

# Report on the 2013-2014 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 and 2. The NUWWSN had 56 entries (& four checks, Table 3) and we obtained phenotypic data on seven traits from 12 locations. The PNUWWSN had 56 entries (& four checks, Table 4) and we obtained phenotypic data from 10 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 8 and 9. We observed good levels of FHB resistance in the 2014 uniform tests though not as good as in the 2013 trials.

- Over 69% of the entries in the PNUWWSN and the NUWWSN had an FHB index < that of Freedom (this was 90% last year)
- Just 2% of the PNUWWSN and 5% of the NUWWSN entries had an FHB index < that of Truman (vs 35% and 14% last year)
- 90% of the PNUWWSN and 65% of the NUWWSN entries had less DON than Freedom
- 63% of the PNUWWSN and 35% of the NUWWSN entries had less DON than Truman

In the NUWWSN, 4 of 60 entries were not significantly different than the most resistant entry for all six FHB traits with an LSD while 13 of 60 entries in the PNUWWSN were not different than the most resistant entry for all six FHB traits (Tables 7a,7b): this is also lower than 2013. This data along with a trend over years suggests that 2014 entries were not as resistant as the 2013 entries: 2013 was one of our best years.

Most of the entries have only native resistance (eg not from Asia, or South America). In the NUWWSN, seven entries had conclusive molecular marker evidence the Asian allele for resistance at Fhb1, two had 5A from Ning and two had 2DL from Wuhan. Over all traits, these seven lines had 87% of the scores of non-FHB1 lines, ranging from 106% for INC (eg. 6% more INC than non-FHB1) to 55% for GHSEV. Two lines (entries 45, 46) had all three Asian QTL. Over all traits these lines had just 66% of the disease that the non-Asian QTL lines had. This ranged from 93% for INC to 43% for IND. These two lines were the most resistant lines in the NUWWSN (Table 7a). There were four entries in the PNUWWSN had conclusive evidence of an Asian QTL at FHB1 (Tables 29). These lines had 3% more disease than the 56 lines without FHB when averaged over all FHB traits.

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 0.36 and 35 of 42 correlations exceeded 0.50 (Table 5a).

Using means over all environments, HD was only moderately correlated ( $r > 0.50$ ) to DON in the PNUWWSN. The correlation of HD with FHB traits varied by environment (Table 5b). There were 86 possible correlations of HD and FHB traits within environments and tests (Table 5b). Of these 86, 52 were positive and significant while just two were negative and significant (INC with HD in MOCOL-NUWWSN and ONRID-PNUWWSN). I would say this was the most consistency of the correlation of HD with FHB traits over environments that I have seen.

## Analysis of changes in FHB resistance from 1998-2014 in the P+NUWWSN

**Objective:** assess the change in FHB resistance for the entries in the PNUWWSN and NUWWSN.

### Methods:

- 1) I used FHB data from 1998 to 2014 PNUWWSN and NUWWSN trials.
- 2) Raw data consisted for means of each entry from each test, from each year, and from each location.
- 3) The mean phenotype of the  $i^{\text{th}}$  line at the  $j^{\text{th}}$  environment ( $y_{ij}$ ) was standardized as

$$y'_{ij} = \frac{y_{ij} - \bar{X}_j}{\sigma_j}$$

where  $y'_{ij}$  is the standardized phenotype of the  $i^{\text{th}}$  line at the  $j^{\text{th}}$  environment,  $\bar{X}_j$  is the mean of all lines in the  $j^{\text{th}}$  environment (env=test/year/location combination) and  $\sigma_j$  is the standard deviation of all lines in the  $j^{\text{th}}$  environment.

- 4) Next the standardized data was used to obtain BLUPs.
- 5) For each line I determined the first year it entered the testing. This is referred to as “year”. I then obtained the mean BLUP for all lines with the same “year” and then expressed “Year” as a deviation from 1998 (eg 1998=0, 1999=1, etc). The mean was then regressed on the “year”.
- 6) I used raw data to determine % of lines that a) had trait values  $\leq$  that of resistant check (Truman), b) had trait values  $\leq$  that of moderate resistant checks (average of Ernie and Freedom), c) had trait values  $\geq$  that of susceptible check (PIO 2545).

### Results/Discussion:

It should be noted that this analysis of the trends in the P+NUWWSN is not equal to a detailed analysis of gains from selection for FHB resistance. The lines are submitted from multiple breeders for multiple reasons: the entries are not necessarily their most resistant lines from a given stage of selection, they are just lines they want more information on. The criteria that breeders use to decide to enter a line can vary by breeder and by year: one year could be elite material, another could be germplasm.

In the analysis of trends over years, data from 2000 was omitted as it was a distinct outlier for all traits. Using the standardized BLUPs there was trend for decreasing trait value with increasing “year”: lines entered later in the trials were more resistant. When analyzed over all years this trend was only significant for SEV, IND (Fig 1). I have been told that in the early years of the FHB trials that there was primarily an interest in finding resistance while ignoring yield. In later years (say year 5 onward), breeders started testing lines that could combine yield and FHB resistance. Thus around years 4 to 6, FHB scores appeared to increase, perhaps due to submitting lines with less FHB resistance but more yield, and then begin to decline. Analysis the trends from years 5 to year 16 showed a significant increase of resistance for all traits except FDK and GHSEV (Fig 1).

The trend described above is also visible when looking at % lines with trait values  $<$  the MR checks (average of Ernie, Freedom). This percentage appears to increase for all traits except DON and GHSEV (Fig. 2). It is particularly noticeable for SEV and IND. For IND and DON the % of lines  $\geq$  than the susceptible check has decreased in recent years (Fig. 3).

### Conclusion:

Breeders are improving resistance with the biggest impact being seen for FHB Index.

Supplementary Table 1. Percentage of entries in a test that had scores  $\leq$  the resistant check,  $\geq$  the MR checks, or  $\geq$  the Susceptible check.

YEAR	TEST	% < Resistant check (Truman)						% < MR checks (Ernie, Freedom)						% > Susceptible check (PIO 2545)						No entries in test/yr					
		INC	SEV	IND	FDK	ISK	DON	GHS	INC	SEV	IND	FDK	ISK	DON	GHS	INC	SEV	IND	FDK		ISK	DON	GHS		
1998	NUWWSN																							33	
1999	NUWWSN																								28
2000	NUWWSN	16.7	33.3	16.7	20.0	10.0	20.0	16.7		26.7	30.0	40.0	63.3	50.0	66.7	33.3	3.3	13.3	6.7	0.0	6.7	3.3	10.0	30	
2001	NUWWSN	0.0	10.2	2.0	2.0	0.0	10.2	8.2		42.9	30.6	36.7	40.8	36.7	53.1	40.8	2.0	8.2	2.0	10.2	0.0	20.4	4.1	49	
2002	NUWWSN	0.0	0.0	0.0	0.0	0.0	0.0	0.0		47.8	8.7	39.1	41.3	37.0	65.2	15.2	15.2	6.5	17.4	0.0	0.0	0.0	17.4	46	
2003	NUWWSN	0.0	0.0	0.0	0.0	0.0	0.0	0.0		33.3	20.4	37.0	38.9	31.5	74.1	18.5	0.0	14.8	14.8	3.7	1.9	7.4	51.9	54	
2004	NUWWSN	1.8	0.0	0.0	12.5	1.8	12.5	0.0		44.6	46.4	44.6	44.6	48.2	41.1	16.1	0.0	1.8	0.0	7.1	1.8	14.3	23.2	56	
2005	NUWWSN	13.2	18.9	11.3	18.9	5.7	37.7	20.8		50.9	34.0	26.4	45.3	35.8	56.6	34.0	1.9	1.9	3.8	0.0	1.9	15.1	34.0	53	
2005	PNUWWSN	47.1	0.0	2.9	0.0	23.5	32.4	0.0		41.2	35.3	47.1	32.4	32.4	32.4	52.9	14.7	5.9	8.8	0.0	5.9	11.8	20.6	34	
2006	NUWWSN	3.4	0.0	8.6	12.1	10.3	24.1	0.0		39.7	62.1	58.6	46.6	55.2	58.6	43.1	1.7	5.2	0.0	0.0	0.0	3.4	24.1	58	
2006	PNUWWSN	5.0	7.5	2.5	5.0	12.5	10.0	25.0		42.5	50.0	42.5	37.5	37.5	52.5	42.5	2.5	10.0	0.0	2.5	0.0	2.5	10.0	40	
2007	NUWWSN	6.7	0.0	1.7	3.3	1.7	16.7	0.0		48.3	41.7	30.0	51.7	40.0	60.0	36.7	3.3	1.7	1.7	5.0	3.3	1.7	5.0	60	
2007	PNUWWSN	0.0	0.0	0.0	18.2	9.1	6.8	22.7		22.7	47.7	34.1	50.0	47.7	65.9	27.3	2.3	9.1	6.8	6.8	4.5	20.5	97.7	44	
2008	NUWWSN	5.0	3.3	5.0	6.7	8.3	15.0	1.7		46.7	38.3	41.7	46.7	50.0	45.0	38.3	1.7	1.7	1.7	5.0	1.7	3.3	8.3	60	
2008	PNUWWSN	3.3	11.7	15.0	11.7	30.0	50.0	21.7		28.3	25.0	31.7	45.0	48.3	46.7	40.0	1.7	0.0	1.7	1.7	0.0	3.3	0.0	60	
2009	NUWWSN	5.0	3.3	3.3	6.7	6.7	33.3	0.0		40.0	20.0	23.3	55.0	33.3	61.7	20.0	1.7	1.7	0.0	0.0	0.0	10.0	15.0	60	
2009	PNUWWSN	0.0	10.9	13.0	6.5	4.3	6.5	10.9		39.1	41.3	45.7	43.5	37.0	82.6	50.0	2.2	6.5	4.3	4.3	6.5	4.3	2.2	46	
2010	NUWWSN	10.0	35.0	21.7	0.0	10.0	21.7	5.0		50.0	35.0	58.3	41.7	45.0	55.0	31.7	0.0	6.7	1.7	0.0	5.0	5.0	33.3	60	
2010	PNUWWSN	3.9	7.8	5.9	0.0	3.9	2.0	31.4		51.0	45.1	51.0	41.2	51.0	58.8	27.5	5.9	0.0	0.0	5.9	3.9	15.7	9.8	51	
2011	NUWWSN	1.7	15.0	0.0	1.7	0.0	11.7	8.3		83.3	48.3	68.3	66.7	56.7	70.0	46.7	3.3	1.7	1.7	0.0	0.0	0.0	38.3	60	
2011	PNUWWSN	0.0	0.0	0.0	0.0	0.0	25.0	0.0		42.5	60.0	72.5	72.5	70.0	82.5	47.5	7.5	0.0	0.0	0.0	0.0	5.0	0.0	40	
2012	NUWWSN	3.3	1.7	15.0	13.3	6.7	53.3	11.7		51.7	43.3	68.3	45.0	55.0	41.7	25.0	0.0	1.7	0.0	6.7	0.0	6.7	3.3	60	
2012	PNUWWSN	51.0	55.1	34.7	16.3	34.7	75.5	4.1		57.1	59.2	87.8	75.5	71.4	71.4	30.6	0.0	20.4	2.0	4.1	2.0	6.1	44.9	49	
2013	NUWWSN	1.7	1.7	1.7	20.0	10.0	26.7	1.7		51.7	31.7	36.7	53.3	46.7	53.3	55.0	3.3	1.7	1.7	1.7	1.7	1.7	10.0	60	
2013	PNUWWSN	2.2	0.0	0.0	2.2	0.0	23.9	0.0		56.5	52.2	56.5	58.7	50.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	46	
2014	NUWWSN	1.7	3.3	5.0	20.0	10.0	40.0	16.7		63.3	45.0	40.0	51.7	38.3	61.7	50.0	11.7	1.7	1.7	1.7	3.3	1.7	20.0	60	
2014	PNUWWSN	5.0	6.7	1.7	41.7	20.0	70.0	10.0		85.0	71.7	73.3	96.7	91.7	80.0	46.7	0.0	0.0	0.0	1.7	0.0	3.3	0.0	60	

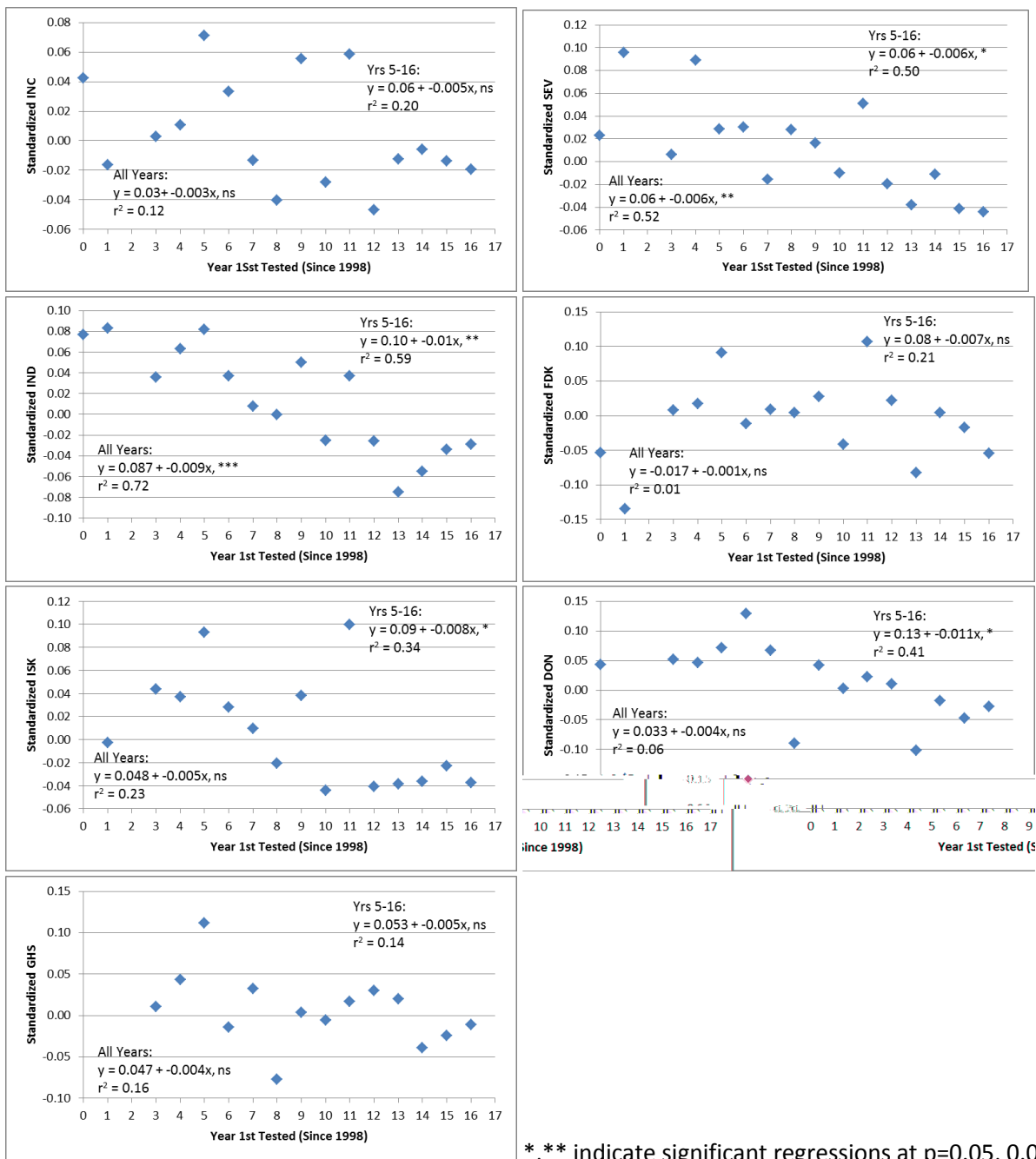


Figure 1. Regression of average disease scores of lines first tested in a particular year, on the year they were first tested. Regression was done 1) over all years, and 2) over just years 5 to 16.

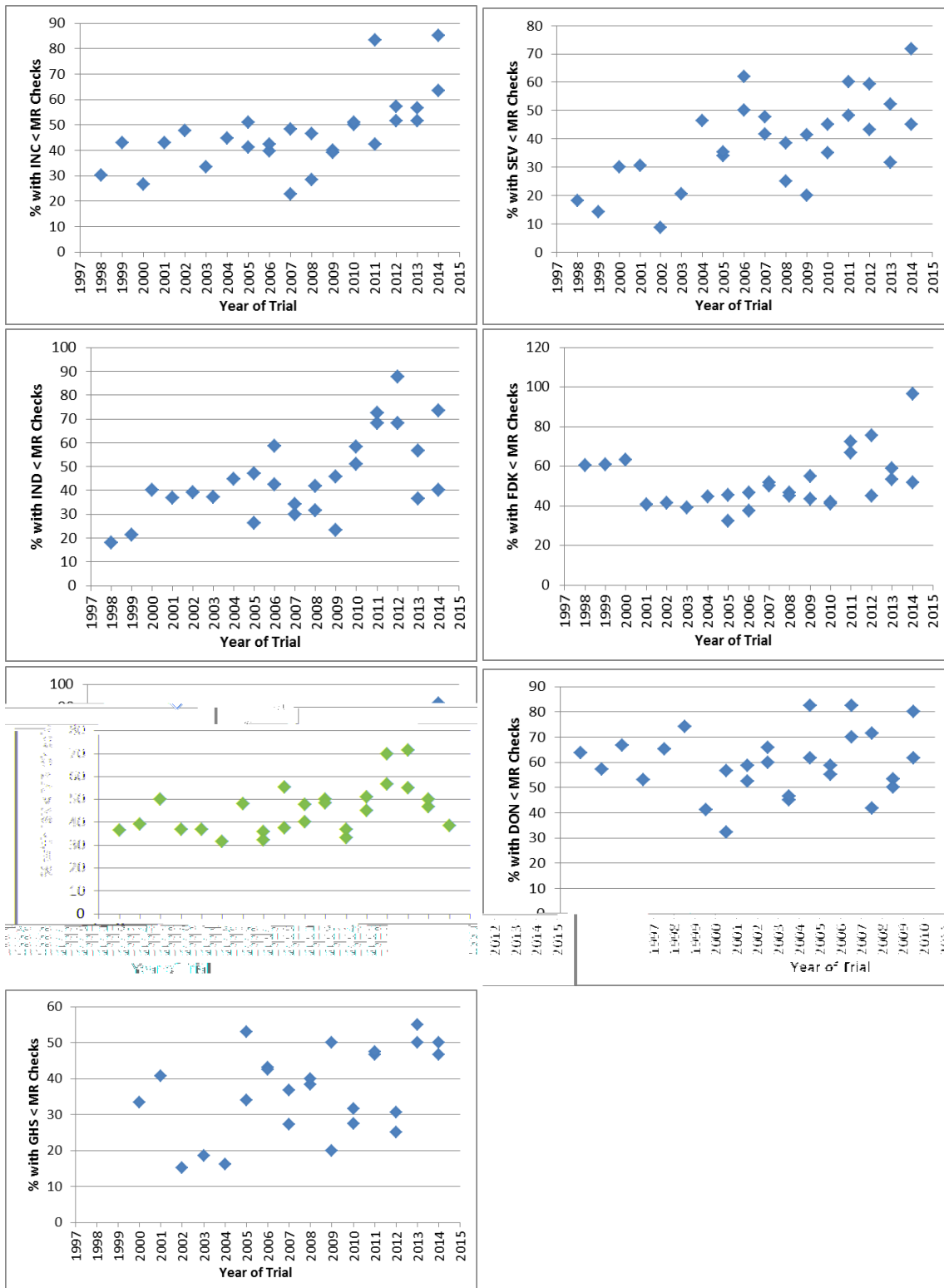


Figure 2. Percentage of entries with disease scores  $\leq$  that of the MR checks (average of Ernie and Freedom) in each year of testing. Starting in 2005 there are two data points per year, one for the NUWWSN and one for the PNUWWSN.

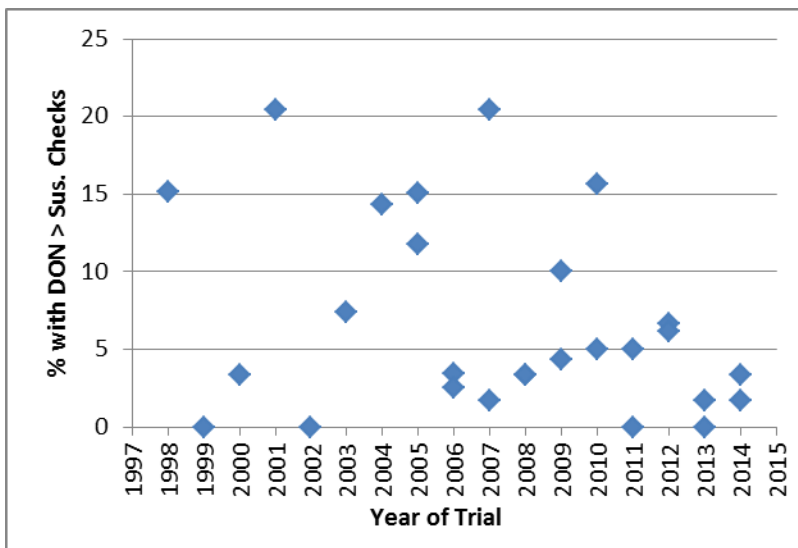
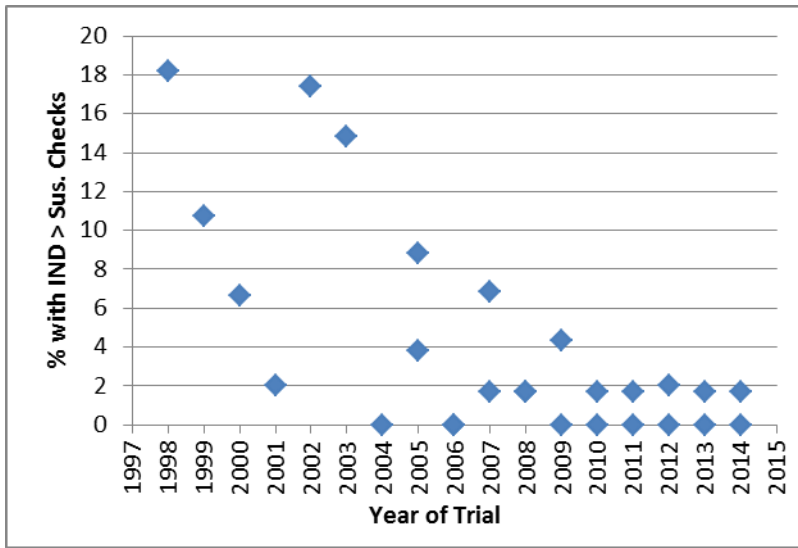


Figure 3. Percentage of entries with disease scores  $\geq$  that of the susceptible check (Pioneer 2545) in each year of testing. Starting in 2005 there are two data points per year, one for the NUWWSN and one for the PNUWWSN.

Table 1. Cooperators in the 2013-2014 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
INWLA	W. Lafayette, IN	yes	yes	Herb Ohm	Purdue University	PUR
INHIG	High Bottom, IN	yes	no	Jennifer Vonderwall	Syngenta	SYN
INTHO	,IN	no	yes	Jennifer Vonderwall	Syngenta	SYN
KYLEX	Lexington, KY	yes	yes	David Van Sanford	University of Kentucky	UKY
MIELA	East Lansing, MI	yes	yes	Russ Freed, Lee Siler	Michigan State University	MSU
MOCOL	Columbia, MO	yes	yes	Anne McKendry, David Teague	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
OHWOO	Wooster, Ohio	yes	yes	Clay Sneller, Pierce Paul	The Ohio State University	OSU
ONRID	Ridgetwon, Ontario	yes	yes	Lily Tamburic	University of Guelph Ridgetown	UGR
VABLA	Blacksburg, VA	yes	yes	Carl Griffey	Virginia Tech	VAT



Table 2. Traits assessed in 2012-13 P+NUWWSN

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

\* data was reported but not used due to very low levels.

Table 3. Entries in the 2013-2014 NUWWSN

ENTRY	NAME	PEDIGREE
1	TRUMAN	
2	ERNIE	
3	FREEDOM	
4	PIONEER2545	
5	NY01016-AN	Caledonia x D8006
6	NY01066-278	Pio 2737W Composite: 96006,14,33,70,76,157
7	NY99059-249	NY87048W-7387/Caledonia (13+18+20)
8	NY99069-249	NY88024-117 x Va96W-250(sisson)
9	NY99069-352	NY88024-117 x Va96W-250(sisson)
10	KWS023	B990399 / M00-3701
11	KWS024	Sunburst / SE97 1054-2
12	KWS025	90C-054-6 /x McCormick / 2552*
13	KWS028	Va03W-409 / X00-1079
14	L29230	B980582/G390299
15	LCS321	IL99-26442/VA02W-555
16	E6012	Caledonia / Pioneer Brand 25W33
17	F0036R	D6234/W14//E0038-1/3/E0038-1
18	F0039	D8006/CJ 9306//Caledonia/3/Caledonia/4/Caledonia
19	F1014	D6234/W14//E0038-1/3/E0038-1
20	OH07-263-3	OH748/BRAVO
21	OH08-206-69	P.92226E2-5-3/OH751
22	OH08-269-58	P.92226E2-5-3/OH708
23	0570A1-2-32-5-1-4	INW0412/6/9017C1//92823A1/9218B4/3/P107/4/PATT/5/ACC3130/PATT/7/99751D8/04302A
24	0762A1-2-8	981129A1-45-3/99793RE2-3//INW0301/92145E8-7-7-3-57/3/981477A1/981312A1//INW0316
25	08334A1-31	IL0134159//INW 0411/011007A1-14-2
26	10641B1-9-11-7	07117B1-29-7-1-1/Wheatear//Roane
27	B08-91993	Coker 9553/VA02W-555
28	B09*900256	VA98W-706/K90C-292-4-1
29	M09L-9547	CRAWFORD/PATTON
30	M10-1100#	MILTON//BRANSON/P 25R47
31	M11-1027#	M04-4802//M03-3149/P 25R47
32	M11-2298	M03-3397/M03-3291
33	GL133	25R56 x Huntley
34	GL164	25R56 x Huntley
35	UGRCC2-78	25R47 x ADV Dyno
36	UGRCC5-116	25R56 x Emmit
37	IL09-24328	IL00-8633/ IL01-11445//IL00-8530
38	IL09-3264	B 990081/ IL00-8109
39	IL10-19464	Bess / IL00-8530 // IL00-8530
40	IL10-6855	DH79-002T-B-B / IL00-8530
41	KY05C-1020-4-6-5	981517A1-1-5-2/25R18
42	KY05C-1105-43-6-1	Roane/Truman//KY98C-1440-01
43	KY06C-3003-43-13-3	Truman/McCormick//KY97C-0519-04-05
44	KY204604	KY97C-0321-05-2*4/VA01W476
45	MD08-22-22-13-4	MD08-22-22-13-4
46	MD08-22-22-13-10	MD08-22-22-13-10
47	MD09W272-8-4-13-3	MD09W272-8-4-13-3
48	MDC07026-12-28	MDC07026-12-28
49	MO120194	081320 SP RS (MO 980525//MO981020/AP Patton)
50	MO120452	960827//Roane/Ning 7840
51	MO120794	981020/P92201D5-2-80/980525
52	MO121183	002246/011174
53	NE06545	KS92-946-B-15-1=(ABI86*3414/JAG//K92)/ALLIANCE
54	NE08499	CDL 91185-1/NE99469 (=NE97V106/NE88588//KARL 92)
55	NE10478	NI03418/Camelot
56	NI12702W	N03Y2014/NW03681//NuHills 10005
57	VA10W-140	VA01W-210[L890714(SAL/FL74265-10-A2-B2) /VA91-54-346 (N71761A4-31-5-48//71-54-147/MCN1813)// Pocahontas] / SS 520 // TRIBUTE
58	VA11W-106†	PIONEER 25R47 / JAMESTOWN [VA02W-370= ROANE (VA93-54-429)/ PION2691]
59	VA11W-301	PIONEER 25R47 / NC00-15389 (GA85240-6 /NC96BGTA5): R-LR // JAMESTOWN [VA02W-370= ROANE (VA93-54-429)/ PION2691]
60	VA12FHB-53	VA04W-433 [NING 7840/PION2684//96-54-244 (CK9803/FREEDOM)] / BRANSON [M00-3701= Pio2737W/891-4584A (Pike/FL302)]

†Indicates a restriction on crossing

Table 4. Entries in the 2013-2014 PNUWWSN

ENTRY	NAME	PEDIGREE
1	TRUMAN	
2	ERNIE	
3	FREEDOM	
4	PIONEER2545	
5	KWS014	Unknown
6	KWS029	COSSACK / X00-1058
7	KWS030	Sunburst / SE97 1054-2
8	KWS031	B990399 / M00-3701
9	KWS032	Patton / M98-2152
10	KWS033	D6234/P2552
11	KWS034	Unknown
12	OH07-264-35	OH708/P.92145E8-7-7-1-9
13	OH08-235-33	OH738/OH740
14	OH09-281-10	OH743/P.984RE1-57-5
15	OH10-194-16	CECIL/OH02-12686
16	OH10-219-65	B980582/OH02-12686
17	OH10-222-78	B980582/OH02-12686
18	OH10-305-39	IL97-6268/OH776
19	05251A1-1-77-8-2	INW0412//3/NY87048-7388/92226*2//91202/4/INW0412/3/981312A1-6-2-2-1
20	0566A1-3-1-52	INW0412/6/9017C1//92823A1/9218B4/3/P107/4/PATT/5/ACC3130/PATT/7/992060G1-1
21	082A1-3-1	INW0411/961341A3-1-4-6
22	1042A1-1-2	99751D8-2-3/96169RE2-3-6-4-1/3/7D(E)//97462A1-21-1-5-1-15/INW0412/4/981477A1-10-2-1/981312A1-6-2-1//INW0316
23	10512RA1-8	02444/06265-89-4-26//0570A1-2-32-5/3/0527A1-9-12/0175A1-31-4-3
24	10565C1-1	Branson//07469A1-10-1/0527A1-9-15-1
25	B09-2949	B990081/P961341A3-2-2
26	M10-1615	IL99-15867/M03-3002
27	M10-1659	COKER 9511/B980006
28	M12-2019#	LA01*425/P 25R56//W1104
29	M12-3189	M03-3616/COKER 9511
30	M12-3326L	IL01-16170/W1-018
31	DH4-12	RCATL31 x 25R51
32	GL119	25R56 x Huntley
33	GL39	25R56 x Huntley
34	OACSnow	25R18 x AC Ron
35	UGRCDH5-15	25R56 x Emmit
36	UGRCDH5-28	25R56 x Emmit
37	IL10-17672	IL04-31573 / IL02-23168
38	IL10-17707	IL04-31573 / IL02-23168
39	IL10-21934	IL97-1828 / IL03-18438 // IL00-8633
40	IL10-21937	IL97-1828 / IL03-18438 // IL00-8633
41	IL10-29145	IL03-18438 / IL00-8633 // IL00-8641
42	KY03C-1237-32	Pioneer Brand 25R18/KY92C-0010-17//KY96C-0767-1
43	KY06C-1003-140-3-3	Truman/McCormick//25R37
44	KY06C-1061-3-18-1	KY96C-0399-5/KY98C-1161-03//25R37
45	KY06C-1065-4-13-3	KY96C-0399-5/SAU-28//KY97C-0299-13-01
46	KY06C-1116-10-2-1	981517A1-1-5-2/E2057//KY97C-0299-13-01
47	KY06C-2020-11-12-1	IL99-15867/B990081
48	MO100172	960304/960815
49	MO120150	081652 SP RS
50	MO120487	980525//980525/IL 95-4162
51	MO120846	002246/011174
52	MO121280	Ernie/980525
53	MO121539	981020//981020/IL 95-4162
54	MO121983	Roane/000917
55	VA11MAS-9409-8-2-798	VA04W-433 / SS 8404 // VA02W-398
56	VA12FHB-34 <sup>†</sup>	GA 991109-4-1-3 (Ernie/Pion2684// GA901146) / PIONEER 26R15
57	VA12FHB-4	IL99-15867 (IL93-2879/P881705A-1-X-60) / VA04W-433 [NING 7840/ PION2684//96-54-244 (CK9803/ FREEDOM)]
58	VA12FHB-55	VA04W-433 [NING 7840/PION2684//96-54-244 (CK9803/FREEDOM)] / BRANSON [M00-3701= Pio2737W/891-4584A (Pike/FL302)]
59	VA12FHB-77 <sup>†</sup>	IL99-15867 (IL93-2879/P881705A-1-X-60) / VA04W-433 [NING 7840/ PION2684 //96-54-244(CK9803/ FREEDOM)] //SS8404
60	VA12FHB-8	IL99-27048 (IL90-6364/Pioneer 2571)/ VA04W-486 [ERNIE//INW 9824 (P92823A1-1-4-4-5=CLARK*4/ NING7840)/McCormick] // SHIRLEY (VA03W-409)

Table 5a. Correlation of traits in the 2013-2014 P+NUWWSN. Above diagonal are correlations of means from the NUWWSN. Below diagonal are correlations of entry means from the PNUWWSN. Grey values are significant at  $p < 0.05$ .

	INC	SEV	IND	FDK	ISK	DON	GH	HD	HGT
INC	1.00	0.75	0.80	0.65	0.81	0.51	0.43	0.06	-0.29
SEV	0.74	1.00	0.99	0.74	0.87	0.65	0.70	0.22	0.06
IND	0.81	0.98	1.00	0.75	0.88	0.66	0.70	0.22	0.00
FDK	0.69	0.66	0.69	1.00	0.92	0.78	0.49	0.26	-0.05
ISK	0.79	0.84	0.86	0.92	1.00	0.71	0.59	0.25	-0.10
DON	0.59	0.63	0.65	0.70	0.71	1.00	0.42	0.50	0.08
GH	0.42	0.52	0.52	0.37	0.46	0.40	1.00	0.17	0.14
HD	0.25	0.22	0.23	0.36	0.35	0.58	0.22	1.00	0.28
HGT	-0.46	-0.24	-0.29	-0.13	-0.16	-0.04	-0.13	0.32	1.00

Table 5b. Correlation of FHB traits with heading date by environment in the 2013-2014 P+NUWWSN. Grey values are significant at  $p < 0.05$ . Black squares indicate correlation could not calculate as data on one or both traits was missing.

	NUWWSN									
	ILCHA	ILURB	INLAF	KYLEX	MIELA	MOCOL	NYITH	OHWOO	ONRID	VABLA
INC with HD	0.49	0.12	-0.16	0.54	-0.09	-0.45	0.38	0.29	-0.10	0.34
SEV with HD	0.26	0.26		0.43	0.03	-0.21	0.34	0.5	-0.12	0.41
IND with HD	0.37	0.25		0.52	0.03	-0.23	0.4	0.51	-0.12	0.38
FDK with HD		0.31	0.31	0.10	-0.01			0.23		0.54
ISK with HD		0.39		0.44	-0.01			0.38		0.50
DON with HD		0.57	0.44	0.36	0.29			0.36		0.59
	PNUWWSN									
	ILCHA	ILURB	INLAF	KYLEX	MIELA	MOCOL	NYITH	OHWOO	ONRID	VABLA
INC with HD	0.62	0.50	0.00	0.50	0.04	-0.01		0.34	-0.29	0.19
SEV with HD	0.58	0.33		0.41	0.21	0.04		0.55	-0.03	0.51
IND with HD	0.53	0.34		0.54	0.11	0.04		0.56	-0.11	0.46
FDK with HD		0.70	0.44	0.13	0.17			0.37		0.42
ISK with HD		0.61		0.44	0.23			0.49		0.45
DON with HD		0.68	0.62	0.56	-0.04			0.45		0.54

Table 6. Summary of genotype ( $V_g$ ) and error ( $V_{error}$ ) variances from the ANOVA of the 2013-2014 P+NUWWSN

	NUWWSN					PNUWWSN				
	# env	$V_g$	$V_{error}$	$V_g/V_{error}$	"h2" of entry mean	# env	$V_g$	$V_{error}$	$V_g/V_{error}$	"h2" of entry mean
INC	12	24.9	202.4	0.12	0.60	10	28.2	146.8	0.19	0.66
SEV	11	78.1	138.2	0.57	0.86	9	54.6	134.7	0.41	0.78
IND	11	72.0	135.1	0.53	0.85	9	47.8	128.8	0.37	0.77
FDK	8	41.4	183.5	0.23	0.64	7	46.0	169.3	0.27	0.66
ISK	7	48.3	78.1	0.62	0.81	6	35.4	68.1	0.52	0.76
DON	6	7.3	24.6	0.30	0.64	6	7.9	13.2	0.60	0.78
HD	10	1.7	2.0	0.87	0.90	9	28.3	5.1	5.60	0.98
HGT	2	3.5	1.0	3.62	0.88	2	2.78	6.73	0.41	0.45

Table 7a. Best (top) and worst (bottom) entries in the 2013-2014 NUWWSN. Summary statistics are over all 60 entries.

ENTRY	NAME	INC	SEV	IND	FDK	ISK	DON	GHSEV	HD	HGT	#ls	#hs	PC1	PC2
46	MD08-22-22-13-10	47.2	14.4	9.2	21.9	33.5	6.6	15.0	145.9	27.8		6 0	-2.10	0.23
45	MD08-22-22-13-4	58.2	16.5	11.7	15.3	34.2	5	19.4	145.6	26.9		6 0	-1.90	1.15
1	TRUMAN	48.6	19.7	13.3	27.9	37.6	9.1	11.6	148.0	h 33.3	h	6 0	-1.60	-0.61
24	0762A1-2-8	54.2	19.8	11.5	27.6	39.7	5.7	12.8	145.2	25.7		6 0	-1.47	-0.23
40	IL10-6855	56.0	25.6	15.8	17.8	35.7	6.4	10.9	144.0	28.8		5 0	-1.64	0.53
39	IL10-19464	56.7	25.0	17.6	18.5	38.4	5.7	11.0	143.3	27.9		5 0	-1.55	0.60
37	IL09-24328	63.9	23.7	17.4	25	41.4	5.4	11.2	143.1	30.3		5 0	-1.23	0.13
50	MO120452	58.7	29.6	18.7	21.7	39.4	8	13.4	147.3	h 34.0	h	5 0	-1.19	0.30
38	IL09-3264	59.8	24.4	16.8	20.4	38.1	4.9	12.9	143.3	27.9		4 0	-1.50	0.70
51	MO120794	53.4	27.9	18.3	26.4	40.1	10.7	13.1	146.4	32.9	h	4 0	-1.13	-0.48
59	VA11W-301	73.5	h 47.3	40.2	43.3	1 59.3	14.8	1 42.3	145.7	26.2		0 3	1.37	0.27
44	KY204604	79.7	h 48.4	42.7	40.9	1 60.9	1 16.9	1 37.9	147.2	28.7		0 4	1.62	-0.26
4	PIONEER2545	71.4	h 53.3	44.6	50.4	1 63.9	1 17.8	1 40.2	144.7	28.0		0 4	1.87	-0.58
18	F0039	78.3	h 64.6	h 56.2	h 52	1 69.2	1 19.3	1 49.7	148.1	h 28.4		0 6	3.05	0.01
100	AVERAGE	64.2	35.6	27.6	34.9	50.4	10.5	21.5	145.3	29.2				
101	MINIMUM	47.2	14.4	9.2	15.3	33.5	4.9	10.9	142.8	25.7			-2.10	-0.61
102	MAXIMUM	79.7	64.6	56.2	52	69.2	19.3	49.7	148.7	34.0			3.05	1.15
103	LSD(0.05)	11.6	10.0	9.9	13.5	9.4	5.7		1.3	2.0				
	Number of Envs	12	11	11	8	7	6	1	10	2				

Table 7b. Best and worst entries in the 2013-2014 PNUWWSN

ENTRY	NAME	INC	SEV	IND	FDK	ISK	DON	GHSEV	HD	HGT	#	#h	PC1	PC2
38	IL10-17707	54.9	24.2	16.8	23.2	36.5	4.7	11.8	141.4	27.3	6	0	-1.71	0.09
49	MO120150	53.0	23.8	17.1	18.7	38.2	5.2	20.0	142.5	29.8 h	6	0	-1.70	1.05
41	IL10-29145	57.7	24.4	16.6	21.7	37.9	4.7	14.6	141.8	28.8 h	6	0	-1.60	0.34
39	IL10-21934	55.5	25.6	16.8	18.0	38.5	7.1	20.8	142.3	30.8 h	6	0	-1.50	1.00
40	IL10-21937	58.3	26.9	18.6	21.3	40.6	6.4	30.3	141.7	30.3 h	6	0	-1.16	1.77
37	IL10-17672	62.6	29.8	19.5	20.1	41	6.0	19.4	143.2	29.8 h	6	0	-1.12	0.73
26	M10-1615	60.5	28.5	20.8	21.2	40	7.8	16.7	142.3	28.3 h	6	0	-1.12	0.35
18	OH10-305-39	57.9	24.4	17.3	28.1	43.6	6.8	23.4	145.2	31.3 h	6	0	-1.09	0.62
52	MO121280	57.4	26.6	18.8	27.8	45.9	8.5	9.4	144.1	31.0 h	6	0	-1.04	-0.89
47	KY06C-2020-11-12-1	60.2	29.8	22.8	22.6	43.4	6.0	17.3	144.1	28.3 h	6	0	-1.01	0.40
48	MO100172	62.0	29.8	21.3	25.1	41.5	6.2	16.2	141.6	27.9	6	0	-1.01	0.19
19	05251A1-1-77-8-2	63.7	21.5	15.1	31.4	44.4	7.3	19.8	143.6	27.3	6	0	-0.99	-0.10
29	M12-3189	61.3	27.2	19.9	29.5	45.4	8.4	9.7	144.8	30.0 h	6	0	-0.88	-0.97
42	KY03C-1237-32	63.8	26.7	19.5	23.6	41	7.8	32.5	144.4	25.4	5	0	-0.86	1.69
50	MO120487	58.4	26.2	19.1	31.8	47.4	8.7	12.8	146.1	30.3 h	5	0	-0.85	-0.81
57	VA12FHB-4	66.4	31.4	23.3	26.0	43.4	6.4	20.6	143.7	26.7	5	0	-0.68	0.47
1	TRUMAN	56.5	24.3	15.7	34.8	43.7	9.8	12.1	147.6	33.4 h	4	0	-1.01	-1.10
54	MO121983	61.6	32.9	25.0	23.8	46.3	5.1	16.5	142.6	31.4 h	4	0	-0.81	0.28
27	M10-1659	61.0	26.5	20.0	32.9	48.7	6.2	14.4	142.3	29.8 h	4	0	-0.80	-0.61
43	KY06C-1003-140-3-3	61.5	34.5	22.9	31.4	47	7.5	11.1	143.1	28.5 h	4	0	-0.59	-0.78
51	MO120846	56.8	28.5	20.4	36.3	50.1	7.9	22.8	145.0	30.7 h	4	0	-0.57	0.02
5	KWS014	74.7	h 51.1	h 40.7	h 34.0	55.8	13.8 h	30.8	148.3 h	31.2 h	0	4	1.35	0.55
3	FREEDOM	76.6	h 42.0	34.7	56.6	h 64.9	h 14.5	h 17.0	146.6	29.4 h	0	4	1.65	-2.38
44	KY06C-1061-3-18-1	71.6	h 46.9	38.7	45.5	h 60.5	h 15.1	h 40.3	145.0	29.0 h	0	4	1.66	0.72
33	GL39	73.2	h 53.9	h 46.2	h 42.0	h 61.7	h 10.2	33.1	143.6	25.5 l	0	4	1.68	0.58
4	PIONEER2545	82.4	h 58.9	h 50.8	h 54.3	h 66.7	h 17.0	h 51.9	144.4	21.8 l	0	6	3.05	1.26
100	AVERAGE	65.9	34.7	26.6	34.6	50.6	9.3	23.1	144.4	28.6				
101	MINIMUM	53.0	21.5	15.1	18.0	36.5	4.7	9.4	141.4	21.3				
102	MAXIMUM	82.4	58.9	50.8	56.6	66.7	17.6	51.9	149.2	33.4				
103	LSD(0.05)	10.8	10.9	10.7	13.9	9.5	4.2	.	1.3	5.2				
	Number of Envs	10	9	9	7	6	6	1	9	2				

Table 8. Summary of all FHB traits from the 2013-2014 NUWWSN: “h” and “l” indicate means that are not significantly different from the highest (h) or lowest (l) mean in that column. Positive PC1 scores indicate great susceptibility.

ENTRY	NAME	INC	SEV	IND	FDK	ISK	DON	GHSEV	HD	HGT	#ls	#hs	PC1	PC2
1	TRUMAN	48.6	l 19.7	l 13.3	l 27.9	l 37.6	l 9.1	l 11.6	l 148.0	h 33.3	6	0	-1.60	-0.61
2	ERNIE	62.4	31.2	21.8	28.9	44.3	9.6	13.1	143.8	l 28.4	1	0	-0.70	-0.50
3	FREEDOM	67.6	38.4	30.6	44.9	h 58.1	12.1	28.9	147.3	29.5	0	1	0.90	-0.69
4	PIONEER2545	71.4	h 53.3	44.6	50.4	h 63.9	h 17.8	h 40.2	144.7	28.0	0	4	1.87	-0.58
5	NY01016-AN	58.7	l 37.7	29.5	47.3	h 55.3	15.3	h 47.5	146.8	32.1	h 1	2	0.71	0.03
6	NY01066-278	67.4	49.7	40.2	42.3	h 57.8	16.6	h 42.1	147.4	h 32.0	0	2	1.33	0.07
7	NY99059-249	63.2	40.3	32.2	30.8	49.4	10.8	36.1	147.0	31.7	0	0	0.13	1.15
8	NY99069-249	65.4	43.1	35.0	40.2	h 53.6	12.1	48.0	145.1	27.9	0	1	0.75	1.24
9	NY99069-352	65.4	39.0	32.4	39.8	h 54.6	15.2	h 13.8	145.8	28.6	0	2	0.46	-1.79
10	KWSO23	60.4	39.6	30.2	36.8	53.1	8.2	l 40.4	145.5	32.0	1	0	0.15	1.45
11	KWSO24	75.7	h 38.9	33.1	39.8	h 55.7	10.2	l 43.8	145.6	26.3	l 1	2	1.03	1.01
12	KWSO25	64.2	45.8	34.6	34.2	53.2	8.6	l 47.0	144.1	l 30.6	1	0	0.47	2.17
13	KWSO28	59.9	41.7	30.6	36.9	52.9	9.8	l 28.4	146.1	32.3	h 1	0	0.13	0.46
14	L29230	67.8	43.4	33.9	37.4	52.6	9.1	l 36.8	143.9	l 29.3	1	0	0.47	1.15
15	LCS321	61.7	38.5	30.8	34.9	51.8	12.7	45.1	143.8	l 29.8	0	0	0.35	1.08
16	E6012	64.8	41.9	32.2	33.4	54.1	10.6	37.5	145.7	29.0	0	0	0.37	1.06
17	F0036R	66.4	41.4	32.5	42.4	h 57	12.8	15.7	146.2	27.3	l 0	1	0.52	-1.31
18	F0039	78.3	h 64.6	h 56.2	h 52	h 69.2	h 19.3	h 49.7	148.1	h 28.4	0	6	3.05	0.01
19	F1014	69.1	h 33.9	27.2	41.9	h 54	16.6	h 9.2	148.7	h 29.3	0	3	0.63	-2.72
20	OH07-263-3	68.3	h 35.3	27.1	31.7	49.2	8.5	l 47.1	144.3	31.4	1	1	0.09	1.91
21	OH08-206-69	71.2	h 38.3	29.8	43.5	h 58	8.7	l 32.5	144.3	28.5	1	2	0.56	0.23
22	OH08-269-58	71.4	h 48.1	39.6	41.4	h 61.5	h 8.8	l 41.4	145.6	31.4	1	3	1.07	1.32
23	0570A1-2-32-5-1-4	60.7	27.2	18.8	l 40.1	h 49.8	14.2	h 31.4	145.7	31.0	1	2	0.14	-0.97
24	0762A1-2-8	54.2	l 19.8	l 11.5	l 27.6	l 39.7	l 5.7	l 12.8	145.2	25.7	l 6	0	-1.47	-0.23
25	08334A1-31	63.1	31.4	21.8	33.3	45	6.6	l 14.1	144.8	28.5	1	0	-0.56	-0.27
26	10641B1-9-11-7	61.1	24.0	l 15.8	l 42.8	h 48.4	13.8	h 8.2	143.7	l 30.5	2	2	-0.20	-2.69
27	B08-91993	66.0	38.7	31.1	35.3	48.4	9.3	l 21.8	143.9	l 30.5	1	0	0.01	0.16
28	B09*900256	68.2	h 42.7	35.0	41.5	h 57.6	11.4	27.5	145.3	26.5	l 0	2	0.69	-0.17
29	M09L-9547	61.4	34.3	26.0	37.9	52.9	10.2	l 11.1	143.7	l 29.9	1	0	-0.19	-1.12
30	M10-1100#	68.5	h 37.5	30.8	38.4	54.2	9.4	l 19.8	145.8	27.6	l 1	1	0.21	-0.33
31	M11-1027#	61.7	31.2	22.8	33.6	50.1	8.8	l 23.0	144.7	29.8	1	0	-0.40	0.02
32	M11-2298	62.5	27.9	21.2	29.3	43.5	10.1	l 16.5	144.3	29.8	1	0	-0.72	-0.38
33	GL133	79.6	h 45.4	39.7	36.9	57.9	10.4	l 16.4	143.3	l 26.8	l 1	1	0.85	-0.41
34	GL164	60.7	35.9	28.0	29.9	44.4	10	l 27.1	144.6	27.9	1	0	-0.34	0.66
35	UGRCC2-78	70.9	h 47.8	40.2	40.9	h 60.1	h 13	32.8	144.7	30.2	0	3	1.11	0.10
36	UGRCC5-116	62.5	37.9	28.9	30.3	49.8	7.3	l 16.5	145.4	31.1	l 1	0	-0.34	0.37
37	IL09-24328	63.9	23.7	l 17.4	l 25	l 41.4	l 5.4	l 11.2	143.1	l 30.3	5	0	-1.23	0.13
38	IL09-3264	59.8	24.4	16.8	l 20.4	l 38.1	l 4.9	l 12.9	143.3	l 27.9	4	0	-1.50	0.70
39	IL10-19464	56.7	l 25.0	17.6	l 18.5	l 38.4	l 5.7	l 11.0	143.3	l 27.9	5	0	-1.55	0.60
40	IL10-6855	56.0	l 25.6	15.8	l 17.8	l 35.7	l 6.4	l 10.9	144.0	l 28.8	5	0	-1.64	0.53
41	KY05C-1020-4-6-5	64.4	24.3	l 18.5	l 34.9	47.4	13.4	10.6	146.4	27.0	l 2	0	-0.51	-1.90
42	KY05C-1105-43-6-1	63.9	28.0	20.8	28	l 44.5	7.4	l 15.3	144.7	28.7	2	0	-0.82	0.03
43	KY06C-3003-43-13-3	59.7	31.3	23.9	29.7	44.3	8.8	l 20.6	146.6	29.4	1	0	-0.65	0.25
44	KY204604	79.7	h 48.4	42.7	40.9	h 60.9	h 16.9	h 37.9	147.2	28.7	0	4	1.62	-0.26
45	MD08-22-22-13-4	58.2	l 16.5	l 11.7	l 15.3	l 34.2	l 5	l 19.4	145.6	26.9	l 6	0	-1.90	1.15
46	MD08-22-22-13-10	47.2	l 14.4	l 9.2	l 21.9	l 33.5	l 6.6	l 15.0	145.9	27.8	6	0	-2.10	0.23
47	MD09W272-8-4-13-3	67.9	28.2	22.5	35.5	50.1	9.7	l 10.8	146.5	28.3	1	0	-0.24	-1.33
48	MDC07026-12-28	60.8	27.0	18.4	l 27	l 43.1	7	l 19.0	144.5	26.9	l 3	0	-0.99	0.37
49	MO120194	59.0	24.8	18.6	l 25.8	l 44.1	6	l 8.4	143.5	l 28.4	3	0	-1.22	-0.15
50	MO120452	58.7	l 29.6	18.7	l 21.7	l 39.4	l 8	l 13.4	147.3	h 34.0	h 5	0	-1.19	0.30
51	MO120794	53.4	l 27.9	18.3	l 26.4	l 40.1	l 10.7	l 13.1	146.4	32.9	h 4	0	-1.13	-0.48
52	MO121183	71.5	h 34.7	28.2	31.5	52.7	7.8	l 15.8	143.7	l 27.3	l 1	1	-0.10	-0.08
53	NE06545	61.7	38.3	31.5	40.9	h 55	10.5	l 28.2	144.3	30.6	1	1	0.29	-0.03
54	NE08499	62.6	39.0	30.8	36.5	52.2	12.4	35.2	144.6	31.4	0	0	0.31	0.39
55	NE10478	67.3	35.5	27.8	47.6	h 56.7	10.4	l 17.1	142.8	l 26.0	l 1	1	0.35	-1.35
56	NI12702W	64.2	42.9	32.0	34.4	53.6	14.6	h 22.3	147.4	h 31.4	0	1	0.40	-0.63
57	VA10W-140	65.3	43.5	35.4	37.9	55.3	9.1	l 37.6	145.8	27.9	1	0	0.65	1.00
58	VA11W-106†	67.5	36.5	29.6	36.1	54.7	12.2	46.0	145.6	27.4	l 0	0	0.63	0.78
59	VA11W-301	73.5	h 47.3	40.2	43.3	h 59.3	14.8	h 42.3	145.7	26.2	l 0	3	1.37	0.27
60	VA12FHB-53	59.9	31.4	21.3	37.8	49.6	11.8	11.3	145.7	26.9	l 0	0	-0.38	-1.49
100	AVERAGE	64.2	35.6	27.6	34.9	50.4	10.5	25.3	145.3	29.2				
101	MINIMUM	47.2	14.4	9.2	15.3	33.5	4.9	8.2	142.8	25.7			-2.10	-2.72
102	MAXIMUM	79.7	64.6	56.2	52	69.2	19.3	49.7	148.7	34.0			3.05	2.17
103	LSD(0.05)	11.6	10.0	9.9	13.5	9.4	5.7		1.3	2.0				
	Number of Envs	12	11	11	8	7	6	1	10	2				



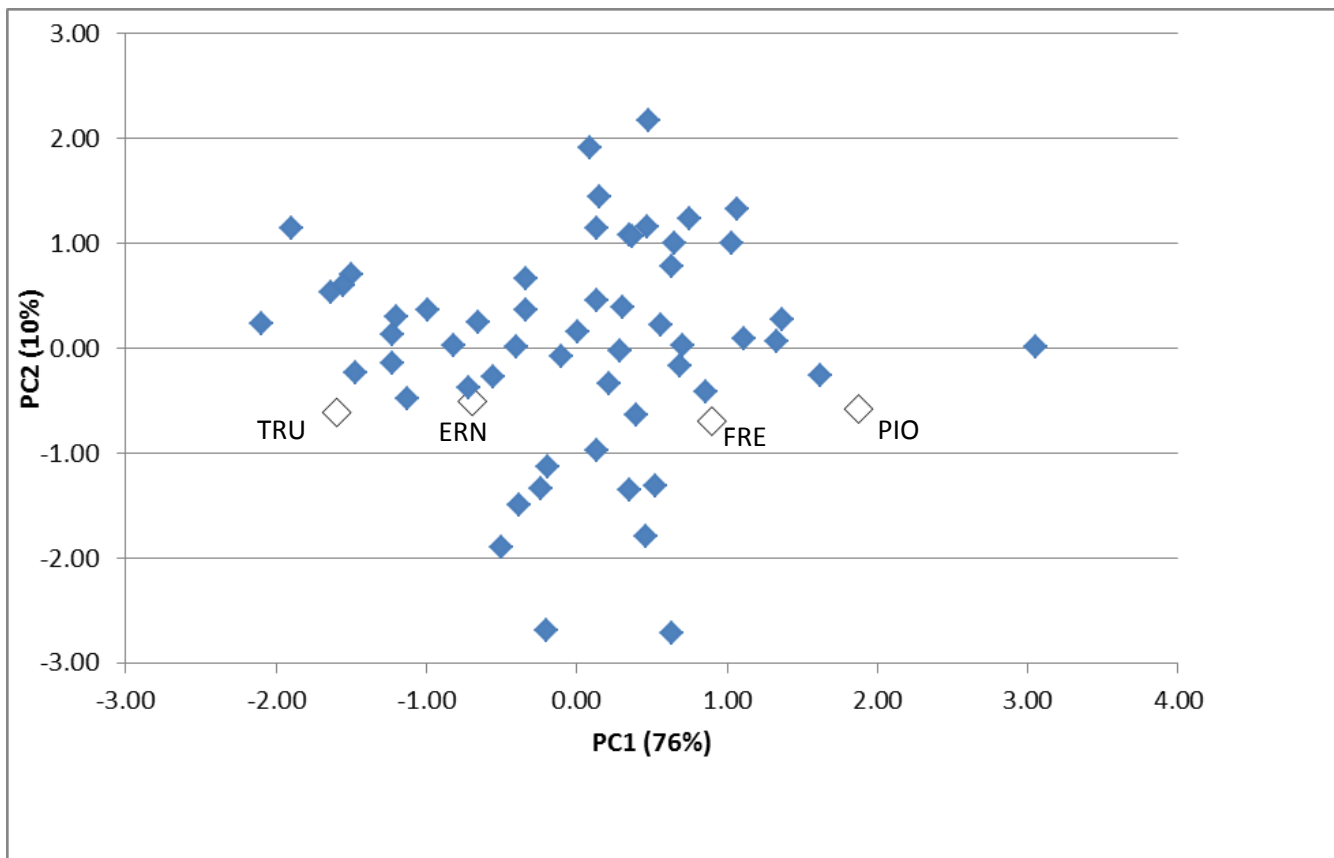


Figure 4. Principal component score of the 60 entries in the 2014 NUWWSN. All seven FHB traits were highly positively correlated to PC1 with all coefficients > 0.7: more susceptible lines had more positive scores. FDK and DON were slightly negatively correlated to PC2 while GHSEV was highly correlated to PC2 ( $r=0.65$ ). Checks are identified.

Table 9. Summary of all FHB traits from the 2013-2014 PNUWWSN: “h” and “l” indicate means that are not significantly different from the highest (h) or lowest (l) mean in that column.

ENTRY	NAME	INC	SEV	IND	FDK	ISK	DON	GHSEV	HD	HGT	#l	#h	PC1	PC2	
1	TRUMAN	56.5	l 24.3	l 15.7	l 34.8	43.7	l 9.8	12.1	148	33	h	4	0	-1.01	-1.10
2	ERNIE	67.8	35.4	27.1	37.0	52.2	8.6	l 23.1	143	27		1	0	0.13	-0.13
3	FREEDOM	76.6	h 42.0	34.7	56.6	h 64.9	h 14.5	h 17.0	147	29	h	0	4	1.65	-2.38
4	PIONEER2545	82.4	h 58.9	h 50.8	h 54.3	h 66.7	h 17.0	h 51.9	144	22	l	0	6	3.05	1.26
5	KWS014	74.7	h 51.1	h 40.7	h 34.0	55.8	13.8	h 30.8	148	h 31	h	0	4	1.35	0.55
6	KWS029	69.4	34.7	27.7	41.9	56.7	9.1	23.8	145	32	h	0	0	0.42	-0.48
7	KWS030	70.7	40.0	31.7	39.8	55.5	12.1	21.6	144	25	l	0	0	0.71	-0.67
8	KWS031	63.1	l 42.6	32.1	42.2	57.8	h 9.8	26.2	145	32	h	1	1	0.64	-0.08
9	KWS032	66.5	42.0	31.2	38.5	55.3	12.0	34.3	145	27		0	0	0.74	0.76
10	KWS033	76.6	h 43.5	38.6	40.4	56.7	15.7	h 29.4	149	h 28		0	2	1.41	-0.18
11	KWS034	72.2	h 45.6	38.3	38.0	57.7	h 17.6	h 45.1	149	h 29	h	0	3	1.58	1.43
12	OH07-264-35	69.3	46.9	37.2	46.6	h 58.9	h 9.0	30.6	143	31	h	0	2	1.13	0.19
13	OH08-235-33	64.1	41.7	30.6	39.8	56.3	9.8	45.4	145	31	h	0	0	0.73	1.94
14	OH09-281-10	75.1	h 33.4	27.3	31.5	l 50.5	7.6	l 24.3	145	27		2	1	0.09	0.20
15	OH10-194-16	65.7	35.0	27.4	29.0	l 52.2	9.3	24.8	145	30	h	1	0	-0.03	0.39
16	OH10-219-65	69.8	38.2	29.8	40.0	53.8	7.8	l 36.4	143	30	h	1	0	0.52	1.10
17	OH10-222-78	64.7	40.4	30.8	36.7	56.1	9.3	18.1	145	32	h	0	0	0.33	-0.62
18	OH10-305-39	57.9	l 24.4	l 17.3	l 28.1	l 43.6	l 6.8	l 23.4	145	31	h	6	0	-1.09	0.62
19	05251A1-1-77-8-2	63.7	l 21.5	l 15.1	l 31.4	l 44.4	l 7.3	l 19.8	144	27		6	0	-0.99	-0.10
20	0566A1-3-1-52	68.6	34.8	27.3	39.9	53.4	6.8	l 13.2	143	24	l	1	0	0.04	-1.18
21	082A1-3-1	67.5	32.0	l 24.0	l 34.7	51.6	11.0	9.6	142	l 27		2	0	-0.12	-1.57
22	1042A1-1-2	67.5	33.5	25.1	l 40.5	52.1	8.3	l 27.3	145	28		2	0	0.13	0.12
23	10512RA1-8	65.7	23.8	l 18.1	l 42.8	h 51.7	14.0	h 27.6	146	31	h	2	2	0.03	-0.48
24	10565C1-1	69.6	36.3	27.7	44.1	h 54.1	17.4	h 20.5	146	29	h	0	2	0.81	-1.35
25	B09-2949	78.9	h 39.5	33.7	40.1	56.7	8.4	l 22.8	144	21	l	1	1	0.84	-0.49
26	M10-1615	60.5	l 28.5	l 20.8	l 21.2	l 40	l 7.8	l 16.7	142	l 28	h	6	0	-1.12	0.35
27	M10-1659	61.0	l 26.5	l 20.0	l 32.9	48.7	6.2	l 14.4	142	l 30	h	4	0	-0.80	-0.61
28	M12-2019#	64.6	30.0	l 22.1	l 39.2	50.5	8.3	l 13.2	142	l 29	h	3	0	-0.31	-1.20
29	M12-3189	61.3	l 27.2	l 19.9	l 29.5	l 45.4	l 8.4	l 9.7	145	30	h	6	0	-0.88	-0.97
30	M12-3326L	69.2	31.9	l 26.1	29.4	l 49.2	7.6	l 14.5	142	l 29	h	3	0	-0.31	-0.56
31	DH4-12	58.7	l 24.9	l 18.3	l 33.5	48.9	9.0	36.4	144	29	h	3	0	-0.53	1.36
32	GL119	66.8	49.0	h 37.3	39.1	55.3	10.2	15.2	143	30	h	0	1	0.76	-0.91
33	GL39	73.2	h 53.9	h 46.2	h 42.0	61.7	h 10.2	33.1	144	26	l	0	4	1.68	0.58
34	OACSnow	71.7	h 37.7	29.8	39.2	55.5	13.1	21.7	146	30	h	0	1	0.68	-0.76
35	UGRCDH5-15	71.8	h 42.6	34.1	38.4	54.7	14.0	h 15.8	146	30	h	0	2	0.84	-1.25
36	UGRCDH5-28	63.9	38.4	29.0	34.8	51.4	11.0	19.1	146	25	l	0	0	0.15	-0.43
37	IL10-17672	62.6	l 29.8	l 19.5	l 20.1	l 41	l 6.0	l 19.4	143	30	h	6	0	-1.12	0.73
38	IL10-17707	54.9	l 24.2	l 16.8	l 23.2	l 36.5	l 4.7	l 11.8	141	l 27		6	0	-1.71	0.09
39	IL10-21934	55.5	l 25.6	l 16.8	l 18.0	l 38.5	l 7.1	l 20.8	142	l 31	h	6	0	-1.50	1.00
40	IL10-21937	58.3	l 26.9	l 18.6	l 21.3	l 40.6	l 6.4	l 30.3	142	l 30	h	6	0	-1.16	1.77
41	IL10-29145	57.7	l 24.4	l 16.6	l 21.7	l 37.9	l 4.7	l 14.6	142	l 29	h	6	0	-1.60	0.34
42	KY03C-1237-32	63.8	26.7	l 19.5	l 23.6	l 41	l 7.8	l 32.5	144	25	l	5	0	-0.86	1.69
43	KY06C-1003-140-3-3	61.5	l 34.5	22.9	l 31.4	l 47	7.5	l 11.1	143	29	h	4	0	-0.59	-0.78
44	KY06C-1061-3-18-1	71.6	h 46.9	38.7	45.5	h 60.5	h 15.1	h 40.3	145	29	h	0	4	1.66	0.72
45	KY06C-1065-4-13-3	67.1	30.7	l 24.5	l 39.8	50.2	10.0	13.3	147	27		2	0	-0.09	-1.33
46	KY06C-1116-10-2-1	65.2	32.8	24.8	l 27.1	l 47.9	5.6	l 15.7	144	24	l	3	0	-0.60	-0.10
47	KY06C-2020-11-12-1	60.2	l 29.8	l 22.8	l 22.6	l 43.4	l 6.0	l 17.3	144	28	h	6	0	-1.01	0.40
48	MO100172	62.0	l 29.8	l 21.3	l 25.1	l 41.5	l 6.2	l 16.2	142	l 28		6	0	-1.01	0.19
49	MO120150	53.0	l 23.8	l 17.1	l 18.7	l 38.2	l 5.2	l 20.0	143	l 30	h	6	0	-1.70	1.05
50	MO120487	58.4	l 26.2	l 19.1	l 31.8	l 47.4	8.7	l 12.8	146	30	h	5	0	-0.85	-0.81
51	MO120846	56.8	l 28.5	l 20.4	l 36.3	50.1	7.9	l 22.8	145	31	h	4	0	-0.57	0.02
52	MO121280	57.4	l 26.6	l 18.8	l 27.8	l 45.9	l 8.5	l 9.4	144	31	h	6	0	-1.04	-0.89
53	MO121539	67.4	29.5	l 23.9	l 40.7	53.8	8.4	l 16.1	143	29	h	3	0	-0.05	-1.13
54	MO121983	61.6	l 32.9	25.0	l 23.8	l 46.3	5.1	l 16.5	143	l 31	h	4	0	-0.81	0.28
55	VA11MAS-9409-8-2-798	78.3	h 38.5	31.3	40.4	53.1	7.8	l 48.5	146	27		1	1	0.91	2.17
56	VA12FHB-34†	59.6	l 34.6	25.2	l 39.4	51.5	9.8	26.7	144	30	h	2	0	-0.01	0.18
57	VA12FHB-4	66.4	31.4	l 23.3	l 26.0	l 43.4	l 6.4	l 20.6	144	27		5	0	-0.68	0.47
58	VA12FHB-55	71.3	31.8	l 24.9	l 34.6	51.4	7.8	l 10.0	145	27		3	0	-0.16	-1.38
59	VA12FHB-77†	66.7	38.0	27.3	36.8	53.8	8.6	l 46.3	146	28	h	1	0	0.46	2.20
60	VA12FHB-8	72.1	h 44.1	36.0	39.3	56.7	9.9	23.6	145	27		0	1	0.88	-0.28
100	AVERAGE	65.9	34.7	26.6	34.6	50.6	9.3	23.1	144	29					
101	MINIMUM	53.0	21.5	15.1	18.0	36.5	4.7	9.4	141	21					
102	MAXIMUM	82.4	58.9	50.8	56.6	66.7	17.6	51.9	149	33					
103	LSD(0.05)	10.8	10.9	10.7	13.9	9.5	4.2	.	1	5					
	Number of Envs	10	9	9	7	6	6	1	9	2					

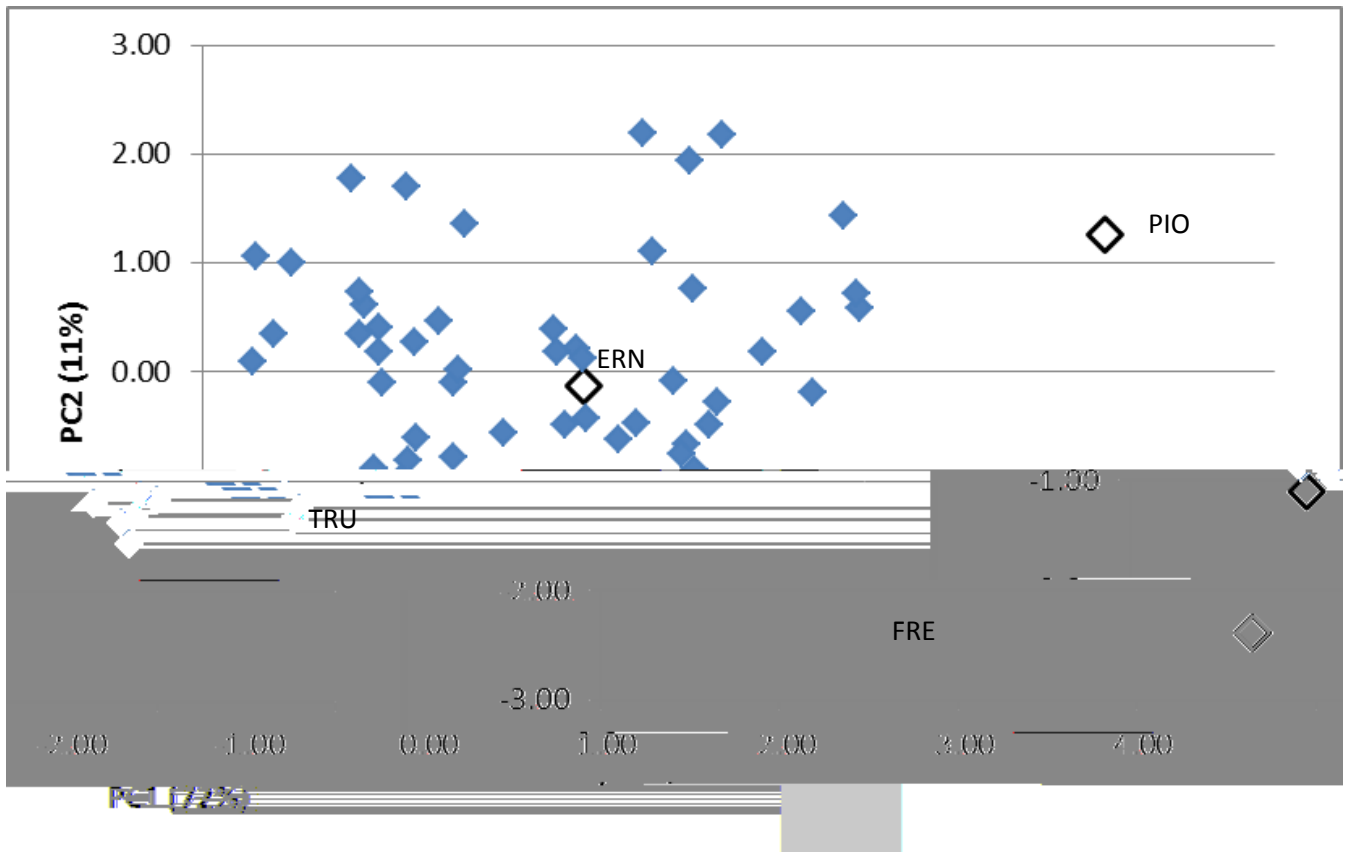


Figure 5. Principal component score of the 60 entries in the 2014 PNUWWSN. All seven FHB traits were highly positively correlated to PC1 with all coefficients > 0.8: more susceptible lines had more positive scores. FDK was slightly negatively correlated to PC2, while GHSEV was highly correlated to PC2 ( $r=0.77$ ). Checks are identified.









Table 14. Summary of INC/SEV/FDK (ISK, %) data from the 2013-2014 NUWWSN

ENTRY	NAME	AVG	ILURB	INHIG	KYLEX	MIELA	NEMEA	OHWOO	VABLA	
1	TRUMAN	37.6	l	39.9	63.9	38.6	45.3	6.8	56.1	12.7
2	ERNIE	44.3		57.5	63.5	34.0	57.9	32.0	47.3	17.7
3	FREEDOM	58.1		72.8	78.5	49.5	62.8		74.1	36.2
4	PIONEER2545	63.9	h	78.4	75.8	60.4	54.9	43.9	86.4	47.2
5	NY01016-AN	55.3		73.9	67.0	41.4	64.5	40.0	62.5	37.8
6	NY01066-278	57.8		85.1	78.4	62.5	63.7	9.6	72.4	33.2
7	NY99059-249	49.4		63.8	84.1	44.9	54.6	3.2	67.9	27.3
8	NY99069-249	53.6		68.7	67.6	52.7	55.5	37.1	66.7	26.6
9	NY99069-352	54.6		56.4	83.5	58.3	60.8	0.0	77.4	46.0
10	KWS023	53.1		70.9	84.5	51.5	54.6	28.0	64.3	18.2
11	KWS024	55.7		61.5	91.0	45.0	56.9		65.3	40.1
12	KWS025	53.2		70.2	74.5	46.5	54.8	20.2	64.6	41.4
13	KWS028	52.9		55.6	66.1	46.6	57.1	34.1	74.5	36.1
14	L29230	52.6		59.4	85.1	54.9	55.2	25.8	67.2	20.5
15	LCS321	51.8		53.7	80.7	46.9	61.5	19.7	65.6	34.5
16	E6012	54.1		56.6	86.5	53.7	57.7	29.0	65.6	29.9
17	F0036R	57.0		74.6	71.5	53.6	57.7	14.2	82.3	44.9
18	F0039	69.2	h	79.8	85.0	67.0	65.2		91.0	52.4
19	F1014	54.0		56.1	82.0	57.4	46.3		76.7	30.9
20	OH07-263-3	49.2		46.1	77.5	41.1	51.8	52.5	51.0	24.1
21	OH08-206-69	58.0		69.7	79.9	47.5	47.3	64.1	55.2	42.2
22	OH08-269-58	61.5	h	57.9	91.7	55.8	71.2	48.4	67.1	38.2
23	0570A1-2-32-5-1-4	49.8		63.8	86.5	45.6	52.5		51.5	24.5
24	0762A1-2-8	39.7	l	45.8	73.0	41.4	39.0		42.2	22.4
25	08334A1-31	45.0		55.7	81.7	40.7	50.6		47.2	19.5
26	10641B1-9-11-7	48.4		63.6	79.8	30.5	50.2		64.3	27.4
27	B08-91993	48.4		50.2	89.5	38.8	58.5	16.7	68.3	17.0
28	B09*900256	57.6		80.5	86.5	42.9	58.7	21.5	78.9	33.9
29	M09L-9547	52.9		53.0	82.0	40.1	62.1	19.4	74.8	38.9
30	M10-1100#	54.2		61.1	81.3	49.9	52.7	27.1	74.2	33.0
31	M11-1027#	50.1		46.7	78.3	42.3	48.0	19.9	74.2	41.3
32	M11-2298	43.5		45.1	68.2	34.8	50.6	7.6	68.8	29.2
33	GL133	57.9		60.6	86.4	50.9	58.3	41.6	81.0	26.6
34	GL164	44.4		54.7	59.3	44.5	58.5	0.8	68.6	24.7
35	UGRCC2-78	60.1	h	62.2	85.0	55.2	63.9	23.4	86.2	45.0
36	UGRCC5-116	49.8		53.2	68.0	49.1	58.2	18.7	67.4	33.8
37	ILO9-24328	41.4	l	36.9	68.8	29.2	53.6	32.6	43.0	25.6
38	ILO9-3264	38.1	l	45.9	57.8	19.9	50.3	37.7	42.3	12.5
39	IL10-19464	38.4	l	37.8	74.3	28.3	50.0	25.5	41.2	11.8
40	IL10-6855	35.7	l	35.9	55.3	16.1	44.1	34.2	46.6	17.6
41	KY05C-1020-4-6-5	47.4		48.6	78.7	39.3	53.9	17.8	71.4	22.1
42	KY05C-1105-43-6-1	44.5		34.9	76.5	44.1	49.4	26.0	55.9	24.4
43	KY06C-3003-43-13-3	44.3		48.1	73.0	41.4	51.3	11.9	58.3	25.8
44	KY204604	60.9	h	77.2	85.7	56.7	60.4	26.8	76.0	43.4
45	MD08-22-22-13-4	34.2	l	29.5	46.7	34.6	35.5	30.8	43.3	19.0
46	MD08-22-22-13-10	33.5	l	43.9	50.1	36.9	40.2	1.6	43.4	18.7
47	MD09W272-8-4-13-3	50.1		61.9	81.8	50.2	51.9		54.1	26.2
48	MDC07026-12-28	43.1		54.9	54.2	39.5	46.3	35.1	56.0	15.4
49	MO120194	44.1		37.7	71.6	42.4	55.0	41.8	39.3	20.8
50	MO120452	39.4	l	39.6	65.4	40.1	39.8	24.9	46.9	18.9
51	MO120794	40.1	l	44.9	74.5	42.4	44.5	4.7	51.9	17.9
52	MO121183	52.7		59.9	85.9	44.5	51.4	32.5	58.1	36.5
53	NE06545	55.0		58.7	86.6	57.9	58.0	19.1	75.1	29.6
54	NE08499	52.2		58.5	86.2	49.8	59.3	15.3	74.1	22.4
55	NE10478	56.7		64.1	89.5	52.1	51.7	34.9	77.2	27.6
56	NI12702W	53.6		63.8	76.5	53.8	49.4	15.4	82.8	33.6
57	VA10W-140	55.3		65.1	85.4	47.7	62.4		68.7	27.8
58	VA11W-106	54.7		60.1	86.0	51.5	53.3		68.6	34.1
59	VA11W-301	59.3		75.1	88.0	47.4	61.0	9.9	86.6	47.2
60	VA12FHB-53	49.6		63.5	67.7	48.1	50.0	12.5	73.7	31.4
100	AVERAGE	50.4		57.5	76.5	45.5	54.0	31.7	58.7	29.1
101	MINIMUM	33.5		29.5	46.7	16.1	35.5	0.0	19.5	11.8
102	MAXIMUM	69.2		85.1	91.7	67.0	71.2	91.0	86.6	47.2
103	LSD(0.05)	9.4		.	.	.	.	.	.	.



Table 15. Summary of deoxynivalenol (DON, ppm) data from the 2013-2014 NUWWSN.

ENTRY	NAME	AVG		ILURB	INWLA	KYLEX	MIELA	OHWOO	VABLA
1	TRUMAN	9.1	l	14.8	0.7	16.1	3.0	18.8	1.2
2	ERNIE	9.6	l	13.8	2.8	14.7	9.0	16.5	0.5
3	FREEDOM	12.1		22.3	1.4	16.5	8.1	19.8	4.6
4	PIONEER2545	17.8	h	44.1	0.4	16.9	14.8	24.2	6.3
5	NY01016-AN	15.3	h	35.2	1.5	15.7	15.1	21.6	2.7
6	NY01066-278	16.6	h	36.3	1.3	14.9	18.4	21.0	7.5
7	NY99059-249	10.8		15.7	0.9	13.8	13.6	19.4	1.3
8	NY99069-249	12.1		22.7	1.6	12.7	7.9	24.5	3.1
9	NY99069-352	15.2	h	20.6	1.7	22.7	10.5	31.3	4.6
10	KWS023	8.2	l	14.3	1.5	11.6	6.4	14.8	0.4
11	KWS024	10.2	l	12.0	2.4	12.5	6.0	24.3	4.0
12	KWS025	8.6	l	10.3	1.4	14.2	6.2	16.7	3.0
13	KWS028	9.8	l	8.6	1.7	13.9	8.2	24.4	1.8
14	L29230	9.1	l	11.5	2.1	12.8	8.5	19.1	0.4
15	LCS321	12.7		17.8	1.1	21.8	5.9	26.0	3.5
16	E6012	10.6		14.8	0.4	16.3	9.5	20.9	1.9
17	F0036R	12.8		32.0	1.1	13.1	6.4	17.4	7.1
18	F0039	19.3	h	46.5	2.1	19.8	14.3	26.0	7.1
19	F1014	16.6	h	40.6	0.8	17.9	6.9	29.9	3.6
20	OH07-263-3	8.5	l	7.1	1.5	15.1	9.9	16.3	1.3
21	OH08-206-69	8.7	l	12.8	1.8	11.6	9.0	15.5	1.6
22	OH08-269-58	8.8	l	7.9	4.2	16.1	8.2	13.9	2.6
23	0570A1-2-32-5-1-4	14.2	h	30.4	3.7	21.6	7.6	20.6	1.5
24	0762A1-2-8	5.7	l	7.5	1.4	7.7	2.9	13.7	0.7
25	08334A1-31	6.6	l	7.4	2.8	12.2	2.8	14.0	0.7
26	10641B1-9-11-7	13.8	h	20.7	1.5	13.4	5.6	41.1	0.4
27	B08-91993	9.3	l	9.0	2.1	11.3	15.2	17.3	0.8
28	B09*900256	11.4		18.5	1.0	17.3	13.1	14.6	3.7
29	M09L-9547	10.2	l	10.0	1.0	15.7	5.3	26.9	2.6
30	M10-1100#	9.4	l	15.1	2.1	10.8	6.6	16.8	4.8
31	M11-1027#	8.8	l	12.0	0.6	11.9	2.3	23.3	3.0
32	M11-2298	10.1	l	8.7	2.2	12.4	2.9	32.1	2.1
33	GL133	10.4	l	10.5	1.2	15.9	5.8	25.8	3.0
34	GL164	10.0	l	6.2	1.8	13.4	7.7	27.5	3.4
35	UGRCC2-78	13.0		9.0	3.1	15.5	9.5	36.1	4.9
36	UGRCC5-116	7.3	l	6.9	1.6	9.5	3.2	21.7	0.6
37	IL09-24328	5.4	l	4.0	3.6	7.5	3.9	13.4	0.2
38	IL09-3264	4.9	l	5.1	3.0	6.2	2.6	12.3	0.1
39	IL10-19464	5.7	l	6.5	0.6	8.1	5.8	12.6	0.7
40	IL10-6855	6.4	l	5.9	2.0	6.3	5.3	18.0	1.1
41	KY05C-1020-4-6-5	13.4		13.6	1.3	15.4	7.2	41.1	1.7
42	KY05C-1105-43-6-1	7.4	l	8.0	2.6	12.2	1.9	18.2	1.7
43	KY06C-3003-43-13-3	8.8	l	7.4	3.2	12.1	3.7	23.3	3.2
44	KY204604	16.9	h	33.8	2.1	17.2	8.2	35.0	5.2
45	MD08-22-22-13-4	5.0	l	3.4	1.3	6.7	1.5	16.1	0.7
46	MD08-22-22-13-10	6.6	l	7.4	1.5	6.8	5.1	17.4	1.4
47	MD09W272-8-4-13-3	9.7	l	18.6	1.7	9.6	5.2	19.5	3.3
48	MDC07026-12-28	7.0	l	10.1	0.8	6.3	3.3	21.6	0.1
49	MO120194	6.0	l	4.4	0.8	13.8	2.8	14.0	0.4
50	MO120452	8.0	l	11.4	1.8	11.0	3.5	18.8	1.2
51	MO120794	10.7		14.2	1.7	13.4	4.3	28.8	2.1
52	MO121183	7.8	l	14.4	2.1	7.3	4.5	15.9	2.4
53	NE06545	10.5	l	12.0	1.9	11.0	8.0	26.1	4.1
54	NE08499	12.4		10.7	1.9	13.6	16.6	29.1	2.4
55	NE10478	10.4	l	18.5	3.3	11.6	5.8	22.8	0.5
56	NI12702W	14.6	h	15.6	1.9	19.3	11.7	34.7	4.7
57	VA10W-140	9.1	l	11.4	3.3	9.3	8.7	20.1	2.0
58	VA11W-106	12.2		18.7	2.3	13.1	7.6	29.5	2.2
59	VA11W-301	14.8	h	24.0	0.8	12.1	8.2	37.4	6.1
60	VA12FHB-53	11.8		18.0	0.7	10.1	5.8	34.9	1.5
100	AVERAGE	10.5		15.5	1.8	13.2	7.3	22.6	2.5
101	MINIMUM	4.9		3.4	0.4	6.2	1.5	12.3	0.1
102	MAXIMUM	19.3		46.5	4.2	22.7	18.4	41.1	7.5
103	LSD(0.05)	5.7		.	.	.	.	.	.

Table 16. Summary of greenhouse severity (GHSEV, %) data from the 2013-2014 NUWWSN.

ENTRY	NAME	GHSEV
1	TRUMAN	11.6
2	ERNIE	13.1
3	FREEDOM	28.9
4	PIONEER2545	40.2
5	NY01016-AN	47.5
6	NY01066-278	42.1
7	NY99059-249	36.1
8	NY99069-249	48.0
9	NY99069-352	13.8
10	KWS023	40.4
11	KWS024	43.8
12	KWS025	47.0
13	KWS028	28.4
14	L29230	36.8
15	LCS321	45.1
16	E6012	37.5
17	F0036R	15.7
18	F0039	49.7
19	F1014	9.2
20	OH07-263-3	47.1
21	OH08-206-69	32.5
22	OH08-269-58	41.4
23	0570A1-2-32-5-1-4	31.4
24	0762A1-2-8	12.8
25	08334A1-31	14.1
26	10641B1-9-11-7	8.2
27	B08-91993	21.8
28	B09*900256	27.5
29	M09L-9547	11.1
30	M10-1100#	19.8
31	M11-1027#	23.0
32	M11-2298	16.5
33	GL133	16.4
34	GL164	27.1
35	UGRCC2-78	32.8
36	UGRCC5-116	16.5
37	IL09-24328	11.2
38	IL09-3264	12.9
39	IL10-19464	11.0
40	IL10-6855	10.9
41	KY05C-1020-4-6-5	10.6
42	KY05C-1105-43-6-1	15.3
43	KY06C-3003-43-13-3	20.6
44	KY204604	37.9
45	MD08-22-22-13-4	19.4
46	MD08-22-22-13-10	15.0
47	MD09W272-8-4-13-3	10.8
48	MDC07026-12-28	19.0
49	MO120194	8.4
50	MO120452	13.4
51	MO120794	13.1
52	MO121183	15.8
53	NE06545	28.2
54	NE08499	35.2
55	NE10478	17.1
56	NI12702W	22.3
57	VA10W-140	37.6
58	VA11W-106+	46.0
59	VA11W-301	42.3
60	VA12FHB-53	11.3
100	AVERAGE	25.3
101	MINIMUM	8.2
102	MAXIMUM	49.7
103	LSD(0.05)	

Table 17. Summary of heading date (HD, Julian days) and height (HGT, inches) data from the 2013-2014 NUWWSN

ENTRY	NAME	AVG	HD									AVG	HGT			
			ILCHA	ILURB	INWLA	KYLEX	MOCOL	NYITH	OHWO	ONRID	VABLA		AVG	KYLEX	MIELA	
1	TRUMAN	148.0	h	154	148	141	141	150	155	149	160	134	33.3	h	38.5	28.2
2	ERNIE	143.8	i	148	144	141	132.5	143	152	147	156	131	28.4		34.5	22.2
3	FREEDOM	147.3		155	147	140.5	139	147	154	148	161	134	29.5		34.5	24.5
4	PIONEER2545	144.7		149	146	140	135	143	152	148	156	133	28.0		34.0	22.0
5	NY01016-AN	146.8		152	147	143.5	134.5	147	154	150	158	135	32.1	h	38.5	25.7
6	NY01066-278	147.4	h	154	148	140	140	147	155	150	158	135	32.0		38.5	25.5
7	NY99059-249	147.0		152	147	142	137	147	155	149	159	135	31.7		37.0	26.3
8	NY99069-249	145.1		150	145	140	134.5	143	153	149	159	132	27.9		33.0	22.8
9	NY99069-352	145.8		149	145	140.5	136	147	153	149	159	134	28.6		33.5	23.7
10	KWS023	145.5		152	147	142.5	134	142	151	148	160	133	32.0		37.0	27.0
11	KWS024	145.6		150	145	144.5	134	143	154	148	158	134	26.3	i	31.5	21.0
12	KWS025	144.1	i	147	145	141	134	141	152	148	156	133	30.6		37.0	24.2
13	KWS028	146.1		150	146	141	136.5	145	154	150	158	134	32.3	h	38.0	26.5
14	L29230	143.9	i	148	143	141.5	133.5	142	152	147	156	132	29.3		34.5	24.0
15	LCS321	143.8	i	147	144	140.5	134	143	151	147	155	133	29.8		36.5	23.0
16	E6012	145.7		150	147	139.5	135	147	154	149	157	133	29.0		34.0	24.0
17	F0036R	146.2		152	148	141	135	147	154	149	156	134	27.3	i	33.5	21.0
18	F0039	148.1	h	156	149	142	138	149	156	150	158	135	28.4		33.5	23.3
19	F1014	148.7	h	153	150	141	142	149	156	151	160	136	29.3		34.5	24.0
20	OH07-263-3	144.3		147	144	142	133.5	143	153	148	155	133	31.4		38.0	24.7
21	OH08-206-69	144.3		152	145	141	133.5	142	151	147	155	132	28.5		33.5	23.5
22	OH08-269-58	145.6		147	145	144	135	143	154	148	158	136	31.4		37.0	25.8
23	0570A1-2-32-5-1-4	145.7		149	147	143.5	135	145	155	148	156	133	31.0		38.0	24.0
24	0762A1-2-8	145.2		149	147	140.5	135	145	153	148	156	133	25.7	i	31.0	20.3
25	08334A1-31	144.8		150	146	143.5	134	143	153	147	156	131	28.5		35.0	22.0
26	10641B1-9-11-7	143.7	i	150	144	139	132.5	142	152	147	155	132	30.5		36.5	24.5
27	B08-91993	143.9	i	150	143	140.5	132.5	142	153	147	156	131	30.5		36.0	25.0
28	B09*900256	145.3		149	145	142.5	133.5	147	153	147	158	133	26.5	i	32.5	20.5
29	M09L-9547	143.7	i	146	144	140	133.5	142	152	147	156	133	29.9		34.5	25.2
30	M10-1100#	145.8		150	146	142.5	135	143	154	148	159	135	27.6	i	32.0	23.2
31	M11-1027#	144.7		148	144	143	133.5	143	154	148	156	133	29.8		35.5	24.0
32	M11-2298	144.3		147	145	141	133	143	151	147	159	133	29.8		35.0	24.5
33	GL133	143.3	i	146	144	140.5	132.5	141	152	147	155	132	26.8	i	31.5	22.0
34	GL164	144.6		147	144	143	133.5	143	155	147	156	133	27.9		32.5	23.2
35	UGRCC2-78	144.7		146	144	142.5	134.5	143	154	148	156	134	30.2		35.0	25.3
36	UGRCC5-116	145.4		148	145	141.5	135.5	143	154	149	159	134	31.1		36.5	25.7
37	IL09-24328	143.1	i	146	143	143	132	141	151	146	155	131	30.3		35.5	25.0
38	IL09-3264	143.3	i	147	143	142.5	132	141	153	146	155	130	27.9		33.5	22.3
39	IL10-19464	143.3	i	145	143	140.5	132.5	142	153	146	157	131	27.9		33.5	22.2
40	IL10-6855	144.0	i	149	142	144.5	131.5	144	152	146	156	131	28.8		33.5	24.0
41	KY05C-1020-4-6-5	146.4		150	146	139	138.5	148	154	150	158	134	27.0	i	33.0	21.0
42	KY05C-1105-43-6-1	144.7		149	144	143.5	134	142	152	147	158	133	28.7		34.0	23.3
43	KY06C-3003-43-13-3	146.6		149	147	142	137.5	149	154	149	158	134	29.4		35.0	23.7
44	KY204604	147.2		152	148	140.5	139	145	155	150	161	134	28.7		33.5	23.8
45	MD08-22-22-13-4	145.6		150	145	142	136	142	153	149	160	133	26.9	i	31.5	22.2
46	MD08-22-22-13-10	145.9		148	148	141	136	145	153	149	159	134	27.8		33.0	22.5
47	MD09W272-8-4-13-3	146.5		156	148	140.5	136	147	152	148	157	134	28.3		35.0	21.5
48	MDC07026-12-28	144.5		150	145	141	134.5	142	154	148	156	130	26.9	i	31.5	22.3
49	MO120194	143.5	i	146	143	141	133.5	142	151	147	158	130	28.4		32.5	24.2
50	MO120452	147.3	h	152	147	142	140	148	154	149	160	134	34.0	h	39.0	29.0
51	MO120794	146.4		152	146	142.5	137	148	152	148	158	134	32.9	h	39.0	26.8
52	MO121183	143.7	i	145	143	141	133.5	143	153	147	155	133	27.3	i	33.5	21.0
53	NE06545	144.3		146	144	141.5	135	143	151	148	157	133	30.6		34.5	26.7
54	NE08499	144.6		145	144	142	137	143	153	147	158	132	31.4		37.0	25.7
55	NE10478	142.8	i	144	142	140	133	143	151	147	155	130	26.0	i	31.5	20.5
56	NI12702W	147.4	h	150	148	141	141.5	147	156	150	158	135	31.4		36.0	26.8
57	VA10W-140	145.8		152	147	141	135	143	152	149	160	133	27.9		33.0	22.8
58	VA11W-106†	145.6		150	147	142	135.5	143	154	148	158	133	27.4	i	33.0	21.8
59	VA11W-301	145.7		153	147	140	136.5	143	153	149	156	134	26.2	i	31.5	20.8
60	VA12FHB-53	145.7		152	149	142.5	135	143	153	148	156	133	26.9	i	33.5	20.2
100	AVERAGE	145.3		149.5	145.5	141.5	135.2	144.2	153.2	148.1	157.3	133.1	29.2		34.6	23.7
101	MINIMUM	142.8		144	142	139	131.5	141	151	146	155	130	25.7		31.0	20.2
102	MAXIMUM	148.7		156	150	144.5	142	150	156	151	161	136	34.0		39.0	29.0
103	LSD(0.05)	1.3		.	.	.	.	.	.	.	.	.	2.0		.	.

Table 18. Summary of other traits collected on the 2013-2014 NUWWSN

ENTRY	NAME	VABLA	VABLA	VABLA	ILCHA	ILCHA
		YR	PM	LR	WINTER KILL	BACTERIAL LEAF STREAK
		0-9	0-9	0-9	0-9	0-9
1	TRUMAN	0.0	2.5	9.0	2.0	3.0
2	ERNIE	9.0	2.0	7.0	4.0	5.0
3	FREEDOM	7.5	1.5	4.0	6.0	4.5
4	PIONEER2545	9.0	1.7	7.0	5.5	4.5
5	NY01016-AN	9.0	3.0	1.0	6.5	4.5
6	NY01066-278	0.0	3.5	8.0	7.0	3.5
7	NY99059-249	0.0	3.0	7.0	6.0	4.0
8	NY99069-249	4.5	2.0	8.0	6.5	5.5
9	NY99069-352	7.5	4.0	6.0	3.0	4.5
10	KWS023	0.0	3.0	3.0	5.5	5.0
11	KWS024	0.0	4.0	2.0	5.0	5.0
12	KWS025	7.5	1.5	4.0	3.5	4.5
13	KWS028	9.0	2.0	6.0	2.0	4.0
14	L29230	0.0	5.0	8.0	5.5	4.0
15	LCS321	0.0	5.0	6.0	6.0	3.0
16	E6012	0.0	3.5	8.0	5.0	5.0
17	F0036R	0.0	3.0	8.0	5.5	4.5
18	F0039	7.5	3.0	7.0	8.0	3.5
19	F1014	0.0	4.0	4.0	5.5	4.0
20	OH07-263-3	9.0	3.0	6.0	4.5	4.0
21	OH08-206-69	0.0	1.5	1.0	7.0	4.5
22	OH08-269-58	9.0	2.0	7.0	4.5	3.5
23	0570A1-2-32-5-1-4	0.0	2.5	1.0	6.5	2.5
24	0762A1-2-8	0.0	3.5	1.0	4.5	4.5
25	08334A1-31	0.0	2.5	5.0	3.0	4.0
26	10641B1-9-11-7	9.0	1.5	1.0	5.0	3.5
27	B08-91993	0.0	1.5	3.0	6.5	2.0
28	B09*900256	0.0	2.0	5.0	4.5	3.5
29	M09L-9547	6.0	1.5	2.0	3.0	3.5
30	M10-1100#	0.0	1.5	4.0	5.0	4.5
31	M11-1027#	0.0	3.5	6.0	2.5	3.0
32	M11-2298	0.0	2.0	1.0	4.0	2.5
33	GL133	6.0	3.0	3.0	3.5	3.5
34	GL164	7.5	2.0	2.0	3.0	3.0
35	UGRCC2-78	4.5	3.0	6.0	3.0	4.5
36	UGRCC5-116	0.0	1.5	2.0	2.0	3.0
37	IL09-24328	0.0	3.5	7.0	2.0	3.5
38	IL09-3264	3.0	1.5	1.0	3.5	1.5
39	IL10-19464	0.0	2.0	6.0	2.5	4.0
40	IL10-6855	0.0	2.5	2.0	7.0	3.5
41	KY05C-1020-4-6-5	0.0	4.0	3.0	6.0	2.5
42	KY05C-1105-43-6-1	7.5	2.5	2.0	5.0	4.5
43	KY06C-3003-43-13-3	0.0	5.0	3.0	2.5	3.5
44	KY204604	6.0	2.7	3.0	5.0	6.0
45	MD08-22-22-13-4	3.0	7.5	.	5.0	4.5
46	MD08-22-22-13-10	3.0	8.0	2.0	5.0	4.0
47	MD09W272-8-4-13-3	0.0	2.0	1.0	8.5	3.5
48	MDC07026-12-28	0.0	1.0	2.0	6.5	6.0
49	MO120194	0.0	2.5	6.0	2.5	5.5
50	MO120452	1.5	3.5	8.0	2.5	5.0
51	MO120794	0.0	1.0	6.0	2.5	5.0
52	MO121183	4.5	3.5	4.0	2.5	6.5
53	NE06545	0.0	4.5	2.0	1.5	4.0
54	NE08499	0.0	2.0	2.0	1.5	3.5
55	NE10478	0.0	4.0	1.0	1.5	5.0
56	NI12702W	0.0	5.0	1.0	1.5	6.5
57	VA10W-140	9.0	2.5	1.0	7.0	7.0
58	VA11W-106+	0.0	2.0	3.0	4.0	6.0
59	VA11W-301	7.5	1.5	1.0	6.0	7.0
60	VA12FHB-53	6.0	1.5	3.0	8.0	6.5
100	AVERAGE	2.9	2.8	4.1	4.5	4.3
	MINIMUM	0.0	1.0	1.0	1.5	1.5
	MAXIMUM	9.0	8.0	9.0	8.5	7.0







Table 22. Summary of Fusarium Damaged Kernel (FDK, %) data from the 2013-2014 PNUWWSN.

ENTRY	NAME	AVG	ILURB	INTHO	INWLA	KYLEX	MIELA	OHWOO	VABLA	
1	TRUMAN	34.8		47.5	94.2	15.0	16.5	30.7	35	5.0
2	ERNIE	37.0		45.0	100.0	7.5	33.1	28.2	30	15.5
3	FREEDOM	56.6	h	75.0	100.0	22.5	37.9	65.8	80	15.0
4	PIONEER2545	54.3	h	82.5	91.2	35.0	39.8	25.5	85	21.0
5	KWS014	34.0		42.5	57.8	20.0	24.9	26.0	55	12.0
6	KWS029	41.9		55.0	100.0	3.0	22.7	36.4	60	16.5
7	KWS030	39.8		42.5	57.6	25.0	33.7	32.4	70	17.7
8	KWS031	42.2		45.0	100.0	12.5	26.8	27.8	75	8.3
9	KWS032	38.5		40.0	60.9	12.5	38.7	51.2	50	16.0
10	KWS033	40.4		57.5	96.0	20.0	30.1	32.6	30	16.4
11	KWS034	38.0		72.5	60.1	20.0	25.6	30.5	45	12.5
12	OH07-264-35	46.6	h	65.0	100.0	20.0	32.9	43.6	50	14.6
13	OH08-235-33	39.8		65.0	100.0	10.5	25.5	17.9	50	10.0
14	OH09-281-10	31.5	l	52.5	68.2	8.0	31.6	22.2	28	10.3
15	OH10-194-16	29.0	l	42.5	66.1	5.5	19.3	19.0	45	5.5
16	OH10-219-65	40.0		42.5	100.0	15.5	23.2	26.0	60	12.5
17	OH10-222-78	36.7		47.5	88.7	5.0	20.6	25.4	60	10.0
18	OH10-305-39	28.1	l	40.0	80.9	5.5	8.4	29.5	25	7.5
19	05251A1-1-77-8-2	31.4	l	40.0	76.2	3.0	26.9	35.0	30	8.5
20	0566A1-3-1-52	39.9		47.5	100.0	7.5	29.4	48.9	30	15.9
21	082A1-3-1	34.7		37.5	80.9	3.0	25.7	34.1	55	6.5
22	1042A1-1-2	40.5		65.0	91.7	12.5	29.6	30.1	40	14.5
23	10512RA1-8	42.8	h	70.0	85.7	8.0	22.2	34.4	55	24.0
24	10565C1-1	44.1	h	72.5	66.4	20.0	23.7	51.4	65	9.5
25	B09-2949	40.1		55.0	93.3	10.0	24.3	25.0	60	13.0
26	M10-1615	21.2	l	15.0	24.4	10.0	20.6	32.0	40	6.5
27	M10-1659	32.9		32.5	76.9	5.5	15.0	57.4	35	8.0
28	M12-2019#	39.2		72.5	65.3	15.5	25.7	35.3	50	10.0
29	M12-3189	29.5	l	30.0	51.7	5.5	18.0	37.1	55	9.0
30	M12-3326L	29.4	l	25.0	83.6	8.0	25.2	23.4	35	5.5
31	DH4-12	33.5		40.0	66.7	7.5	22.1	39.1	50	9.1
32	GL119	39.1		42.5	62.5	8.0	31.0	56.0	55	18.7
33	GL39	42.0		67.5	81.5	7.5	27.6	32.0	70	8.0
34	OACSnow	39.2		77.5	50.8	15.0	25.5	24.3	65	16.0
35	UGRCDH5-15	38.4		67.5	59.6	12.5	29.3	24.5	65	10.7
36	UGRCDH5-28	34.8		62.5	36.7	5.5	26.6	23.8	70	18.5
37	IL10-17672	20.1	l	12.5	29.8	10.0	19.0	36.5	30	3.0
38	IL10-17707	23.2	l	10.0	63.3	5.5	21.1	38.3	20	4.5
39	IL10-21934	18.0	l	20.0	19.4	3.0	18.3	32.1	30	3.5
40	IL10-21937	21.3	l	17.5	59.0	1.0	17.6	17.7	35	1.5
41	IL10-29145	21.7	l	10.0	55.7	3.0	20.0	24.5	30	8.5
42	KY03C-1237-32	23.6	l	72.5	16.0	10.5	18.4	9.3	35	3.5
43	KY06C-1003-140-3-3	31.4	l	35.0	59.7	10.5	22.4	44.0	35	13.2
44	KY06C-1061-3-18-1	45.5	h	85.0	45.0	35.0	22.4	31.2	80	20.0
45	KY06C-1065-4-13-3	39.8		70.0	40.9	30.0	37.9	28.9	50	21.0
46	KY06C-1116-10-2-1	27.1	l	37.5	65.5	5.5	17.3	31.5	25	7.5
47	KY06C-2020-11-12-1	22.6	l	35.0	60.3	5.5	12.5	22.6	15	7.5
48	MO100172	25.1	l	25.0	59.8	12.5	21.2	20.7	25	11.5
49	MO120150	18.7	l	20.0	38.7	3.0	18.3	18.7	25	6.9
50	MO120487	31.8	l	32.5	100.0	5.5	19.9	23.8	35	6.0
51	MO120846	36.3		37.5	100.0	5.5	23.0	39.9	40	8.5
52	MO121280	27.8	l	37.5	20.9	3.0	23.7	60.7	45	3.5
53	MO121539	40.7		47.5	100.0	3.0	24.4	44.8	50	15.4
54	MO121983	23.8	l	15.0	64.1	5.5	18.2	30.1	25	8.4
55	VA11MAS-9409-8-2-798	40.4		65.0	83.9	12.5	37.9	27.8	30	25.5
56	VA12FHB-34	39.4		60.0	78.5	17.5	26.0	43.9	40	10.1
57	VA12FHB-4	26.0	l	22.5	65.5	5.5	20.3	28.1	35	5.0
58	VA12FHB-55	34.6		67.5	55.3	3.0	24.4	52.2	30	10.0
59	VA12FHB-77	36.8		77.5	47.7	27.5	27.4	28.3	30	19.5
60	VA12FHB-8	39.3		65.0	66.5	27.5	27.8	39.0	40	9.5
100	AVERAGE	34.6		47.6	69.5	11.3	24.7	33.2	45	11.2
101	MINIMUM	18.0		10.0	16.0	1.0	8.4	9.3	15	1.5
102	MAXIMUM	56.6		85.0	100.0	35.0	39.8	65.8	85	25.5
103	LSD(0.05)	13.9		.	.	.	.	.	.	.



Table 23. Summary of INC/SEV/FDK (ISK, %) data from the 2013-2014 PNUWWSN

ENTRY	NAME	AVG		ILURB	INTHO	KYLEX	MIELA	OHWO0	VABLA
1	TRUMAN	43.7	l	52.1	57.2	34.6	45.4	56.7	16.3
2	ERNIE	52.2		57.9	86.5	43.9	48.2	53.4	23.2
3	FREEDOM	64.9	h	73.8	79.0	47.4	70.2	78.8	40.5
4	PIONEER2545	66.7	h	86.6	84.5	49.7	47.8	88.8	43.1
5	KWS014	55.8		52.9	71.1	51.3	47.7	67.4	44.4
6	KWS029	56.7		59.4	88.0	42.1	48.8	68.5	33.4
7	KWS030	55.5		55.0	69.6	45.2	50.3	74.9	37.7
8	KWS031	57.8	h	65.2	85.0	48.7	55.1	75.1	17.9
9	KWS032	55.3		59.5	60.4	47.7	66.3	61.8	36.1
10	KWS033	56.7		63.9	72.9	56.3	59.0	55.1	33.1
11	KWS034	57.7	h	70.0	67.5	45.9	54.9	63.6	44.1
12	OH07-264-35	58.9	h	76.9	83.5	50.0	52.5	62.5	27.7
13	OH08-235-33	56.3		75.3	80.5	38.3	48.7	62.1	33.1
14	OH09-281-10	50.5		62.8	69.3	49.4	50.5	47.7	23.1
15	OH10-194-16	52.2		55.6	71.4	43.2	52.2	59.6	31.4
16	OH10-219-65	53.8		50.3	79.0	41.0	49.1	65.0	38.4
17	OH10-222-78	56.1		59.5	70.0	42.5	58.3	75.0	31.5
18	OH10-305-39	43.6	l	45.8	65.3	23.2	46.9	46.2	34.1
19	05251A1-1-77-8-2	44.4	l	52.8	54.5	42.7	49.0	43.9	23.3
20	0566A1-3-1-52	53.4		54.9	83.5	45.8	54.1	54.2	27.7
21	082A1-3-1	51.6		48.8	75.9	40.0	53.4	63.0	28.7
22	1042A1-1-2	52.1		58.5	71.2	48.4	47.5	53.2	33.6
23	10512RA1-8	51.7		58.8	70.3	40.8	42.5	60.6	37.2
24	10565C1-1	54.1		67.3	62.5	40.9	43.2	73.9	36.8
25	B09-2949	56.7		64.0	77.8	43.5	49.0	68.3	37.8
26	M10-1615	40.0	l	30.6	53.3	34.2	46.5	55.3	20.3
27	M10-1659	48.7		43.6	75.8	32.1	63.0	51.9	25.6
28	M12-2019#	50.5		67.8	57.6	40.5	50.6	59.3	27.0
29	M12-3189	45.4	l	48.5	62.7	32.1	44.1	60.7	24.3
30	M12-3326L	49.2		47.5	69.5	43.1	49.8	52.6	32.8
31	DH4-12	48.9		48.3	68.7	39.7	58.2	52.6	25.9
32	GL119	55.3		60.8	73.0	47.0	49.4	67.8	34.0
33	GL39	61.7	h	81.9	80.6	44.5	45.2	80.8	37.3
34	OACSnow	55.5		78.7	62.3	42.8	46.5	67.2	35.4
35	UGRCDH5-15	54.7		67.1	67.4	47.7	53.5	72.0	20.7
36	UGRCDH5-28	51.4		73.1	50.7	40.5	41.4	75.8	26.8
37	IL10-17672	41.0	l	36.9	46.4	35.3	50.5	50.3	26.6
38	IL10-17707	36.5	l	22.8	55.3	25.7	56.9	37.2	21.2
39	IL10-21934	38.5	l	33.1	49.7	29.4	52.2	40.1	26.8
40	IL10-21937	40.6	l	32.7	68.6	26.8	43.2	49.5	23.1
41	IL10-29145	37.9	l	30.4	59.8	28.1	38.9	51.8	18.4
42	KY03C-1237-32	41.0	l	66.6	45.4	32.2	39.7	52.5	9.5
43	KY06C-1003-140-3-3	47.0		47.1	62.9	37.2	52.8	53.6	28.5
44	KY06C-1061-3-18-1	60.5	h	82.6	64.5	39.9	51.3	83.1	41.3
45	KY06C-1065-4-13-3	50.2		63.3	53.8	53.1	44.2	60.3	26.6
46	KY06C-1116-10-2-1	47.9		46.7	72.7	37.2	54.0	45.1	31.6
47	KY06C-2020-11-12-1	43.4	l	42.1	76.6	31.6	47.0	41.8	21.4
48	MO100172	41.5	l	37.8	71.9	34.3	36.8	46.6	21.7
49	MO120150	38.2	l	39.8	63.5	27.3	41.8	40.0	16.8
50	MO120487	47.4		48.4	76.0	34.6	44.1	55.3	26.0
51	MO120846	50.1		53.9	73.0	41.1	51.3	57.8	23.8
52	MO121280	45.9	l	48.1	45.8	36.6	61.2	61.4	22.3
53	MO121539	53.8		52.2	86.5	42.4	53.8	63.4	24.3
54	MO121983	46.3		33.2	76.7	31.9	59.3	49.5	27.1
55	VA11MAS-9409-8-2-798	53.1		63.9	61.3	51.0	46.8	54.4	41.3
56	VA12FHB-34	51.5		64.4	76.3	42.2	54.0	56.1	16.0
57	VA12FHB-4	43.4	l	43.8	71.2	33.0	47.1	46.7	18.9
58	VA12FHB-55	51.4		56.6	61.1	42.9	69.1	49.8	29.0
59	VA12FHB-77	53.8		74.7	61.1	42.9	48.2	58.1	38.0
60	VA12FHB-8	56.7		77.9	67.1	48.4	55.4	58.7	33.0
100	AVERAGE	50.6		56.2	68.4	40.5	50.6	59.0	29.0
101	MINIMUM	36.5		22.8	45.4	23.2	36.8	37.2	9.5
102	MAXIMUM	66.7		86.6	88.0	56.3	70.2	88.8	44.4
103	LSD(0.05)	9.5		.	.	.	.	.	.

Table 24. Summary of deoxynivalenol (DON, ppm) data from the 2013-2014 PNUWWSN.

ENTRY	NAME	AVG	ILURB	INWLA	KYLEX	MIELA	OHWOO	VABLA
1	TRUMAN	9.8	12.3	0.7	12.9	3.6	28.5	0.7
2	ERNIE	8.6 l	9.0	1.0	13.9	7.3	19.7	0.9
3	FREEDOM	14.5 h	11.3	2.4	18.8	13.7	32.4	8.4
4	PIONEER2545	17.0 h	17.2	3.8	15.6	20.7	37.0	7.5
5	KWS014	13.8 h	16.7	6.8	19.8	4.6	30.3	4.6
6	KWS029	9.1	11.1	0.6	15.1	3.2	22.5	1.9
7	KWS030	12.1	10.0	2.4	16.0	9.9	32.1	2.0
8	KWS031	9.8	7.9	1.2	12.3	4.1	33.1	0.4
9	KWS032	12.0	17.0	2.7	11.6	12.1	23.5	5.0
10	KWS033	15.7 h	24.5	7.7	31.6	10.0	16.1	4.3
11	KWS034	17.6 h	26.6	7.5	22.5	10.0	35.5	3.7
12	OH07-264-35	9.0	9.3	1.7	13.7	5.3	22.5	1.3
13	OH08-235-33	9.8	14.6	1.0	12.6	4.7	23.8	2.3
14	OH09-281-10	7.6 l	7.8	1.1	13.1	6.1	17.3	0.5
15	OH10-194-16	9.3	11.5	1.7	12.8	4.8	23.9	0.9
16	OH10-219-65	7.8 l	7.3	1.1	6.8	10.8	19.5	1.1
17	OH10-222-78	9.3	10.9	1.3	8.8	6.3	26.5	1.9
18	OH10-305-39	6.8 l	6.7	0.5	7.4	2.2	23.0	1.1
19	05251A1-1-77-8-2	7.3 l	9.4	0.5	6.5	3.6	22.7	1.0
20	0566A1-3-1-52	6.8 l	6.2	0.8	8.2	3.6	21.2	0.7
21	082A1-3-1	11.0	8.8	1.2	11.1	4.1	37.9	2.7
22	1042A1-1-2	8.3 l	11.4	1.0	7.6	5.3	22.2	2.1
23	10512RA1-8	14.0 h	17.5	2.1	22.7	4.4	32.4	5.0
24	10565C1-1	17.4 h	26.8	5.6	26.7	8.7	33.9	2.8
25	B09-2949	8.4 l	10.7	0.7	5.8	5.4	25.9	1.8
26	M10-1615	7.8 l	5.1	0.7	12.0	2.3	25.3	1.5
27	M10-1659	6.2 l	5.3	0.3	6.3	6.0	18.9	0.2
28	M12-2019#	8.3 l	14.4	1.5	10.4	1.8	20.4	1.3
29	M12-3189	8.4 l	7.1	0.4	10.5	2.8	28.3	1.5
30	M12-3326L	7.6 l	8.3	0.5	12.7	2.6	20.0	1.3
31	DH4-12	9.0	7.4	0.8	10.8	3.0	30.7	1.4
32	GL119	10.2	11.0	0.4	12.5	3.3	31.8	2.3
33	GL39	10.2	15.2	1.6	16.1	3.6	22.9	2.1
34	OACSnow	13.1	19.1	2.8	14.1	5.8	33.3	3.3
35	UGRCDH5-15	14.0 h	18.1	1.5	27.8	9.4	26.1	1.3
36	UGRCDH5-28	11.0	13.1	0.9	16.1	3.5	30.4	1.8
37	IL10-17672	6.0 l	8.0	1.0	11.8	1.7	12.8	0.6
38	IL10-17707	4.7 l	3.1	0.2	7.3	2.9	14.5	0.1
39	IL10-21934	7.1 l	5.1	0.5	12.1	2.3	22.6	0.3
40	IL10-21937	6.4 l	4.8	0.6	7.0	5.1	19.7	1.1
41	IL10-29145	4.7 l	3.2	0.4	8.1	2.4	12.9	1.3
42	KY03C-1237-32	7.8 l	13.6	0.8	9.6	4.0	18.0	0.7
43	KY06C-1003-140-3-3	7.5 l	6.0	1.0	10.7	3.9	22.7	0.9
44	KY06C-1061-3-18-1	15.1 h	18.4	2.5	15.4	13.9	37.8	2.8
45	KY06C-1065-4-13-3	10.0	13.5	2.3	9.1	7.4	23.7	3.9
46	KY06C-1116-10-2-1	5.6 l	3.6	0.5	6.6	5.3	15.3	2.0
47	KY06C-2020-11-12-1	6.0 l	7.4	0.6	7.0	4.0	16.2	0.7
48	MO100172	6.2 l	5.0	1.5	7.4	7.1	14.6	1.3
49	MO120150	5.2 l	5.1	0.5	10.6	2.3	12.3	0.2
50	MO120487	8.7 l	12.2	0.7	10.7	3.5	21.1	3.9
51	MO120846	7.9 l	10.4	0.8	9.1	6.6	19.1	1.3
52	MO121280	8.5 l	8.9	0.8	14.6	4.1	22.4	0.5
53	MO121539	8.4 l	13.0	0.6	11.3	3.1	21.7	0.6
54	MO121983	5.1 l	5.4	0.5	9.4	1.8	13.2	0.4
55	VA11MAS-9409-8-2-798	7.8 l	10.0	4.1	9.2	6.2	13.4	4.2
56	VA12FHB-34	9.8	10.6	1.7	25.1	5.2	15.3	1.2
57	VA12FHB-4	6.4 l	7.2	1.0	13.1	2.7	13.4	1.3
58	VA12FHB-55	7.8 l	13.0	0.9	10.9	1.0	17.6	3.2
59	VA12FHB-77	8.6 l	10.8	1.3	14.7	5.6	15.2	4.0
60	VA12FHB-8	9.9	10.9	3.4	11.7	7.2	23.7	2.7
100	AVERAGE	9.3	10.9	1.6	12.8	5.5	23.2	2.0
101	MINIMUM	4.7	3.1	0.2	5.8	1.0	12.3	0.1
102	MAXIMUM	17.6	26.8	7.7	31.6	20.7	37.9	8.4
103	LSD(0.05)	4.2	.	.	.	.	.	.

Table 25. Summary of greenhouse severity (GHSEV, %) data from the 2013-2014 PNUWWSN.

ENTRY	NAME	GHSEV
1	TRUMAN	12.1
2	ERNIE	23.1
3	FREEDOM	17.0
4	PIONEER2545	51.9
5	KWS014	30.8
6	KWS029	23.8
7	KWS030	21.6
8	KWS031	26.2
9	KWS032	34.3
10	KWS033	29.4
11	KWS034	45.1
12	OH07-264-35	30.6
13	OH08-235-33	45.4
14	OH09-281-10	24.3
15	OH10-194-16	24.8
16	OH10-219-65	36.4
17	OH10-222-78	18.1
18	OH10-305-39	23.4
19	05251A1-1-77-8-2	19.8
20	0566A1-3-1-52	13.2
21	082A1-3-1	9.6
22	1042A1-1-2	27.3
23	10512RA1-8	27.6
24	10565C1-1	20.5
25	B09-2949	22.8
26	M10-1615	16.7
27	M10-1659	14.4
28	M12-2019#	13.2
29	M12-3189	9.7
30	M12-3326L	14.5
31	DH4-12	36.4
32	GL119	15.2
33	GL39	33.1
34	OACSnow	21.7
35	UGRCDH5-15	15.8
36	UGRCDH5-28	19.1
37	IL10-17672	19.4
38	IL10-17707	11.8
39	IL10-21934	20.8
40	IL10-21937	30.3
41	IL10-29145	14.6
42	KY03C-1237-32	32.5
43	KY06C-1003-140-3-3	11.1
44	KY06C-1061-3-18-1	40.3
45	KY06C-1065-4-13-3	13.3
46	KY06C-1116-10-2-1	15.7
47	KY06C-2020-11-12-1	17.3
48	MO100172	16.2
49	MO120150	20.0
50	MO120487	12.8
51	MO120846	22.8
52	MO121280	9.4
53	MO121539	16.1
54	MO121983	16.5
55	VA11MAS-9409-8-2-798	48.5
56	VA12FHB-34†	26.7
57	VA12FHB-4	20.6
58	VA12FHB-55	10.0
59	VA12FHB-77†	46.3
60	VA12FHB-8	23.6
100	AVERAGE	23.1
101	MINIMUM	9.4
102	MAXIMUM	51.9
103	LSD(0.05)	.

Table 26. Summary of other traits collected on the 2013-2014 PNUWWSN

ENTRY	NAME	VABLA		VABLA		ILCHA		ILCHA	
		YR	PM	LR	WINTER	BACTERIAL	KILL	LEAF STREAK	
		0-9	0-9	0-9	0-9	0-9	0-9	0-9	
1	TRUMAN	0.0	3.5	9.0	1.7				3.5
2	ERNIE	9.0	2.0	8.0	3.0				5.0
3	FREEDOM	7.5	1.5	6.0	6.0				5.0
4	PIONEER2545	7.5	3.0	9.0	2.3				4.5
5	KWS014	7.5	2.5	3.0	5.7				3.0
6	KWS029	0.0	1.5	4.0	4.7				4.0
7	KWS030	0.0	1.0	3.0	4.5				4.5
8	KWS031	0.0	2.5	7.0	5.5				4.5
9	KWS032	3.0	1.5	7.0	5.5				7.0
10	KWS033	9.0	3.5	1.0	6.0				5.0
11	KWS034	4.5	2.0	2.0	8.0				3.0
12	OH07-264-35	0.0	1.5	6.0	4.0				6.0
13	OH08-235-33	6.0	1.0	8.0	7.0				5.5
14	OH09-281-10	0.0	2.0	6.0	4.5				6.0
15	OH10-194-16	0.0	1.0	4.0	3.0				4.5
16	OH10-219-65	7.5	2.0	6.0	3.0				5.0
17	OH10-222-78	0.0	1.5	2.0	5.5				3.5
18	OH10-305-39	0.0	2.0	3.0	5.0				7.5
19	O5251A1-1-77-8-2	7.5	3.5	2.0	5.0				2.0
20	O566A1-3-1-52	0.0	2.0	2.0	5.0				4.0
21	O82A1-3-1	9.0	2.0	4.0	4.5				6.0
22	1042A1-1-2	0.0	3.5	1.0	3.0				2.5
23	10512RA1-8	9.0	4.0	2.0	6.5				4.5
24	10565C1-1	9.0	1.0	4.0	6.5				4.5
25	B09-2949	6.0	1.5	3.0	8.0				5.5
26	M10-1615	0.0	3.5	3.0	3.5				4.0
27	M10-1659	7.5	2.0	1.0	2.0				2.0
28	M12-2019#	0.0	2.0	6.0	6.0				3.5
29	M12-3189	6.0	2.0	5.0	3.0				3.5
30	M12-3326L	0.0	4.0	3.0	4.5				5.0
31	DH4-12	7.5	4.0	4.0	2.0				3.0
32	GL119	3.0	3.5	7.0	3.0				3.5
33	GL39	0.0	4.0	4.0	5.0				2.5
34	OACSnow	7.5	3.5	6.0	4.0				5.0
35	UGRCDH5-15	6.0	2.5	3.0	5.0				3.5
36	UGRCDH5-28	4.5	5.0	5.0	3.0				4.5
37	IL10-17672	0.0	1.5	1.0	7.0				3.0
38	IL10-17707	0.0	1.0	1.0	7.0				3.5
39	IL10-21934	0.0	4.5	2.0	2.0				3.0
40	IL10-21937	0.0	2.0	3.0	2.5				3.0
41	IL10-29145	0.0	2.5	3.0	4.5				3.5
42	KY03C-1237-32	0.0	1.0	6.0	4.0				3.0
43	KY06C-1003-140-3-3	0.0	3.0	6.0	3.5				4.5
44	KY06C-1061-3-18-1	3.0	5.0	7.0	3.5				4.0
45	KY06C-1065-4-13-3	3.0	7.5	7.0	7.5				5.0
46	KY06C-1116-10-2-1	9.0	2.5	1.0	3.5				3.5
47	KY06C-2020-11-12-1	9.0	2.0	3.0	4.0				3.5
48	MO100172	9.0	2.5	9.0	6.5				6.0
49	MO120150	1.5	2.0	6.0	3.5				3.0
50	MO120487	0.0	6.0	5.0	5.0				3.0
51	MO120846	0.0	2.0	4.0	4.0				3.5
52	MO121280	0.0	3.0	7.0	3.5				5.0
53	MO121539	0.0	3.5	2.0	2.5				4.5
54	MO121983	7.5	5.5	3.0	2.0				4.5
55	VA11MAS-9409-8-2-798	7.5	1.0	1.0	8.5				6.0
56	VA12FHB-34†	0.0	3.0	2.0	7.5				4.0
57	VA12FHB-4	9.0	1.0	1.0	6.0				5.0
58	VA12FHB-55	9.0	1.5	1.0	8.0				5.5
59	VA12FHB-77†	9.0	3.0	1.0	6.0				4.5
60	VA12FHB-8	7.5	1.0	1.0	4.5				5.0
100	AVERAGE	3.8	2.6	4.0	4.7				4.3

Table 27. Summary of heading date (HD, Julian days) and height (HGT, inches) data from the 2013-2014 PNUWWN

ENTRY	NAME	HD	ILCHA	ILURB	INWLA	KYLEX	MOCOL	OHWOO	ONRID	VABLA	HGT	KYLEX	MIELA
		AVG									AVG		
1	TRUMAN	148	155	148	144	142	149	149	159	135	33.4 h	38.5	28.3
2	ERNIE	143	149	143	139	135	142	147	157	131	27.3	32.0	22.5
3	FREEDOM	147	155	148	144	137	148	148	158	135	29.4 h	36.0	22.8
4	PIONEER2545	144	148	146	142	136	145	148	156	134	21.8 l	32.0	11.5
5	KWS014	148 h	153	149	145	143	149	152	160	136	31.2 h	36.5	25.8
6	KWS029	145	148	146	142	137	145	149	158	134	31.8 h	38.5	25.0
7	KWS030	144	146	145	142	135	145	149	159	134	25.0 l	28.5	21.5
8	KWS031	145	152	145	142	136	147	149	159	132	32.4 h	37.5	27.3
9	KWS032	145	151	144	142	135	147	148	156	134	27.0	32.5	21.5
10	KWS033	149 h	154	149	146	143	151	149	161	136	28.0	33.5	22.5
11	KWS034	149 h	156	150	147	141	151	151	161	137	28.8 h	34.0	23.5
12	OH07-264-35	143	147	143	140	135	142	148	158	134	30.9 h	35.5	26.3
13	OH08-235-33	145	153	148	140	136	145	148	157	133	31.3 h	37.5	25.0
14	OH09-281-10	145	151	146	141	135	148	147	156	133	27.3	32.0	22.5
15	OH10-194-16	145	150	145	144	137	145	148	156	134	30.4 h	35.0	25.8
16	OH10-219-65	143	150	144	141	133	143	147	156	132	29.8 h	33.5	26.0
17	OH10-222-78	145	151	146	144	137	147	149	156	134	31.5 h	35.5	27.5
18	OH10-305-39	145	152	147	142	137	147	148	155	134	31.3 h	38.0	24.5
19	05251A1-1-77-8-2	144	152	144	140	135	143	147	155	133	27.3	33.0	21.5
20	0566A1-3-1-52	143	151	143	139	134	142	148	155	133	24.4 l	29.5	19.3
21	082A1-3-1	142 l	147	142	138	132	142	147	154	131	26.8	31.0	22.5
22	1042A1-1-2	145	152	145	141	137	149	147	158	134	27.5	32.5	22.5
23	10512RA1-8	146	154	148	142	137	147	148	156	134	31.4 h	35.0	27.8
24	10565C1-1	146	154	147	142	139	149	148	158	133	28.5 h	33.5	23.5
25	B09-2949	144	151	146	139	134	143	148	156	132	21.3 l	33.0	9.5
26	M10-1615	142 l	146	142	140	133	145	147	155	131	28.3 h	33.0	23.5
27	M10-1659	142 l	145	144	139	134	143	147	156	130	29.8 h	36.0	23.5
28	M12-2019#	142 l	146	144	140	132	141	147	155	133	29.4 h	35.0	23.8
29	M12-3189	145	149	146	142	135	147	148	158	134	30.0 h	35.0	25.0
30	M12-3326L	142 l	145	143	140	133	143	147	156	132	29.3 h	33.0	25.5
31	DH4-12	144	148	143	141	135	145	148	156	133	29.0 h	34.5	23.5
32	GL119	143	148	144	140	134	146	148	156	132	30.4 h	34.0	26.8
33	GL39	144	149	145	141	134	143	148	157	133	25.5 l	36.0	15.0
34	OACSnow	146	152	147	144	137	147	147	158	134	30.3 h	35.0	25.5
35	UGRCDH5-15	146	153	147	142	139	147	149	158	134	29.9 h	35.0	24.8
36	UGRCDH5-28	146	149	147	144	137	148	149	160	135	24.5 l	36.0	13.0
37	IL10-17672	143	150	143	141	134	142	148	156	132	29.8 h	33.5	26.0
38	IL10-17707	141 l	148	142	139	132	141	147	154	129	27.3	33.0	21.5
39	IL10-21934	142 l	145	143	141	132	145	147	155	131	30.8 h	36.0	25.5
40	IL10-21937	142 l	146	142	139	133	142	147	155	130	30.3 h	36.0	24.5
41	IL10-29145	142 l	146	142	139	132	142	147	154	132	28.8 h	34.5	23.0
42	KY03C-1237-32	144	151	147	142	133	148	147	156	132	25.4 l	30.5	20.3
43	KY06C-1003-140-3-3	143	149	143	142	134	143	148	155	132	28.5 h	32.5	24.5
44	KY06C-1061-3-18-1	145	151	147	143	137	145	149	156	133	29.0 h	33.5	24.5
45	KY06C-1065-4-13-3	147	153	149	144	138	150	149	158	136	27.3	32.0	22.5
46	KY06C-1116-10-2-1	144	148	144	141	137	145	147	158	133	23.8 l	27.0	20.5
47	KY06C-2020-11-12-1	144	151	145	142	135	143	148	156	133	28.3 h	32.5	24.0
48	MO100172	142 l	150	142	139	131	142	146	154	129	27.9	32.5	23.3
49	MO120150	143 l	145	143	141	134	143	147	156	132	29.8 h	33.0	26.5
50	MO120487	146	149	147	145	139	147	149	160	134	30.3 h	34.5	26.0
51	MO120846	145	149	146	144	136	148	148	156	133	30.7 h	35.5	25.8
52	MO121280	144	149	146	141	137	145	148	156	131	31.0 h	36.5	25.5
53	MO121539	143	147	144	140	134	143	148	156	132	28.9 h	33.5	24.3
54	MO121983	143 l	146	142	140	133	145	147	157	132	31.4 h	34.5	28.3
55	VA11MAS-9409-8-2-798	146	156	149	142	135	147	148	156	133	26.7	30.0	23.3
56	VA12FHB-34+	144	152	146	141	134	148	147	156	132	30.3 h	37.0	23.5
57	VA12FHB-4	144	152	145	140	134	143	147	156	133	26.7	31.0	22.3
58	VA12FHB-55	145	152	148	140	136	143	148	156	133	26.9	31.5	22.3
59	VA12FHB-77+	146	152	149	144	137	147	149	156	133	28.4 h	31.0	25.8
60	VA12FHB-8	145	151	146	142	137	145	148	157	133	27.0	30.5	23.5
100	AVERAGE	144	150	145	141	135	145	148	157	133	28.6	33.8	23.4
101	MINIMUM	141	145	142	138	131	141	146	154	129	21.3	27.0	9.5
102	MAXIMUM	149	156	150	147	143	151	152	161	137	33.4	38.5	28.3
103	LSD(0.05)	1	.	.	.	.	.	.	.	.	5.2	.	.

Table 28. Presence or absence of FHB QTL in the 2013-2014 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](mailto:sneller.5@osu.edu). Data is from the USDA Eastern Regional Small Grains Genotyping Lab. , Raleigh NC.

Entry	Cultivar/Designation	Fhb1	Fhb_Massey 3BL	Fhb_2DL-Wuhan1/W14	Fhb_5A
1	Truman	no	no	no	no
2	Ernie	no	<b>Fhb Massey 3BL</b>	no	<b>Fhb_5A Ernie het</b>
3	Freedom	no	<b>Fhb Massey 3BL</b>	no	no
4	Pioneer2545	no	no	no	no
5	NY01016-AN	no	no	no	no
6	NY01066-278	no	no	no	no
7	NY99059-249	no	no	no	<b>Fhb_5A Ernie</b>
8	NY99069-249	no	no	no	<b>Fhb_5A Ernie het</b>
9	NY99069-352	no	no	no	<b>Fhb_5A Ernie</b>
10	KWS023	no	<b>Fhb Massey 3BL</b>	no	no
11	KWS024	no	no	no	no
12	KWS025	no	no	no	<b>Fhb_5A Ernie het</b>
13	KWS028	no	no	no	no
14	L29230	no	<b>Fhb Massey 3BL</b>	no	no
15	LCS321	no	no	no	no
16	E6012	no	no	no	<b>Fhb_5A Ernie</b>
17	F0036R	no	no	no	no
18	F0039	no	no	no	no
19	F1014	<b>Fhb1</b>	no	no	no
20	OH07-263-3	no	no	no	no
21	OH08-206-69	no	no	no	no
22	OH08-269-58	no	<b>Fhb Massey 3BL het</b>	no	<b>Fhb_5A Ernie het</b>
23	0570A1-2-32-5-1-4	no	no	no	<b>Fhb_5A Ernie</b>
24	0762A1-2-8	<b>Fhb1</b>	no	no	no
25	08334A1-31	no	no	no	<b>Fhb_5A Ernie het</b>
26	10641B1-9-11-7	<b>Fhb1</b>	no	no	<b>Fhb_5A Ernie</b>
27	B08-91993	no	<b>Fhb Massey 3BL</b>	no	no
28	B09*900256	no	no	no	<b>Fhb_5A Ernie</b>
29	M09L-9547	no	no	no	no
30	M10-1100#	no	no	no	no
31	M11-1027#	no	no	no	no
32	M11-2298	no	no	no	no
33	GL133	no	no	no	<b>Fhb_5A Ernie</b>
34	GL164	no	no	no	no
35	UGRCC2-78	no	no	no	no
36	UGRCC5-116	no	no	no	<b>Fhb_5A Ernie het</b>
37	IL09-24328	no	no	no	no
38	IL09-3264	no	no	no	no
39	IL10-19464	no	no	no	no
40	IL10-6855	no	no	no	<b>Fhb_5A Ernie</b>
41	KY05C-1020-4-6-5	<b>Fhb1</b>	no	no	no
42	KY05C-1105-43-6-1	no	no	no	no
43	KY06C-3003-43-13-3	no	no	no	no
44	KY204604	no	no	no	no
45	MD08-22-22-13-4	<b>Fhb1</b>	no	<b>Fhb_2DL-Wuhan1/W14</b>	<b>Fhb_5A Ning7840</b>
46	MD08-22-22-13-10	<b>Fhb1</b>	no	<b>Fhb_2DL-Wuhan1/W14</b>	<b>Fhb_5A Ning7840</b>
47	MD09W272-8-4-13-3	<b>Fhb1</b>	no	no	no
48	MDC07026-12-28	<b>Fhb1 het</b>	no	<b>Fhb_2DL-Wuhan1/W14</b>	<b>Fhb_5A Ning7840 het</b>
49	MO120194	no	no	no	no
50	MO120452	no	no	no	no
51	MO120794	no	no	no	no
52	MO121183	no	no	no	no
53	NE06545	no	no	no	no
54	NE08499	no	no	no	no
55	NE10478	no	no	no	no
56	NI12702W	no	no	no	no
57	VA10W-140	no	no	no	no
58	VA11W-106	no	no	no	no
59	VA11W-301	no	no	no	no
60	VA12FHB-53	<b>Fhb1 het</b>	no	no	no

Table 29. Presence or absence of FHB QTL in the 2013-2014 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](mailto:sneller.5@osu.edu). Data is from the USDA Eastern Regional Small Grains Genotyping Lab, Raleigh NC.

Entry	Cultivar/Designation	Fhb1	Fhb Massey 3BL	Fhb 2DL-Wuhan1/W14	Fhb 5A
1	Truman	no	no	no	no
2	Ernie	no	<b>Fhb Massey 3BL het</b>	no	<b>Fhb_5A Ernie</b>
3	Freedom	no	<b>Fhb Massey 3BL</b>	no	no
4	Pioneer2545	no	no	no	no
5	KWS014	no	no	no	no
6	KWS029	no	no	no	no
7	KWS030	no	no	no	no
8	KWS031	no	<b>Fhb Massey 3BL</b>	no	no
9	KWS032	no	no	no	<b>Fhb_5A Ernie</b>
10	KWS033	no	no	no	no
11	KWS034	no	no	no	no
12	OH07-264-35	no	<b>Fhb Massey 3BL</b>	no	no
13	OH08-235-33	no	no	no	no
14	OH09-281-10	no	no	no	no
15	OH10-194-16	no	<b>Fhb Massey 3BL</b>	no	no
16	OH10-219-65	no	no	no	no
17	OH10-222-78	no	no	no	no
18	OH10-305-39	no	no	no	no
19	05251A1-1-77-8-2	no	no	no	<b>Fhb_5A Ernie</b>
20	0566A1-3-1-52	no	no	no	no
21	082A1-3-1	<b>Fhb1</b>	no	no	no
22	1042A1-1-2	no	no	no	<b>Fhb_5A Ernie</b>
23	10512RA1-8	<b>Fhb1</b>	no	no	<b>Fhb_5A Ernie</b>
24	10565C1-1	<b>Fhb1 het</b>	<b>Fhb Massey 3BL het</b>	no	no
25	B09-2949	no	no	no	no
26	M10-1615	no	no	no	no
27	M10-1659	no	no	no	no
28	M12-2019#	no	<b>Fhb Massey 3BL</b>	no	no
29	M12-3189	no	no	no	<b>Fhb_5A Ernie het</b>
30	M12-3326L	no	no	no	no
31	DH4-12	<b>Fhb1 het</b>	no	no	no
32	GL119	no	no	no	<b>Fhb_5A Ernie</b>
33	GL39	no	no	no	<b>Fhb_5A Ernie</b>
34	OACSnow	no	no	no	no
35	UGRCDH5-15	no	no	no	no
36	UGRCDH5-28	no	no	no	no
37	IL10-17672	no	no	no	no
38	IL10-17707	no	no	no	no
39	IL10-21934	no	no	no	no
40	IL10-21937	no	no	no	no
41	IL10-29145	no	no	no	no
42	KY03C-1237-32	<b>Fhb1 het</b>	no	no	no
43	KY06C-1003-140-3-3	no	no	no	no
44	KY06C-1061-3-18-1	no	no	no	no
45	KY06C-1065-4-13-3	<b>Fhb1 het</b>	no	no	no
46	KY06C-1116-10-2-1	no	no	no	no
47	KY06C-2020-11-12-1	no	no	no	no
48	MO100172	no	no	no	no
49	MO120150	no	no	no	no
50	MO120487	no	no	no	no
51	MO120846	no	no	no	no
52	MO121280	no	no	no	no
53	MO121539	no	no	no	no
54	MO121983	no	no	no	no
55	VA11MAS-9409-8-2-798	<b>Fhb1</b>	no	no	no
56	VA12FHB-34†	no	no	no	no
57	VA12FHB-4	<b>Fhb1 het</b>	no	no	no
58	VA12FHB-55	<b>Fhb1</b>	no	no	no
59	VA12FHB-77	no	no	no	no
60	VA12FHB-8	no	no	no	no

Table 30. Quality parameters for the 2013-2014 NUWWSN. Data is from the USDA Soft Wheat Quality Lab. Additional analytical data is available in an excel file from [sneller.5@osu.edu](mailto:sneller.5@osu.edu).

Entry Number	Entry	*Entry in RED is the check used for this evaluation					*For highlighted entries, please see the notes in lir				
		Test Weight (LB/BU)	NIR Kernel Protein (at 12%)	SKCS Kernel Hardness	SKCS Kernel Diameter (mm)	SKCS Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (at 14%)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)
1	TRUMAN	57.2	9.9	4.8	2.3	35.5	67.7	58.3	7.7	111.6	68.2
2	ERNE	56.9	11.1	1.5	2.8	42.0	65.8	55.7	8.6	115.8	67.3
3	FREEDOM	55.5	9.6	18.5	2.4	37.0	64.4	55.1	7.9	97.8	67.8
4	PIONEER 2545	56.1	10.0	17.3	2.3	36.4	64.3	58.0	8.5	107.7	70.2
5	NY01016-AN	60.1	11.2	6.0	2.7	42.2	69.4	57.9	8.6	133.6	66.4
6	NY01066-278	58.9	10.5	8.0	2.5	37.5	69.0	62.0	8.0	106.9	64.3
7	NY99059-249	60.4	9.7	9.1	2.3	34.6	70.5	59.8	7.8	111.8	64.7
8	NY99069-249	60.1	10.1	5.4	2.5	36.9	67.9	59.7	7.8	112.8	66.5
9	NY99069-352	57.9	10.6	10.4	2.4	35.1	67.8	59.6	8.1	112.7	66.8
10	KWS023	60.2	11.0	6.6	2.4	37.8	69.4	57.5	8.3	121.2	65.2
11	KWS024	62.9	10.8	30.5	2.5	37.4	65.7	55.1	8.4	119.7	74.6
12	KWS025	59.7	10.7	1.4	2.5	39.8	70.3	55.9	8.0	124.5	64.6
13	KWS028	60.4	11.0	4.4	2.3	36.0	68.6	58.1	8.3	118.3	65.7
14	L29230	60.9	11.1	7.9	2.5	35.7	68.4	60.6	8.6	127.5	64.5
15	LCS321	62.3	10.9	1.3	2.6	40.3	68.6	57.5	8.3	123.4	67.8
16	E6012	58.2	10.8	2.7	2.5	36.6	68.5	59.8	8.2	127.4	67.4
17	F0036R	59.0	10.7	-3.8	2.4	36.5	67.7	65.3	7.8	101.5	70.7
18	F0039	58.5	9.6	2.7	2.6	40.3	69.8	60.7	7.7	108.9	65.6
19	F1014	58.7	10.9	28.4	2.4	33.8	67.8	53.7	8.3	84.5	67.6
20	OH07-263-3	61.8	10.2	3.5	2.5	40.5	69.0	57.6	8.0	104.2	65.2
21	OH08-206-69	61.2	12.6	9.7	3.0	44.9	70.8	50.5	9.7	115.1	61.6
22	OH08-269-58	59.7	10.8	-9.6	2.6	39.4	65.2	65.0	7.7	120.6	73.0
23	0570A1-2-32-5-1-4	61.2	10.5	5.9	2.8	44.0	67.7	58.9	8.2	118.1	67.5
24	0762A1-2-8	58.9	10.7	6.0	2.8	41.0	66.3	56.0	8.4	104.0	67.6
25	08334A1-31	57.8	10.7	-1.2	2.5	38.6	66.4	63.5	7.9	125.9	68.3
26	10641B1-9-11-7	62.1	12.7	37.3	2.9	40.2	69.9	42.3	10.3	129.4	73.6
27	B08-91993	62.5	10.8	3.1	2.5	42.5	66.1	58.8	8.2	114.8	74.3
28	B09*900256	60.9	10.3	21.2	2.3	34.3	65.6	57.8	8.1	131.4	70.6
29	M09L-9547	Missing Entry									
30	M10-1100#	58.1	9.8	-1.9	2.3	38.3	68.9	62.0	7.3	108.0	64.9
31	M11-1027#	60.9	10.7	8.8	2.2	33.2	65.7	61.7	8.2	133.1	72.9
32	M11-2298	60.4	11.2	9.2	2.5	34.7	67.3	56.5	8.5	124.2	63.1
33	GL133	58.8	10.4	9.6	2.5	35.8	66.8	58.9	8.6	114.0	66.8
34	GL164	59.7	10.2	18.6	2.3	32.6	64.2	56.9	7.9	104.4	67.5
35	UGRCC2-78	58.7	9.7	3.1	2.4	38.1	67.4	66.0	7.9	108.6	68.8
36	UGRCC5-116	59.1	10.3	6.4	2.3	33.3	68.0	60.7	7.5	83.7	67.1
37	IL09-24328	60.7	10.3	-0.4	2.3	35.0	68.2	59.2	8.0	135.2	66.3
38	IL09-3264	60.2	12.1	1.5	2.6	39.7	68.2	57.4	8.9	135.0	65.2
39	IL10-19464	61.6	10.9	-2.5	2.6	40.1	68.5	58.3	8.6	127.7	66.2
40	IL10-6855	61.8	11.6	-0.5	2.8	40.6	67.8	58.8	8.6	139.3	67.4
41	KY05C-1020-4-6-5	62.9	11.5	20.4	2.5	36.5	66.9	55.1	8.8	121.9	66.7
42	KY05C-1105-43-6-1	61.6	11.1	15.6	2.4	34.1	66.1	58.5	8.1	135.5	69.1
43	KY06C-3003-43-13-3	59.3	10.8	12.9	2.1	32.6	64.7	60.9	8.5	124.3	70.0
44	KY204604	58.7	11.1	17.0	2.4	34.6	66.1	60.0	8.6	133.8	70.5
45	MD08-22-22-13-4	61.5	11.9	26.6	2.3	29.4	66.2	53.7	9.2	115.1	69.1
46	MD08-22-22-13-10	62.2	11.8	32.6	2.3	29.8	66.0	51.6	9.3	109.6	69.5
47	MD09W272-8-4-13-3	61.6	13.2	14.3	2.4	36.0	64.0	56.2	10.1	122.3	71.0
48	MDC07026-12-28	60.8	12.9	24.0	2.2	29.4	65.7	53.2	10.1	145.3	68.6
49	MO120194	60.1	11.3	-4.3	2.3	37.5	67.3	61.3	8.5	124.9	71.0
50	MO120452	60.1	10.0	6.9	2.3	36.1	66.5	58.9	7.3	109.8	67.7
51	MO120794	58.8	10.4	4.6	2.2	33.7	66.7	59.0	7.8	111.1	66.7
52	MO121183	59.3	10.4	2.3	2.2	34.0	64.8	61.5	8.0	126.8	71.6
53	NE06545	58.5	10.7	41.1	2.5	35.5	68.7	54.2	8.5	153.6	79.1
54	NE08499	60.2	9.9	43.1	2.5	35.1	68.1	52.9	7.9	127.3	74.3
55	NE10478	59.9	10.7	66.9	2.6	34.1	69.7	36.4	8.9	150.7	85.7
56	NI12702W	62.3	11.8	76.6	2.6	35.0	68.7	32.4	9.7	141.7	99.2
57	VA10W-140	61.5	10.9	11.6	2.5	37.9	68.5	56.3	8.3	128.1	70.2
58	VA11W-106†	60.9	9.8	5.5	2.4	36.7	66.2	61.5	7.5	118.6	73.6
59	VA11W-301	59.4	10.0	1.0	2.4	38.6	67.4	58.9	7.1	95.9	70.2
60	VA12FHB-53	60.0	10.9	11.6	2.4	33.1	65.3	58.8	8.0	107.8	69.4
	Mean	60.0	10.8	12.2	2.5	36.7	67.3	57.3	8.3	119.5	69.3
	Std Dev	1.6	0.8	16.0	0.2	3.3	1.7	5.7	0.7	14.2	5.6



Table 31. Quality parameters for the 2013-2014 PNUWWSN. Data is from the USDA Soft Wheat Quality Lab. Additional analytical data is available in an excel file from [sneller.5@osu.edu](mailto:sneller.5@osu.edu).

*Entry in RED is the check used for this evaluation												*For highlighted entries, please see the notes in line											
Entry Number	Entry	Test Weight (LB/BU)	NIR Kernel Protein (at 12%)	SKCS Kernel Hardness	SKCS Kernel Diameter (mm)	SKCS Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (at 14%)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)												
1	TRUMAN	56.5	9.6	-0.2	2.2	34.0	66.0	61.5	7.4	110.9	70.3												
2	ERNIE	58.4	10.4	-6.5	3.0	43.3	66.3	56.6	7.8	119.8	69.0												
3	FREEDOM	55.0	8.8	14.6	2.3	35.7	65.4	58.3	7.2	102.1	69.0												
4	PIONEER 2545	55.7	10.0	9.2	2.3	33.9	63.9	61.0	8.1	113.5	73.0												
5	KWS014	59.0	10.1	6.0	2.4	36.9	67.5	62.4	7.6	124.3	69.0												
6	KWS029	59.3	10.0	0.0	2.2	35.8	65.0	64.4	7.3	129.8	73.1												
7	KWS030	61.2	9.8	26.3	2.6	38.1	64.7	58.7	7.6	117.5	74.3												
8	KWS031	61.2	10.2	2.5	2.4	38.2	68.5	61.7	7.4	130.9	67.2												
9	KWS032	58.7	9.6	12.6	2.5	36.3	64.9	62.5	7.4	124.1	76.7												
10	KWS033	62.2	10.2	16.4	2.5	41.4	67.3	52.9	7.8	104.1	68.6												
11	KWS034	59.6	9.5	8.9	2.5	39.0	67.1	59.7	7.1	122.9	68.7												
12	OH07-264-35	59.1	9.8	4.3	2.5	37.1	67.9	60.8	7.1	112.9	64.9												
13	OH08-235-33	59.6	11.0	1.6	2.8	42.7	67.6	61.4	8.4	121.2	68.3												
14	OH09-281-10	60.1	10.5	17.0	2.7	37.6	67.9	56.1	7.7	114.3	65.6												
15	OH10-194-16	62.0	10.1	7.6	2.3	35.4	67.3	60.9	7.7	123.1	67.3												
16	OH10-219-65	60.3	10.8	5.1	2.3	35.0	65.5	60.2	8.0	119.5	70.6												
17	OH10-222-78	57.4	10.5	-5.2	2.2	36.3	68.0	62.3	7.9	115.5	64.7												
18	OH10-305-39	61.1	9.5	10.5	2.8	45.0	66.7	56.2	8.1	117.5	71.9												
19	05251A1-1-77-8	59.9	10.2	7.4	2.4	34.3	65.5	62.0	7.4	115.6	72.2												
20	0566A1-3-1-52	58.7	10.7	6.4	2.6	36.7	64.7	61.9	7.5	121.5	70.4												
21	082A1-3-1	59.3	11.4	10.7	2.9	39.9	66.5	54.5	8.0	88.0	68.7												
22	1042A1-1-2	58.2	10.6	6.3	2.5	34.6	65.2	63.8	7.6	115.9	77.1												
23	10512RA1-8	58.5	10.1	8.1	2.8	39.8	64.9	58.3	7.8	120.6	76.2												
24	10565C1-1	61.2	11.2	11.3	2.6	36.7	65.9	59.5	8.2	107.6	71.0												
25	B09-2949	62.2	10.6	9.2	2.7	39.3	66.0	57.3	7.7	141.2	69.3												
26	M10-1615	61.0	10.1	4.8	2.5	39.8	68.0	56.2	7.7	112.6	67.4												
27	M10-1659	61.3	11.9	7.2	2.8	38.7	67.3	53.4	8.8	127.2	64.0												
28	M12-2019#	60.7	11.0	12.4	2.5	36.9	65.7	52.6	8.6	90.5	66.2												
29	M12-3189	61.2	10.9	12.3	2.8	35.3	68.7	53.7	8.3	120.1	64.1												
30	M12-3326L	56.4	9.1	-2.7	2.3	35.0	67.7	63.9	7.6	122.6	72.0												
31	DH4-12	55.2	8.6	12.6	2.2	35.0	62.8	62.3	7.3	115.8	76.1												
32	GL119	58.2	9.7	2.0	2.5	35.1	67.7	58.1	7.7	111.0	70.4												
33	GL39	57.5	10.1	7.0	2.7	41.2	68.7	54.7	8.1	109.6	66.3												
34	OACSnow	55.5	8.3	10.1	2.4	37.7	67.1	60.8	7.2	96.1	71.3												
35	UGRCDH5-15	59.2	10.3	17.3	2.6	38.1	65.8	54.2	7.9	85.5	66.8												
36	UGRCDH5-28	61.3	10.6	16.7	2.4	35.6	66.5	55.6	7.9	86.1	67.2												
37	IL10-17672	60.1	9.9	-3.8	2.3	35.0	66.7	61.6	7.7	137.7	68.3												
38	IL10-17707	62.1	10.4	9.9	2.4	34.5	66.0	58.2	7.5	133.7	68.9												
39	IL10-21934	62.1	10.4	-0.2	2.6	39.0	67.3	55.4	7.7	123.2	64.9												
40	IL10-21937	61.2	10.4	6.2	2.4	35.5	65.8	54.7	8.0	131.7	65.6												
41	IL10-29145	60.8	10.6	1.5	2.6	40.8	67.7	58.3	8.1	137.9	66.2												
42	KY03C-1237-32	60.7	11.2	8.8	2.8	41.8	67.1	54.8	8.5	143.8	68.7												
43	KY06C-1003-14	60.9	10.6	13.1	2.6	39.8	67.3	55.0	7.9	106.4	69.7												
44	KY06C-1061-3-1	60.4	11.1	6.2	2.5	41.9	65.9	58.5	8.5	132.3	76.4												
45	KY06C-1065-4-1	59.0	10.7	42.5	2.4	33.9	68.8	49.2	8.4	141.4	76.7												
46	KY06C-1116-10	60.8	11.5	1.8	2.5	37.5	66.9	58.6	8.4	138.9	67.0												
47	KY06C-2020-11	61.2	10.6	-2.0	2.5	35.1	67.2	59.8	8.0	127.4	66.0												
48	MO100172	59.7	9.9	5.9	2.2	36.8	65.7	59.8	7.9	147.2	71.3												
49	MO120150	62.4	11.1	13.0	2.5	36.2	65.4	58.7	8.0	132.2	71.8												
50	MO120487	59.9	10.2	4.8	2.1	32.8	66.6	60.0	7.9	112.9	68.5												
51	MO120846	60.2	10.7	7.4	2.2	33.6	66.8	58.8	8.0	121.3	68.3												
52	MO121280	59.9	10.3	4.9	2.5	39.7	63.7	58.2	7.6	117.7	71.4												
53	MO121539	60.1	11.7	0.8	2.4	37.0	66.4	55.4	8.7	130.4	66.6												
54	MO121983	61.4	11.3	4.5	2.6	37.7	67.2	57.4	8.0	119.9	65.8												
55	VA11MAS-9409	59.2	11.9	23.7	2.3	32.4	67.2	54.0	9.6	116.7	64.4												
56	VA12FHB-34†	60.8	11.7	4.2	2.4	37.2	66.9	59.3	9.1	154.5	72.6												
57	VA12FHB-4	60.0	12.0	-2.7	2.6	39.2	65.0	57.9	8.7	109.0	70.1												
58	VA12FHB-55	59.6	11.7	2.9	2.6	40.8	67.5	56.1	8.4	107.5	69.9												
59	VA12FHB-77†	61.1	12.7	11.8	2.5	35.0	67.9	55.4	10.0	121.6	67.5												
60	VA12FHB-8	59.9	11.1	9.6	2.5	34.4	66.7	57.6	8.2	110.5	69.0												
	Average	59.8	10.5	7.7	2.5	37.3	66.5	58.2	8.0	119.5	69.4												
	Mean	1.8	0.8	7.9	0.2	2.8	1.3	3.2	0.6	14.4	3.4												

Note: Entry #45 has much higher SKCS kernel hardness than typical SRW wheat, lower softness equivalent and higher sodium carbonate SRC.