14W0464	41.1 h	44.8	41.5	37.0	0	135.3 h	134	141	130	148	131	143	120
33	0527A1-9-14-4-3-1-1	37.3	43.2	36.8	32.0	0	134.7	133	140	129	148	133	142	118
34	0566A1-3-1-6	33.6	39.0	33.8	28.0	0	131.0	131	135	125	145	127	140	115
35	05247A1-7-3-120	30.3 l	33.3	30.5	27.0	0	130.3 l	129	135	123	146	128	138	113
36	0566A1-3-1-51	31.5 l	36.2	33.3	25.0	0	129.8 l	129	135	121	145	128	138	112
37	05247A1-7-3-114	30.5 l	34.1	31.3	26.0	0	128.9 l	130	136	121	145	124	137	109
38	IL12-8545	36.0	40.6	37.3	30.0	0	131.9	130	136	125	146	130	139	118
39	IL12-13746	32.2 l	38.8	32.8	25.0	0	129.1 l	129	135	120	143	127	136	114
40	IL12-14179	35.3	39.4	37.5	29.0	1	129.3 l	127	134	123	144	128	135	115
41	IL12-26448	33.2	38.5	35.3	26.0	0	129.1 l	128	136	121	143	126	135	115
42	IL12-30879	34.4	39.6	34.8	29.0	0	131.6	131	137	123	146	130	139	116
100	AVERAGE	34.7	39.7	34.8	29.5	.	132.1	131	138	125	146	130	140	.
101	MINIMUM	30.3	29.0	30.0	25.0	.	128.9	127	134	120	119	124	135	.
102	MAXIMUM	41.1	45.9	41.5	37.0	.	136.4	135	148	141	149	133	145	.
103	LSD(0.05)	2.2	.	.	.	.	1.6	.	.	.	.	.	.	.

Table 30. Presence or absence of FHB QTL in the 2015-2016 NUWWSN entries. Entries were also genotyped for Rht, Ppd, Vrn,rust, PM, Hessian Fly, BYDV, rye translocation, and quality genes. That data is available in an excel file from sneller.5@osu.edu. Data is from the USDA Eastern Regional Small Grains Genotyping Lab , Raleigh NC.

Entry		Fhb1	Fhb_Massey_3BL	Fhb_2DL-Wuhan/W14	Fhb_5A
1	TRUMAN	no	no	no	no
2	FREEDOM	no	Fhb_Massey_3BL_het	no	no
3	ERNIE	no	Fhb_Massey_3BL_het	no	no
4	PIONEER2545	no	no	no	no
5	OH10-219-65	no	no	no	no
6	OH09-207-68	no	no	no	no
7	OH08-206-69	no	no	no	no
8	OH11-118-18	Fhb1	no	no	no
9	KWS060	no	Fhb_Massey_3BL	no	no
10	KWS072	no	no	no	no
11	KWS074	no	no	no	no
12	KWS078	no	no	no	no
13	KY09C-0052-26-12-3	no	no	no	no
14	X08C-1070-73-18-1	Fhb1	no	no	Fhb_5A_Ning7840?
15	X09-0187-112-14-1	no	no	no	no
16	KY09C-1024-96-1-3	Fhb1	no	no	no
17	KY09C-0601-39-8-1	Fhb1_het	no	no	no
18	NY05158-833	Fhb1	no	no	no
19	NY05158-864	Fhb1	no	no	no
20	NY05158-841	Fhb1	no	no	no
21	NY05158-859	Fhb1	no	no	no
22	NY99069-352	no	no	no	Fhb_5A_Ernie
23	VA14W-6	no	no	no	no
24	VA10W-21BSR124	no	no	no	no
25	VA14FHB-22	no	no	no	no
26	VA14FHB-31	no	no	no	no
27	MI14R0233	no	no	no	Fhb_5A_Ernie
28	MI14R0082	Fhb1	no	no	no
29	MI14W0217	no	no	no	Fhb_5A_Ernie
30	MI14R0080	no	no	Fhb_2DL-Wuhan/W14_het	Fhb_5A_Ning7840_het
31	MI14R0109	no	no	Fhb_2DL-Wuhan/W14	Fhb_5A_Ning7840_het
32	0762A1-2-8	Fhb1	no	no	Fhb_5A_Ernie_het
33	05247A1-7-3-108-2	no	Fhb_Massey_3BL	no	ND
34	0566A1-3-1-52	no	no	no	no
35	05247A1-7-3-120	no	Fhb_Massey_3BL	no	Fhb_5A_Ernie_het
36	04620A1-1-7-4-17	no	no	no	no
37	ES14-0937	no	no	no	Fhb_5A_Ernie
38	ES14-1398	no	no	no	no
39	ES14-1860	no	no	no	no
40	ES14-1847	no	no	no	no
41	IL10-21934	no	no	no	no
42	IL10-21937	no	no	no	no
43	IL11-6543	no	no	no	no
44	IL11-28222	no	no	no	no
45	IL12-5110	no	no	no	no
46	NE13625	no	no	no	no
47	NE13515	no	no	no	no
48	NE05548	no	no	no	no
49	NE13604	no	no	no	no
50	NI12702W	no	no	no	no

Table 31. Presence or absence of FHB QTL in the 2015-2016 PNUWWSN entries. Entries were also genotyped for Rht, Ppd, Vrn,rust, PM, Hessian Fly, BYDV, rye translocation, and quality genes. That data is available in an excel file from sneller.5@osu.edu. Data is from the USDA Eastern Regional Small Grains Genotyping Lab, Raleigh NC.

Entry		Fhb1	Fhb_Massey_3BL	Fhb_2DL-Wuhan/W14	Fhb_5A
1	TRUMAN	no	no	no	no
2	FREEDOM	no	Fhb_Massey_3BL	no	Fhb_5A_Ning7840?
3	ERNIE	no	Fhb_Massey_3BL_het	no	Fhb_5A_Ernie_het
4	PIONEER2545	no	no	no	no
5	OH10-316-20	no	no	no	Fhb_5A_Ning7840?
6	OH12-263-1	no	no	no	Fhb_5A_Ernie
7	OH12-195-22	no	no	no	no
8	OH12-223-12	no	no	no	no
9	OH12-319-13	no	no	no	no
10	OH12-140-13	no	no	no	no
11	KWS081	no	no	no	no
12	KWS083	no	no	no	no
13	KWS085	no	no	no	no
14	KWS087	no	no	no	no
15	KWS086	no	no	no	no
16	KY09C-0128-72-2-1	Fhb1	no	no	no
17	X08C-1232-30-6-3	no	no	no	no
18	X08C-1108-20-4-5	no	no	no	no
19	KY09C-1021-36-20-3	Fhb1	no	ND	no
20	KY09C-1024-97-9-5	Fhb1	no	no	no
21	VA14W-41	no	no	no	no
22	DH11SRW063-14	no	no	no	no
23	VA15FHB-11	no	no	no	Fhb_5A_Ernie
24	VAMD10422-98	Fhb1	no	no	no
25	13VA-FHB-DH131	no	no	no	no
26	13VA-FHB-DH192	no	no	no	no
27	MI14R0180	no	no	no	no
28	MI14R0235	no	no	no	Fhb_5A_Ernie
29	MI14W0447	Fhb1	no	no	no
30	MI14W0604	no	no	no	no
31	MI14R0112	no	no	no	no
32	MI14W06464	no	no	no	no
33	0527A1-9-14-4-3-1-1	no	no	no	Fhb_5A_Ning7840?
34	0566A1-3-1-6	no	no	no	no
35	05247A1-7-3-120	no	Fhb_Massey_3BL	ND	Fhb_5A_Ernie
36	0566A1-3-1-51	no	no	no	no
37	05247A1-7-3-114	no	Fhb_Massey_3BL_het	no	Fhb_5A_Ernie
38	IL12-8545	Fhb1	no	no	Fhb_5A_Ernie
39	IL12-13746	no	no	no	no
40	IL12-14179	no	no	no	no
41	IL12-26448	Fhb1	no	no	Fhb_5A_Ernie
42	IL12-30879	Fhb1	no	no	no

Table 32. Quality parameters for the 2015-2016 NUWWSN. Data is from the USDA Soft Wheat Quality Lab. Additional analytical data is available in an excel file from sneller.5@osu.edu.

Entry	Test Weight (LB/BU)	NIR Kernel Protein (at 12%)	SKCS Kernel Hardness	SKCS Kernel Diameter (mm)	SKCS Kernel Weight (mg)	Adjusted Flour Yield (%)	Adjusted Flour Yield % Rank	Adjusted Flour Yield % Grade	Softness Equivalent (%)	Flour Protein (at 14%)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)
TRUMAN	59.2	10.2	14.7	2.6	33.4	66.0	34	F	56.7	8.2	100.2	67.6
FREEDOM	57.1	10.8	17.0	2.7	32.4	66.3	27	F	55.6	8.3	93.4	66.2
ERNIE	57.8	11.1	7.4	2.9	37.2	65.8	37	F	54.8	8.6	115.9	69.5
PIONEER 2545												
OH10-219-65	58.7	10.6	9.9	2.7	33.3	66.3	28	F	58.2	8.3	100.0	68.3
OH09-207-68	58.5	9.7	7.1	2.8	36.4	68.8	8	C	58.3	7.9	110.2	71.4
OH08-206-69	61.5	11.1	13.7	2.9	37.4	69.8	5	B	53.2	9.3	113.3	65.7
OH11-118-18	61.8	10.6	30.5	2.7	33.6	65.5	43	F	52.8	8.9	110.2	70.0
KWS060	58.1	9.4	5.1	2.8	34.9	68.6	10	C	61.7	7.5	107.5	67.0
KWS072	60.6	10.7	22.3	3.0	41.5	65.8	36	F	49.9	8.6	124.9	79.8
KWS074	58.5	9.7	8.7	2.7	30.7	65.2	46	F	61.9	7.8	118.9	71.5
KWS078	59.5	10.9	10.9	2.9	37.7	69.1	6	C	57.1	8.5	124.2	68.5
JAMESTOWN	60.2	11.1	15.4	2.9	36.3	65.5	41	F	52.8	8.6	126.3	77.2
KY09C-0052-26-12-3	60.7	9.8	18.5	2.8	34.7	70.0	4	B	59.4	8.0	113.3	68.6
X08C-1070-73-18-1	59.3	11.4	30.1	2.9	36.9	65.8	38	F	46.3	9.2	120.8	69.1
X09-0187-112-14-1	60.6	10.3	15.2	3.0	40.9	68.0	13	D	56.2	8.5	138.0	66.6
KY09C-1024-96-1-3	57.6	10.3	18.3	2.8	34.1	66.3	26	F	56.3	8.4	96.1	66.5
KY09C-0601-39-8-1	61.6	11.3	19.2	2.8	36.1	68.9	7	C	51.4	9.0	103.1	63.8
NY05158-833	57.7	10.8	13.8	2.8	32.0	64.7	49	F	60.3	8.5	86.7	66.8
NY05158-864	58.2	10.9	13.4	2.8	33.5	65.0	47	F	59.0	8.4	88.7	67.4
NY05158-841	57.7	10.7	13.2	2.8	33.1	64.3	52	F	59.9	8.4	82.7	66.9
NY05158-859	58.1	11.0	14.1	2.8	33.7	64.7	50	F	59.1	8.5	89.3	67.6
NY99069-352	57.4	9.7	10.6	2.7	31.7	67.9	14	D	58.0	7.8	88.5	64.2
TRIBUTE	61.9	10.8	29.1	2.8	35.2	66.9	21	D	53.1	8.9	124.3	73.6
VA14W-6	58.2	11.3	17.8	2.9	36.3	66.0	32	F	51.6	8.9	101.1	69.6
VA10W-21BSR124	59.0	9.2	45.6	2.8	34.1	70.5	3	B	49.7	7.4	119.5	80.4
VA14FHB-22	60.5	10.4	23.6	2.8	35.5	67.2	19	D	56.7	8.4	116.1	73.0
VA14FHB-31	60.0	10.7	18.0	2.9	36.7	65.5	42	F	53.7	8.1	125.8	76.8
M14R0233	58.2	12.2	15.2	2.8	33.9	65.8	39	F	53.5	9.7	117.5	66.7
M14R0082	58.7	11.6	29.2	2.8	32.2	62.9	55	F	51.5	9.5	80.5	72.7
M14W0217	58.9	10.3	12.1	2.7	34.2	66.5	23	F	58.1	8.4	104.5	68.0
M14R0080	58.3	10.1	9.8	2.7	29.9	65.7	40	F	60.4	8.0	110.9	68.0
M14R0109	59.3	10.4	14.0	2.8	31.0	64.3	53	F	57.4	8.2	95.9	70.2
PIONEER 26R10	58.0	10.3	9.5	2.8	37.1	67.4	18	D	65.0	8.1	106.7	71.7
0762A1-2-8	57.3	9.6	12.7	2.9	36.1	66.2	30	F	57.3	8.1	100.7	68.6
05247A1-7-3-108-2	59.3	10.9	24.5	2.8	34.2	65.9	35	F	55.4	8.9	112.7	73.3
0566A1-3-1-52	56.5	10.7	20.2	2.8	32.0	64.5	51	F	58.6	8.8	113.1	73.3
05247A1-7-3-120	59.2	10.7	20.3	2.7	33.0	66.3	25	F	55.9	8.5	104.8	74.5
04620A1-1-7-4-17	58.4	10.9	20.5	2.8	34.7	63.2	54	F	54.9	8.3	100.5	73.4
ES14-0937	58.8	10.3	5.8	2.7	33.8	66.0	33	F	59.2	8.6	123.5	67.6
ES14-1398	59.2	10.2	19.8	2.8	35.6	66.5	22	F	51.8	8.2	127.9	71.4
ES14-1860	60.4	10.8	18.2	2.7	31.3	67.4	17	D	57.2	9.0	124.4	68.8
ES14-1847	58.6	10.2	9.5	2.8	33.6	65.2	45	F	60.6	8.5	83.0	70.2
BRANSON	58.4	10.4	7.9	2.7	34.3	67.4	16	D	59.5	8.4	122.0	68.6
IL10-21934	59.2	9.6	12.3	2.8	36.5	66.1	31	F	52.4	8.2	121.2	69.3
IL10-21937	59.1	9.7	18.8	2.9	37.3	64.8	48	F	48.8	8.4	121.6	72.5
IL11-6543	61.3	10.4	10.8	2.8	34.0	66.2	29	F	56.9	8.8	116.5	65.7
IL11-28222	60.0	10.2	23.2	2.7	28.1	66.9	20	D	56.7	8.2	110.8	68.0
IL12-5110	59.8	10.5	7.4	2.7	31.4	66.5	24	F	57.8	8.8	118.1	64.0
NE13625	60.1	10.1	53.8	2.8	34.6	70.6	2	B	47.6	9.3	124.7	70.5
NE13515	60.0	11.5	62.1	2.7	32.4	68.8	9	C	45.1	10.4	130.5	82.1
NE05548	58.3	11.6	50.9	2.7	32.6	72.6	1	A	47.6	10.3	122.5	70.6
NE13604	59.7	11.3	69.4	2.9	36.2	68.3	11	C	40.4	9.9	122.1	80.1
NI12702W	62.1	11.5	79.0	2.8	35.4	65.4	44	F	33.1	10.1	125.3	92.9
HILLIARD	59.5	10.1	12.9	2.7	34.7	67.5	15	D	60.3	8.1	124.3	73.0
SHIRLEY	57.4	10.2	3.9	2.7	35.8	68.2	12	D	58.6	7.9	93.3	70.3
Average	59.2	10.5	20.7	2.8	34.5	66.7			55.0	8.6	111.3	70.9
Standard Deviation	1.3	0.6	15.9	0.1	2.5	1.9			5.6	0.6	14.1	5.1

Table 33. Quality parameters for the 2015-2016 PNUWWSN. Data is from the USDA Soft Wheat Quality Lab. Additional analytical data is available in an excel file from sneller.5@osu.edu.

Entry	Test Weight (LB/BU)	NIR Kernel Protein (at 12%)	SKCS Kernel Hardness	SKCS Kernel Diameter (mm)	SKCS Kernel Weight (mg)	Adjusted Flour Yield (%)	Adjusted Flour Yield % Rank	Adjusted Flour Yield % Grade	Softness Equivalent (%)	Flour Protein (at 14%)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)
TRUMAN	58.3	9.6	10.7	2.5	31.8	65.9	32	F	58.4	7.7	103.1	68.5
FREEDOM	56.7	10.3	13.1	2.7	31.0	66.4	25	F	57.7	8.0	92.7	66.5
ERNIE	57.8	10.5	3.2	2.9	36.7	66.2	27	F	56.5	8.4	114.7	70.2
PIONEER2545	58.0	10.0	5.6	2.8	37.8	67.7	12	D	65.7	8.0	107.4	71.9
OH10-316-20	58.5	9.8	18.6	2.8	36.7	67.0	20	D	57.4	7.9	120.1	72.6
OH12-263-1	58.5	10.3	10.7	2.6	30.5	64.6	42	F	56.4	8.4	102.5	67.3
OH12-195-22	57.0	10.0	9.3	2.7	32.5	64.1	43	F	59.3	8.5	96.9	76.1
OH12-223-12	60.6	10.9	5.2	2.8	36.5	70.7	2	B	58.3	8.7	126.4	65.9
OH12-319-13	58.1	10.3	17.7	2.8	36.8	66.8	22	F	53.8	8.3	103.9	68.8
OH12-140-13	57.4	10.2	9.3	2.7	33.7	67.0	19	D	56.3	8.1	91.8	69.4
JAMESTOWN	59.9	10.7	16.9	2.8	35.2	65.2	37	F	53.7	8.4	129.8	77.2
KWS081	56.8	9.8	6.7	2.5	31.0	66.4	26	F	60.9	7.9	112.8	69.5
KWS083	60.9	10.9	30.0	2.7	33.6	63.0	45	F	55.2	9.0	115.1	76.9
KWS085	58.4	9.8	25.4	2.7	31.9	64.6	41	F	58.5	7.5	106.5	71.9
KWS087	57.5	10.2	6.8	2.8	37.4	67.6	13	D	57.2	8.2	93.8	70.2
KWS086	57.6	10.2	2.6	2.9	38.5	69.2	4	C	60.4	8.0	107.1	65.9
KY09C-0128-72-2-1	59.3	10.4	20.8	2.8	33.2	69.0	5	C	52.3	8.7	90.6	66.1
X08C-1232-30-6-3	61.5	10.6	25.6	2.8	35.6	68.6	6	C	53.1	8.9	102.9	70.1
X08C-1108-20-4-5	57.9	9.9	8.8	2.8	35.0	66.6	23	F	60.5	8.3	112.8	71.0
KY09C-1021-36-20-3	58.2	10.0	14.5	2.7	31.5	65.9	30	F	58.2	7.8	89.3	65.1
KY09C-1024-97-9-5	57.1	10.1	12.5	2.8	31.9	65.6	35	F	58.4	8.1	106.2	71.0
TRIBUTE	60.9	10.3	26.2	2.8	35.0	67.2	17	D	54.4	8.4	125.4	75.3
VA14W-41	59.9	10.5	17.5	2.9	36.2	67.7	11	D	53.8	8.5	125.9	72.8
DH11SRW063-14	60.2	10.1	15.4	2.8	39.4	71.1	1	A	56.0	8.2	132.1	69.0
VA15FHB-11	61.2	9.8	15.1	2.7	34.6	68.4	7	C	57.7	8.3	113.3	71.3
VAMD10422-98	60.8	10.9	17.3	2.7	33.3	67.3	14	D	57.8	9.1	120.7	71.5
13VA-FHB-DH131	60.6	11.2	18.5	2.9	38.2	67.7	10	D	51.3	9.2	113.7	69.4
13VA-FHB-DH192	59.8	11.4	13.5	2.8	37.3	68.4	8	C	56.4	9.4	127.0	69.5
M14R0180	60.6	10.7	18.0	2.8	33.8	65.0	38	F	55.3	8.6	115.4	70.9
M14R0235	58.8	12.2	17.0	2.8	34.0	65.6	34	F	51.9	9.7	122.3	68.9
M14W0447	55.6	10.1	19.8	2.7	34.1	66.0	29	F	57.2	8.5	102.0	70.5
M14W0604	56.5	11.1	3.9	2.7	36.1	66.5	24	F	58.0	8.9	79.5	66.3
M14R0112	59.0	11.0	8.6	2.8	37.2	65.9	31	F	57.3	9.1	111.1	71.0
M14W0464	55.2	9.7	6.0	2.6	34.0	70.2	3	B	62.2	7.8	78.7	65.6
PIONEER 26R10	57.9	9.8	8.4	2.8	38.8	67.1	18	D	64.2	8.2	106.6	72.9
0527A1-9-14-4-3-1-1	59.6	10.5	18.7	2.8	35.4	65.3	36	F	57.2	8.3	99.4	71.1
0566A1-3-1-6	57.5	10.7	19.6	2.7	32.3	64.7	40	F	58.7	9.0	114.4	70.3
05247A1-7-3-120	59.0	11.3	19.7	2.7	32.9	65.7	33	F	56.0	8.8	106.4	75.9
0566A1-3-1-51	57.3	11.0	23.8	2.8	33.7	64.1	44	F	57.3	9.0	119.4	75.0
05247A1-7-3-114	58.7	11.4	27.1	2.7	33.0	65.0	39	F	52.9	9.1	103.6	74.9
IL12-8545	59.7	11.2	8.3	2.7	33.1	67.3	16	D	56.4	8.9	119.4	65.8
IL12-13746	58.5	10.2	14.2	2.7	32.5	67.3	15	D	58.5	8.6	125.2	68.4
IL12-14179	59.6	11.0	28.0	2.7	30.9	66.9	21	F	53.7	9.1	102.9	70.1
IL12-26448	58.1	11.4	21.5	2.6	30.5	67.7	9	D	52.5	9.6	109.4	65.3
IL12-30879	58.6	10.0	10.2	2.7	32.9	66.1	28	F	59.7	8.3	125.8	72.9
Average	58.7	10.5	14.9	2.7	34.4	66.7			57.0	8.5	109.5	70.4
Standard Deviation	1.5	0.6	7.2	0.1	2.4	1.7			3.1	0.5	13.0	3.2