Small Grains Management Field Day



Robert Musgrave Research Farm
Cornell University
Aurora, NY
June 5, 2014

An Educational Program of the Integrated Field Crop, Soil, and Pest Management Program Work Team; Cornell Cooperative Extension; the Cornell University Agricultural Experiment Station; and Cornell University Departments of Crop and Soil Sciences, Plant Breeding and Genetics, and Plant Pathology and Plant-Microbe Biology.

Cornell University

Agenda

1	***Sign-in, name tags, and refreshments*** *(Leon Field Laboratory)* ***Remember to sign recertification forms prior to start of program*		*9:30 am*
2	***Welcome and introductions; Board wagons to Field 'Z'***		*10:00 am*
3	***2014 Crop development overview***, Bill Cox		*10:15 am*
4	***Straw - the hidden money maker***, farmer panel with Bill Cox		*10:30 am*
5	***Disease management update***, Gary Bergstrom		*10:40 am*
6	***Wheat management updates***, Extension educators and producers		*10:55 am*
7	***Board wagons or walk to Leon Lab*** ***Soft drinks, coffee, water, and tea available in Leon Lab*		*11:05 am*
8	***Small grain varieties and availability of seed***, Mark Sorrells [Walk to Wintmalt barley field in Field 'D' behind Leon Lab]		*11:15 am*
9	***Malting barley: what do buyers want and how can producers deliver?*** Malt house owners, Bill Verbeten, and others		*11:40 am*
10	***Updates and comments from attendees***		*12:00 pm*
11	***Adjourn*** ***Pick up recertification credit sheets in Leon Lab*		*12:15 pm*

WINTER WEATHER AND WHEAT YIELDS IN GENESSEE CO. 1993-2012

Seasonal Temperature Rankings
Station: BATAVIA State: NY ID: 300443
Latitude: 43.03 degrees Longitude: -78.17 degrees Elevation: 913 feet

11/1 -12/31

Rank	Value	Year	Yield
1	30.3	2000	59
2	30.3	1995	58
3	**32.7**	**2013**	?
4	33.7	2010	**69**
5	33.8	2002	**62**
6	34.1	2007	53
7	34.4	1996	53
8	34.5	1993	47
9	34.5	2008	**70**
10	34.6	1997	58
11	35.0	2005	58
12	35.9	2004	54
13	36.2	2009	**74**
14	37.8	2012	**63**
15	37.8	1999	**68**
16	38.0	2003	53
17	38.6	1998	46
18	39.5	1994	54
19	40.8	2006	**67**
20	40.9	2011	59
21	41.3	2001	56

NS

1/1-3/31

Rank	Value	Year	Yield
1	**22.3**	**2014**	?
2	24.5	1994	54
3	24.6	2003	53
4	25.3	1996	53
5	26.0	2011	59
6	26.2	2005	57
7	26.7	2004	54
8	27.0	2009	**74**
9	27.2	1993	47
10	27.8	2007	53
11	28.4	1999	**68**
12	28.8	2010	**69**
13	28.8	2001	56
14	28.9	2008	**70**
15	29.2	1997	58
16	29.8	2013	?
17	30.1	1995	58
18	31.2	2000	59
19	32.3	2002	**62**
20	32.8	2006	**67**
21	33.9	1998	46
22	36.6	2012	**63**

NS

WINTER WEATHER AND WHEAT YIELDS IN CAYUGA COUNTY: 1993-2012

Seasonal Rankings
Station: AURORA RSCH FARM State: NY ID: 300331
Latitude: 42.73 degrees Longitude: -76.66 degrees Elevation: 830 feet

11/1 -12/31

Rank	Value	Year	Yield
1	30.2	1995	56
2	31.0	2000	52
3	**31.7**	**2013**	?
4	32.8	2010	**65**
5	33.4	1993	46
6	33.5	2002	59
7	33.9	2007	**60**
8	34.6	2008	**61**
9	34.6	1996	56
10	34.7	1997	56
11	35.6	2009	**61**
12	36.0	2004	52
13	36.0	2012	**61**
14	36.1	2005	52
15	37.6	2003	53
16	38.8	1999	**63**
17	39.2	1994	53
18	39.4	1998	56
19	39.6	2011	**61**
20	41.6	2006	54
21	42.0	2001	55

NS

1/1-3/31

Rank	Value	Year	Yield
1	**20.6**	**2014**	?
2	22.0	1994	53
3	25.1	2003	53
4	25.3	1996	56
5	25.3	2011	**61**
6	25.5	1993	46
7	26.4	2005	52
8	26.9	2004	52
9	27.1	2007	**60**
10	27.4	2001	55
11	27.6	2009	**61**
12	27.7	2013	?
13	28.1	1997	56
14	28.6	1999	**63**
15	28.8	2010	**65**
16	28.9	2008	**61**
17	29.7	1995	56
18	31.0	2000	52
19	32.2	2006	54
20	33.5	2002	59
21	33.6	1998	56
22	35.3	2012	**61**

$Y=44.9+0.41x$
$r^2=0.10$

CLIMATE AND WHEAT YIELDS -WESTERN/CENTRAL NY: 1984-1998

	APRIL		MAY		JUNE		YIELD
	TEMP.	**PRECIP.**	**TEMP.**	**PRECIP.**	**TEMP.**	**PRECIP.**	**bu/acre**
1984	45.0	3.60	52.0	6.10	65.8	3.28	46
1985	47.7	1.92	57.1	2.60	61.0	3.76	**58**
1986	47.5	3.20	58.7	2.84	63.3	5.88	49
1987	48.2	3.63	58.1	1.30	66.7	4.80	45
1988	43.8	2.90	57.2	2.45	62.8	1.45	**55**
1989	41.1	2.00	54.8	5.86	66.0	6.52	45
1990	47.3	4.11	53.2	5.61	65.6	2.46	49
1991	48.4	4.19	61.7	2.82	67.2	1.11	49
1992	42.8	3.10	55.5	3.33	62.0	2.13	**56**
1993	45.4	4.05	55.7	1.65	64.2	3.68	46
1994	46.7	3.88	52.3	2.82	66.7	4.17	53
1995	40.5	1.62	55.2	2.01	67.7	1.91	**55**
1996	42.4	4.84	54.0	4.86	67.0	4.80	43
1997	41.9	1.71	50.1	2.88	66.5	3.65	**56**
1998	46.5	2.69	61.2	2.74	64.2	6.06	54
1984-1998	**45.0**	**3.16**	**55.8**	**3.32**	**65.1**	**3.71**	**51**
1984-2013	**45.4**	**3.14**	**56.3**	**3.30**	**65.5**	**3.74**	**55**

	NS	**60.3-3.1x** r^2**=0.39**	**NS**	**54.9-1.3x** r^2**= 0.16**	**122.5-1.1x** r^2**=0.22**	**54.5-1.06x** r^2**=0.13**	

CLIMATE AND WHEAT YIELDS -WESTERN/CENTRAL NY: 1999-2013

	APRIL		MAY		JUNE		YIELD
	TEMP.	PRECIP.	TEMP.	PRECIP.	TEMP.	PRECIP.	bu/acre
1999	44.4	2.57	59.8	1.63	67.5	2.35	**65**
2000	43.3	4.40	57.2	4.14	65.1	4.95	53
2001	46.5	1.25	58.5	2.98	66.0	2.53	53
2002	46.4	3.77	52.0	5.39	66.6	3.99	58
2003	42.3	2.13	54.4	4.82	63.4	2.81	53
2004	45.3	3.78	59.0	5.85	63.0	2.84	53
2005	46.3	4.78	52.0	**1.24**	70.4	3.51	54
2006	47.1	**2.32**	56.9	**2.28**	65.8	4.24	**61**
2007	42.6	**3.15**	56.7	**1.18**	67.5	2.50	52
2008	50.1	**2.38**	52.5	**1.96**	68.0	3.87	**63**
2009	46.4	**2.53**	56.7	3.63	62.1	4.45	**65**
2010	50.9	**1.87**	**60.0**	2.66	66.9	6.22	**67**
2011	45.7	6.11	**58.3**	5.32	66.6	2.81	56
2012	44.0	2.69	**62.2**	2.54	66.7	3.00	**63**
2013	44.5	3.44	**59.0**	3.54	64.5	6.43	**68**
2014	44.3	3.46	58.1	4.36	?	?	**?**
1984-1998	**45.0**	**3.16**	**55.8**	**3.32**	**65.1**	**3.71**	**51**
1999-2013	**45.7**	**3.15**	**57.1**	**3.35**	**66.0**	**3.77**	**59**
1984-2013	**45.4**	**3.15**	**56.4**	**3.33**	**65.6**	**3.74**	**55**

	9.0+1.1x r^2**=0.21**	**63.5-1.5x r2=0.10**	**24.1+0.6x r2=0.11**	**NS**	**NS**	**49.1+2.61x r2=0.34**

Crop Management

Wheat Value Almost Triples in New York Over the Last 25 Years While Oat and Dry Bean Values Stagnate Because of Plummeting Acerage

Bill Cox, Department of Crop and Soil Sciences, Cornell University

Wheat has been a major crop in NY since the late 18th century. In fact, NY along with Pennsylvania and Ohio were the major wheat producing states in the USA in 1850. The acreage of wheat in NY declined steadily in the late 1800s and early 1900s while increasing in the Plains States. By 1915, Kansas, North Dakota, Minnesota, Nebraska, and South Dakota were the leading wheat producing states. Wheat acreage in these states and the USA, however, has decreased by almost 25% over the last 20 years. In contrast, wheat acreage in NY has remained relatively stable over the same period. Let's examine the acreage and value of wheat and two other small grains, oats and barley, along with dry beans in NY over the last 25 years to see why the acreage of NY wheat has remained relatively stable.

Annual wheat acreage in NY over 5-year periods during the last 25 years has hovered between ~110,000 and ~135,000 (Fig.1). In contrast, annual oat acreage has plummeted from ~125,000 during the 1989-1993 period to ~40,000 in the 2009-2013 period. Likewise, annual dry bean acreage in NY has plummeted from ~35,000 to ~10,000 during the past 25 years.Certainly, a major reason for the ~70% decrease in both oat and dry bean acreage over the last 25 years has been the adoption of soybean by NY crop producers. All three crops are summer annuals so oat and dry beans along with other summer annuals, including potatoes, processed vegetables, and some fresh market vegetables, have ceded acreage to soybean. Wheat on the other hand, is a winter annual and can fit into the rotation after soybean harvest, if fall conditions are conducive for soybean harvest by October 25th.

The value of wheat exceeded $50M In NY in 2013, in part because of a record 68 bushel/acre State average yield.

Another reason for the stability of wheat acreage over the last 25 years is that wheat yields have continued to increase, whereas oat, dry bean, and barely yields have stagnated during this period (Fig.2). The average annual wheat yield has increased from 49 bushels/acre during 1989-1993 to 64 bushels/acre during 2009-2013. In contrast, annual oat yield has fluctuated between 61 and 65 bushels/acre and barley yield has remained stagnant at ~50 bushels/acre during the last 25 years. Wheat yield has increased by 30% over the last 25 years because leading growers on high-yielding soils continue to grow the crop, these growers have adopted more intensive management systems, and Cornell still has an active wheat breeding program. In contrast, leading growers on high-yielding soils have abandoned oats, barley, and dry beans for soybean, growers manage the three crops similarly in 2014 to how they managed them in 1989, and Cornell no longer has an active oat and barley breeding program. Barley yields, however, may increase in the next 10-year period, given the mandate by NY State for the use of 90% locally-sourced

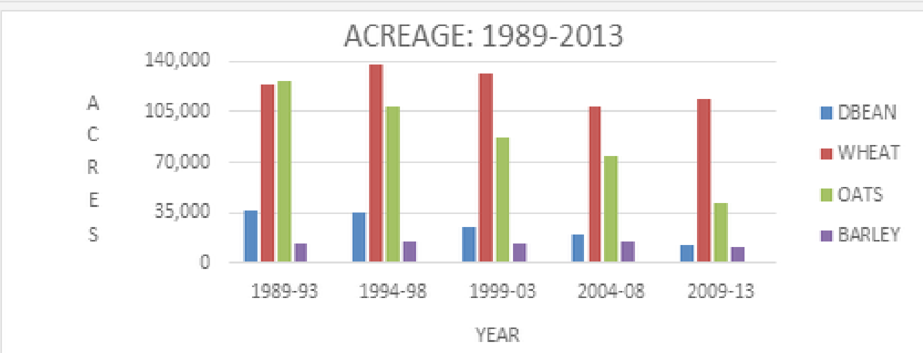


Fig.1. 5-year averages of annual dry bean, wheat, oat, and barley acres planted in NY over the last 25 years.

Crop Management

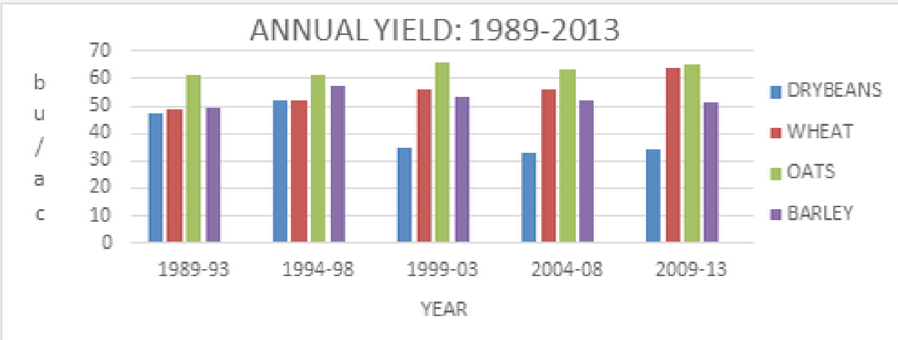


Fig.2. 5-year averages of annual dry bean, wheat, oat, and barley yields in NY over the last 25 years (all units are in bushels/acre except for dry beans, which are reported in 1,000 weights/10).

ingredients by 2024, if growers wish to receive a Farm Brewery License.

The stable wheat acreage, coupled with the 30% yield increase and the more than doubling of wheat market prices over the last 25 years (~$3.10 during 1989-1993 to ~$6.60/bushel during 2009-2013), has increased the annual value of wheat from ~$15M during 1989-1993 to over $40M during 2009-2013 (Fig.3). In fact, the value of wheat in NY exceeded $50M in 2013, making its annual value similar to some high-value fresh market vegetables, such as onions and tomatoes.
Furthermore, only estimating the value of the grain

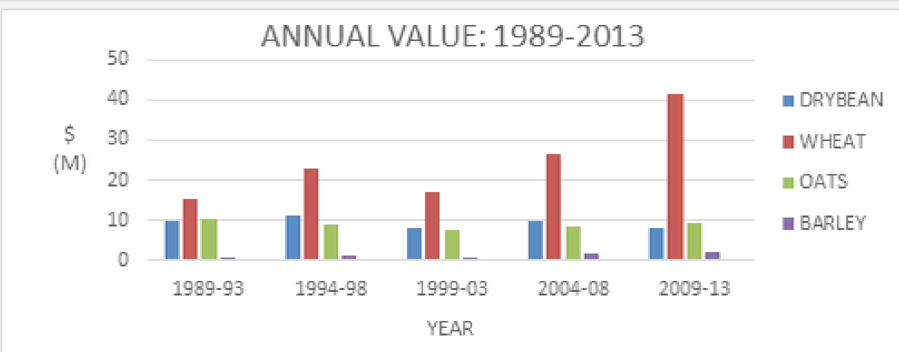


Fig. 3. 5-year averages of the annual value of dry bean, wheat, oat, and barley in NY over the last 25 years.

significantly under-estimates the value of wheat in NY because most growers also bale and market wheat straw. Indeed, the value of straw has averaged over $150/ton in NY over the last 5 years, adding an additional $20M in value to the crop. Consequently, another reason why wheat acreage has remained stable in NY, whereas acreage has decreased by 25% in the USA, is the demand of wheat straw by the dairy industry. Wheat is no longer the leading crop in NY as it was in the 1800s, but wheat continues to play an important role in the NY agricultural economy as a cash crop, a rotation crop, and supplier of coveted straw to the dairy industry.

2014 FHB Wheat Uniform Fungicide Trial

J.A. Cummings, G.C. Bergstrom, R.J. Richtmyer, and R.R. Hahn

110 (2)	**120 (14)**	**210 (10)**	**220 (20)**	**310 (12)**	**320 (2)**	**410 (9)**	**420 (6)**
109 (15)	**119 (20)**	**209 (9)**	**219 (19)**	**309 (14)**	**319 (7)**	**409 (12)**	**419 (13)**
108 (7)	**118 (17)**	**208 (8)**	**218 (18)**	**308 (4)**	**318 (13)**	**408 (15)**	**418 (19)**
107 (9)	**117 (19)**	**207 (7)**	**217 (17)**	**307 (19)**	**317 (16)**	**407 (5)**	**417 (10)**
106 (16)	**116 (8)**	**206 (6)**	**216 (16)**	**306 (10)**	**316 (9)**	**406 (3)**	**416 (11)**
105 (11)	**115 (10)**	**205 (5)**	**215 (15)**	**305 (1)**	**315 (8)**	**405 (8)**	**415 (14)**
104 (13)	**114 (3)**	**204 (4)**	**214 (14)**	**304 (5)**	**314 (6)**	**404 (7)**	**414 (18)**
103 (6)	**113 (18)**	**203 (3)**	**213 (13)**	**303 (17)**	**313 (15)**	**403 (1)**	**413 (4)**
102 (5)	**112 (4)**	**202 (2)**	**212 (12)**	**302 (11)**	**312 (20)**	**402 (20)**	**412 (17)**
101 (1)	**111 (12)**	**201 (1)**	**211 (11)**	**301 (18)**	**311 (3)**	**401 (2)**	**411 (16)**

In each box: Plot # (Trtmnt #)

Trtmnt #	App at Tillering	App at Flag Lf	App at Flowering	App at 5-7 daf
1	non-treated control			
2	Tilt 2oz	Quilt Excel 10.5oz + A15457 4.1oz	Prosaro 6.5oz	
3	Tilt 2oz	Quilt Excel 10.5oz	Prosaro 6.5oz	
4		Quilt Excel 10.5oz + A15457 4.1oz	Prosaro 6.5oz	
5		A15457 2.74oz + Tilt 4oz	Prosaro 6.5oz	
6		A15457 4.1oz + Tilt 4oz + Quadris 6.0oz	Prosaro 6.5oz	
7		Quilt Excel 10.5oz	Prosaro 6.5oz	
8		Priaxor 4oz	Caramba 13.5oz	
9		Twinline 9oz	Caramba 13.5oz	
10		Aproach 9oz	Prosaro 6.5oz	
11		Prosaro 5oz		
12		Prosaro 6.5oz		
13			Prosaro 6.5oz	
14			Caramba 13.5oz	
15			Prosaro 8.2oz	
16			Caramba 17oz	
17			Tebustar 4oz	
18			Taegro 5.2oz	Taegro 5.2oz
19			Prosaro 6.5oz	Taegro 5.2oz
20				Taegro 5.2oz

2014 FHB Wheat Integrated Management J.A. Cummings, G.C. Bergstrom, R.J. Richtmyer, and R.R. Hahn			
Emmit	**Otsego**	**P25R40**	**P25R46**
non-trtd	**non-trtd**	**non-trtd**	**non-trtd**
104	105	112	113
inoculum only	**Prosaro late**	**inoculum only**	**Prosaro flower**
103	106	111	114
Prosaro flower	**inoculum only**	**Prosaro flower**	**inoculum only**
102	107	110	115
Prosaro late	**Prosaro flower**	**Prosaro late**	**Prosaro late**
101	108	109	116
Rep 1			

Treatments:

1 Non-treated, non-inoculated control (non-trtd)

2 Prosaro 6.5 fl oz + induce 0.125% v/v AND inoculated at anthesis; then inoculated again 5-7 days later (Prosaro flower)

3 Not treated AND inoculated at anthesis; then inoculated again 5-7 days later (inoculum only)

4 Inoculated only at flowering; then Prosaro 6.5 fl oz + induce 0.125% v/v AND inoculated 5-7 days after anthesis (Prosaro late)

Varieties: Emmit, Otsego, Pioneer 25R40, Pioneer 25R46

Efficacy of fungicides for wheat disease control based on appropriate application timing*

Fungicide(s)												
Class	Active ingredient	Product	Rate/A (fl. oz)	Powdery mildew	Stagonospora leaf/glume blotch	Septoria leaf blotch	Tan spot	Stripe rust	Leaf rust	Stem rust	Fusarium head blight	Harvest Restriction
Strobi-lurin	pyraclostrobin 23.3%	Headline SC	6.0 - 9.0	G	VG	VG	E	E[1]	E	G	NL	Feekes 10.5
Triazole	metconazole 8.6%	Caramba 0.75 SL	10.0 - 17.0	VG	VG	--[2]	VG	E	E	E	G	30 days
	propiconazole 41.8%	Fitness 3.6 EC PropiMax 3.6 EC Tilt 3.6 EC	4.0	VG	VG	VG	VG	VG	VG	VG	P	Feekes 10.5
	prothioconazole 41%	Proline 480 SC	5.0 - 5.7[3]	--[2]	VG	VG	VG	--[2]	VG	VG	G	30 days
	prothioconazole19% tebuconazole 19%	Prosaro 421 SC[4]	6.5 - 8.2	G	VG	VG	VG	E	E	E	G	30 days
Mixed modes of action[5]	metconazole 7.4% pyraclostrobin 12%	TwinLine 1.75 EC[4]	7.0 – 9.0	G	VG	VG	E	E	E	VG	NL	Feekes 10.5 and 30 days
	fluxapyroxad 14.3% pyraclostrobin 28.6 %	Priaxor[4,6]	4.0 – 8.0	G	VG	VG	E	VG	VG	G	NL	Feekes 10.5
	propiconazole 11.7% azoxystrobin 7.0%	Avaris 200 SC Quilt 200 SC	14.0	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5
	propiconazole 11.7% azoxystrobin 13.5%	Quilt Xcel 2.2 SE	10.5 - 14.0	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5
	prothioconazole 10.8% trifloxystrobin 32.3%	Stratego YLD[4]	4.0	G	VG	VG	VG	VG	VG	VG	NL	35 days
	tebuconazole 22.6% trifloxystrobin 22.6%	Absolute 500 SC[4]	5.0	G	VG	VG	VG	VG	VG	VG	NL	35 days

** Adapted for New York by Gary C. Bergstrom from information developed by the USDA-NIFA Committee on Management of Small Grain Cereal Diseases (NCERA-184). This information is provided only as a guide. It is the responsibility of the pesticide applicator by law to read and follow all current label directions. No endorsement is intended for products listed, nor is criticism meant for products not listed. Members or participants in the NCERA-184 committee assume no liability resulting from the use of these products. Efficacy categories: NL=Not Labeled and Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent.*

[1] Efficacy may be significantly reduced if solo strobilurin products are applied after stripe rust infection has occurred

[2] Insufficient data to make statement about efficacy of this product

[3] Rates of 5.0 to 5.7 fl oz are labeled only for applications at flowering to suppress Fusarium head blight; Lower rates of 4.3-5.0 fl oz are labeled for applications to control foliar and stem diseases.

[4] Aerial application is not allowed in New York.

[5] Products with mixed modes of action generally combine triazole and strobilurin active ingredients. Priaxor is an exception and combines carboxamide and strobilurin active ingredients.

[6] A supplemental Special Local Needs label must be in the possession of the applicator for use of Priaxor in New York; this product is not for sale, distribution, or application in Nassau or Suffolk Counties.

Subscribe to FHB Alerts by Cell Phone at:

http://www.scabusa.org/fhb_alert.php

Select Type of Alert

- ☐ Text Messages and Email Alerts
- ☐ Text Message Alerts
- ☐ Email Alerts

Which FHB update alerts do you wish to subscribe to? (Select all that apply)

- ☐ Southern Soft Winter Wheat (AL, AR, LA, MS)
- ☐ Southern Atlantic Soft Winter Wheat (NC)
- ☐ Central Great Plains Hard Winter Wheat (KS, NE, OK)
- ☐ Mid West / Mid South Soft Winter Wheat (IA, IN, KY, OH)
- ☐ Mid Atlantic Soft Winter Wheat (DE, MD, PA, VA)
- ☒ Northern Soft Winter Wheat (MI, NY, WI, VT)
- ☐ Northern Great Plains: Hard Spring Wheat, Durum, Hard Winter Wheat and Malting Barley (MN, ND, SD)
- ☐ National
- ☐ All

WHEAT (*Triticum aestivum* 'Otsego', 'Pioneer 25R34', 'Pioneer 25R46' and 'Truman')
Fusarium head blight (scab); *Fusarium graminearum*
Septoria blotch; *Septoria tritici*
Stagonospora blotch; *Stagonospora nodorum*
Powdery mildew; *Erysiphe graminis*

J.A. Cummings and G.C. Bergstrom, Dept. of Plant Pathology and Plant-Microbe Biology,
R.J. Richtmyer III and R.R. Hahn, Dept. of Crop and Soil Science, Cornell University,
Ithaca, NY 14853

Evaluation of integrated methods for management of Fusarium head blight and foliar diseases of winter wheat in New York, 2013.

Two experiments were conducted at the Musgrave Research Farm in Aurora, NY in a Kendaia silt loam soil with four soft red winter wheat cultivars: 'Pioneer 25R34' (moderately susceptible to Fusarium head blight (FHB), 'Pioneer 25R46' (classified as moderately resistant to FHB), 'Otsego' (classified initially as moderately resistant to FHB), and 'Truman' (established as moderately resistant to FHB). The two experimental environments, both planted on 10 Oct 2012, were characterized by no-till planting of winter wheat 1) into soybean residue and 2) into corn residue. Each experimental design was a split-split plot with four wheat cultivars as whole plots, inoculation with *F. graminearum* as subplot, and fungicide as sub-subplot, in four replicated blocks. Main plots were sown with wheat at 118.8 lb/A with a 10 ft wide commercial grain drill. Subplots were 20 x 10 ft including 15 rows with 7-in. row spacing. The plots were fertilized at planting (200 lb/A of 10-20-20) and on 8 Apr (170 lb/A of a 50/50 mix of ammonium sulfate and urea, providing ca. 57 lb/A of nitrogen), and again on 22 Apr (30 lb/A of urea, providing an additional 13.8 lb/A of nitrogen). Treatments were applied at anthesis (Feekes growth stage, FGS 10.5.1) on 1 Jun including the surfactant Induce at 0.125% V/V. A conidial suspension of *F. graminearum* (40,000 conidia/ml) was applied the same day after the fungicide had dried to augment the development of FHB. Fungicide and *F. graminearum* treatments were applied with a tractor-mounted sprayer with paired TJ-60 8003vs nozzles mounted at an angle (30^o from horizontal) forward and backward, 20-in. apart, pressurized at 30 psi, and calibrated to deliver 20 gal/A. Incidence and severity (percent of symptomatic spikelets on symptomatic heads) of FHB in each plot was rated on 24 Jun and used to calculate FHB Index, where FHB index = (FHB severity * FHB incidence)/100. Foliar diseases were rated on 24 Jun and 2 Jul as percent severity on flag leaves (average rating for whole plot). Grain was harvested from a 20 x 4 ft area in each subplot using an Almaco plot combine on 16 Jul in both experiments. Grain moistures, plot yields, and test weights were recorded. Yields and test weights were adjusted to bu/A at 13.5% moisture. Fusarium damaged kernels (FDK) were evaluated post-harvest as a percentage of kernels visibly infected with FHB out of a 100 kernel subsample from each plot. Twenty gram subsamples of grain from each plot were dried and ground and submitted for deoxynivalenol (DON) analysis. Analysis of DON content in grain was conducted in the US Wheat and Barley Scab Initiative-supported mycotoxin analysis laboratory at the University of Minnesota, St. Paul, MN. Treatment means were calculated, subjected to a split plot analysis of variance, and separated by Fisher's protected LSD test (P = 0.05).

All measures of FHB were higher in the presence of corn stubble suggesting a dramatic within-plot increase in available spore inoculum from corn debris. The most striking observation was the average 7-8 fold increase in DON contamination levels in grain where wheat followed no-till after corn as compared to soybean. On the other hand, artificial inoculation at flowering with conidial suspensions had almost no significant effect on FHB parameters following either corn or soybean. The fairly late development of FHB symptoms is consistent with infections occurring during moist conditions after peak flowering and for which spores from within-plot corn debris may have contributed a greater portion than sprayed conidia or regional atmospheric inoculum. Prosaro application resulted in significant reductions in FHB and DON as well as in flag leaf severity of fungal leaf blotches and powdery mildew in both experiments. Prosaro also resulted in increased yield and test weight in both trials. Otsego, regarded initially as moderately resistant to FHB, was significantly more susceptible than the other cultivars, thus should be designated as no better than moderately susceptible. Pioneer 25R46 showed reduced levels of FHB and DON and should probably be designated as moderately resistant along with the moderately resistant check cultivar Truman. Pioneer 25R34 showed intermediate FHB reaction between Otsego and the more resistant cultivars. Prosaro application further reduced FHB and DON in all cultivars, but the combined suppression was not sufficient to reduce DON levels below 2 ppm in Otsego. Yield and test weight for each cultivar were higher in the experiment following soybean than that following corn, regardless of treatment. Some of this reduction undoubtedly reflects the impact of higher FHB pressure following corn, but may also be attributable in part to an increased soil nitrogen benefit following soybean.

No-till after corn Cultivar, treatment[z], and rate/A[y]	Leaf Blotch (%)	Powdery Mildew (%)	FHB[x] Incidence (%)	FHB Index[w]	FDK[v] (%)	DON[u] (ppm)	Yield (bu/A)	Test weight (lb/bu)
Otsego								
Non-sprayed	9.0 a[t]	0.1 a	47.5 a	9.61 a	38.3 ab	20.4 ab	69.2 b	50.6 bc
Prosaro SC (6.5 fl oz)	1.5 b	0.0 b	15.5 b	1.24 b	13.7 c	7.6 c	82.5 a	55.9 a
Non-sprayed, inoculated	8.5 a	0.1 a	55.0 a	10.92 a	51.7 a	26.3 a	76.2 ab	47.9 c
Prosaro SC (6.5 fl oz), inoculated	1.5 b	0.0 b	21.5 b	1.63 b	30.0 bc	12.0 bc	83.3 a	54.1 ab
LSD (P=0.05)	1.33	0.00	12.56	2.201	18.04	8.42	8.13	3.51
cv (%)	74.68	103.28	53.76	81.43	49.51	51.18	8.97	6.89
Pioneer 25R34								
Non-sprayed	7.8 a	2.0 b	23.0 a	3.90 a	40.0 a	13.8 a	70.2 c	52.7 b
Prosaro SC (6.5 fl oz)	1.0 b	0.0 c	7.0 b	0.70 b	5.7 b	2.4 b	82.0 b	57.0 a
Non-sprayed, inoculated	7.8 a	2.8 a	27.5 a	4.72 a	38.3 a	11.3 a	80.7 b	52.2 b
Prosaro SC (6.5 fl oz), inoculated	1.5 b	0.0 c	11.0 b	0.94 b	13.3. b	6.2 b	90.0 a	57.1 a
LSD (P=0.05)	2.29	0.39	8.33	1.513	10.78	3.95	7.33	1.59
cv (%)	80.33	106.42	57.99	79.19	67.81	58.77	10.01	4.59
Pioneer 25R46								
Non-sprayed	7.0 a	0.8 a	13.0 a	1.21 a	22.7	8.9 b	75.3	57.0
Prosaro SC (6.5 fl oz)	1.5 b	0.0 b	2.5 b	0.10 b	2.7	2.8 c	87.5	59.6
Non-sprayed, inoculated	7.8 a	0.8 a	17.0 a	1.54 a	24.3	12.5 a	88.5	57.0
Prosaro SC (6.5 fl oz), inoculated	2.0 b	0.0 b	5.5 b	0.23 b	11.0	7.8 b	91.6	59.0
LSD (P=0.05)	2.34	0.55	6.75	0.920	NS	2.62	NS	NS
cv (%)	70.67	133.33	75.12	108.69	83.30	47.94	10.09	3.17
Truman								
Non-sprayed	3.5	0.1	9.5 a	0.71 a	25.0 a	14.7 a	63.4 b	53.4 b

Prosaro SC (6.5 fl oz).........................	1.0	0.0	2.0 b	0.07 b	2.0 b	2.7 c	71.0 ab	56.4 ab
Non-sprayed, inoculated	4.5	0.1	11.0 a	0.93 a	25.0 a	15.8 a	66.8 b	54.1 b
Prosaro SC (6.5 fl oz), inoculated	1.3	0.0	4.0 b	0.15 b	4.3 b	6.8 b	78.3 a	58.5 a
LSD (*P*=0.05)....................................	NS	NS	4.85	0.469	15.73	3.25	8.23	3.06
cv (%)	93.99	178.89	72.05	100.06	95.67	58.87	9.57	4.42
Cultivar mean								
Otsego	5.1	0.1 b	34.9 a	5.8 a	33.4 a	16.6 a	77.8 b	52.1 c
Pioneer 25R34....................................	4.5	1.2 a	17.1 b	2.6 b	24.3 b	8.4 b	80.7 ab	54.8 b
Pioneer 25R46....................................	4.6	0.4 b	9.5 c	0.8 c	15.2 c	8.0 b	85.6 a	58.2 a
Truman...	2.6	0.0 b	6.6 c	0.5 c	14.1 c	10.0 b	70.8 c	55.6 b
LSD (*P*=0.05)....................................	NS	0.48	8.09	1.86	12.25	4.97	6.60	2.33
cv (%)	80.64	199.45	92.37	139.16	75.61	63.27	13.45	6.17
Treatment mean								
Non-sprayed.......................................	6.8 a	0.7 a	23.3 a	3.9 a	31.5 a	14.5 a	70.1 c	53.5 b
Prosaro SC (6.5 fl oz).........................	1.3 b	0.0 b	6.8 b	0.5 b	6.0 c	3.9 c	80.1 ab	57.3 a
Non-sprayed, inoculated	7.1 a	0.9 a	27.6 a	4.5 a	34.8 a	16.5 a	79.1 b	52.7 b
Prosaro SC (6.5 fl oz), inoculated	1.6 b	0.0 b	10.5 b	0.7 b	17.7 b	8.2 b	85.8 a	57.2 a
LSD (*P*=0.05)....................................	1.36	0.51	9.49	2.05	9.55	3.87	5.99	2.31
cv (%)	80.64	199.45	93.37	139.16	75.61	63.27	13.45	6.17

No-till after soybean Cultivar, treatment, and rate/A	Leaf Blotch (%)	Powdery Mildew (%)	FHB Incidence (%)	FHB Index	FDK (%)	DON (ppm)	Yield (bu/A)	Test weight (lb/bu)
Otsego								
Non-sprayed.......................................	7.3 a	0.05 ab	8.5 b	0.66 ab	13.5	4.7	89.6	57.9
Prosaro SC (6.5 fl oz).........................	1..0 b	0.00 b	4.5 c	0.26 c	8.5	2.7	100.1	58.8
Non-sprayed, inoculated	7.8 a	0.08 a	11.5 a	0.84 a	11.5	4.5	93.3	58.3
Prosaro SC (6.5 fl oz), inoculated	1.0 b	0.00 b	5.0 c	0.31 bc	10.3	3.7	102.8	59.3
LSD (*P*=0.05)....................................	1.96	0.060	2.71	0.347	NS	NS	NS	NS
cv (%)	83.52	153.19	45.07	62.28	64.95	36.60	9.86	2.50
Pioneer 25R34								
Non-sprayed.......................................	8.3 a	0.78	5.0 ab	0.31	2.3	0.75	106.2	60.5
Prosaro SC (6.5 fl oz).........................	1.8 b	0.00	2.0 b	0.08	1.0	0.37	113.2	61.4
Non-sprayed, inoculated	7.8 a	1.03	6.5 a	0.38	3.8	0.32	105.4	60.5
Prosaro SC (6.5 fl oz), inoculated	2.0 b	0.00	2.5 b	0.15	2.5	0.32	108.8	60.9
LSD (*P*=0.05)....................................	2.60	NS	3.39	NS	NS	NS	NS	NS
cv (%)	71.12	179.44	68.31	95.38	117.97	79.52	8.80	2.55
Pioneer 25R46								
Non-sprayed.......................................	9.5 a	1.28	4.5	0.21	2.0	0.72 ab	102.2 b	60.0
Prosaro SC (6.5 fl oz).........................	2.3 b	0.00	3.0	0.09	0.8	0.32 c	120.1 a	60.0
Non-sprayed, inoculated	10.0 a	1.28	6.0	0.28	1.5	0.81 a	107.8 ab	60.5
Prosaro SC (6.5 fl oz), inoculated	2.5 b	0.00	3.5	0.13	1.0	0.39 bc	120.5 a	61.5
LSD (*P*=0.05)....................................	1.16	NS	NS	NS	NS	0.374	13.68	NS
cv (%)	63.87	159.54	56.67	75.87	66.53	54.63	10.11	2.72
Truman								
Non-sprayed.......................................	5.0 a	0.05	4.5	0.24	5.0 a	1.67 a	84.6	59.6
Prosaro SC (6.5 fl oz).........................	1.3 b	0.00	1.0	0.03	1.3 b	0.51 c	98.0	61.7
Non-sprayed, inoculated	4.5 a	0.25	5.5	0.29	4.5 a	1.36 ab	89.0	60.6
Prosaro SC (6.5 fl oz), inoculated	1.3 b	0.00	1.0	0.04	1.3 b	0.93 bc	97.8	61.7
LSD (*P*=0.05)....................................	2.01	NS	NS	NS	2.01	0.621	NS	NS
cv (%)	72.01	214.99	106.11	133.39	46.19	51.96	12.55	2.39
Cultivar mean								
Otsego	4.3	0.0 b	7.4 a	0.5 a	10.9 a	3.86 a	96.4 b	58.6 b
Pioneer 25R34....................................	4.9	0.5 a	4.0 b	0.2 b	2.4 b	0.86 bc	108.4 a	60.8 a
Pioneer 25R46....................................	6.1	0.6 a	4.3 b	0.2 b	1.3 b	0.56 c	112.7 a	60.5 a
Truman...	3.0	0.0 b	3.0 b	0.1 b	1.3 b	1.12 b	92.4 b	60.9 a
LSD (*P*=0.05)....................................	NS	0.46	2.08	0.16	2.73	0.60	7.46	1.08
cv (%)	75.5	242.4	80.0	99.9	139.8	98.2	12.97	2.95
Treatment mean								
Non-sprayed.......................................	7.5 a	0.5 a	5.6 b	0.4 a	4.8	1.95 a	95.7 c	59.5
Prosaro SC (6.5 fl oz).........................	1.6 b	0.0 b	2.6 c	0.1 b	2.9	0.97 b	107.8 a	60.5
Non-sprayed, inoculated	7.5 a	0.6 a	7.4 a	0.4 a	4.5	1.99 a	98.9 bc	60.0
Prosaro SC (6.5 fl oz), inoculated	1.7 b	0.0 b	3.0 c	0.2 b	3.7	1.48 ab	107.5 ab	60.9
LSD (*P*=0.05)....................................	1.28	0.45	1.93	0.17	NS	0.53	8.81	NS
cv (%)	75.5	242.4	80.0	99.9	139.8	98.2	12.97	2.95

[z] Prosaro SC was applied with Induce at 0.125% V/V at anthesis (Feekes growth stage, FGS 10.5.1) 1 June
[y] Inoculated treatments had a conidial suspension of *F. graminearum* (40,000 conidia/ml), applied 1 June, after the fungicide had dried
[x] FHB = Fusarium Head Blight
[w] FHB Index = Fusarium Head Blight Index, where FHB index = (FHB severity * FHB incidence)/100
[v] FDK = Fusarium Damaged Kernels
[u] DON = deoxynivalenol
[t] Column numbers followed by the same letter are not significantly different at *P*=0.05 as determined by Fisher's protected LSD

WHEAT (*Triticum aestivum* 'Pioneer 25R34')
Fusarium head blight (scab); *Fusarium graminearum*
Stagonospora blotch; *Stagonospora nodorum*
Septoria blotch; *Septoria tritici*
Powdery mildew; *Erysiphe graminis* f. sp. *tritici*

J.A. Cummings and G.C. Bergstrom, Dept. of Plant Pathology and Plant-Microbe Biology, R.J. Richtmyer III and R.R. Hahn, Dept. of Crop and Soil Science, Cornell University, Ithaca, NY 14853

Evaluation of a biological control agent for management of Fusarium head blight and foliar diseases of winter wheat in New York, 2013.

The fungicide trial was conducted at the Musgrave Research Farm in Aurora, NY in a Kendaia silt loam soil planted with the soft red winter wheat variety 'Pioneer 25R34' sown at 2 bu/A following soybean harvest on 25 Sep 2012. Ten foliar treatments were arranged in a randomized complete block design with four replications. Subplots were 20 x 10 ft including 15 rows with 7 in.-row spaces. The plots were fertilized at planting (200 lb/A of 10-20-20) and on 8 Apr (57 lb/A of a 50/50 mix of ammonium sulfate and urea) and again on 22 Apr (30 lb/A of urea, providing an additional 13.8 lb N/A). The treatments included Taegro (bacterium *Bacillus amyloliquefacians* strain FZB24 containing 5.0 x 10^{10} cfu/g, Novozymes Biologicals Inc.) alone or in combination or alternation with industry standard fungicides, Prosaro and Tebucon and also commercially available canola oil and a nitrogen formulation. All treatments including Prosaro also included the adjuvant Induce at 0.125% v/v. Treatments were applied on 31 May at Feekes growth stage (FGS) 10.5.1 (anthesis), and 6 Jun at six days after the first application. All plots were inoculated with a conidial suspension of *Fusarium graminearum* (40,000 conidia/ml) on 31 May and 6 Jun at least two hours after fungicide applications to initiate development of Fusarium head blight (FHB). Treatments were applied with a backpack sprayer with 8002DG flat fan nozzles, 18.5-in. apart, pressurized at 34 psi, and calibrated to deliver 20 gal/A. The *F. graminearum* was applied by a tractor-mounted sprayer with TJ-60 8003vs nozzles, 20-in. apart, pressurized at 30 psi, and calibrated to deliver 20 gal/A. Incidence and severity of FHB for each plot were rated on 2 Jul. Foliar diseases were rated on 26 Jun and 2 Jul as percent disease severity on flag leaves (average rating for whole plot). Grain was harvested on 16 Jul from a 20 x 4 ft area in each subplot using an Almaco plot combine. Grain moistures, grain yields, and test weights for individual plots were recorded and yield was recalculated to bu/A at 13.5% moisture. Fusarium damaged kernels (FDK) were recorded as a percent of kernels visibly infected with *F. graminearum* out of 200 kernels. Means were calculated, subjected to analysis of variance, and separated by Fisher's protected LSD test (P=0.05). Analysis of deoxynivalenol (DON) content in grain was conducted in the US Wheat and Barley Scab Initiative-supported mycotoxin analysis laboratory of Dr. Dong at the University of Minnesota, St. Paul, MN. Treatment means were calculated, subjected to analysis of variance, and separated by Fisher's protected LSD test (P = 0.05).

All treatments resulted in significantly lower severity of powdery mildew and fungal leaf blotches on flag leaves than the non-treated control, with the exception of the late application of Taegro with canola oil and nitrogen. Overall, treatments that included Prosaro resulted in the best control of foliar diseases, and treatments including Tebucon resulted in better control of foliar diseases than any biocontrol alone treatments. FHB developed in all plots at moderately low levels, with significant differences among treatments for FHB incidence and FHB index. Prosaro application at flowering resulted in significant reductions in FHB incidence and index, however only resulted in modest reductions of FDK and DON which may be attributed to later infection after the fungicide applications. Though it did result in significant reductions of FHB incidence and index, Tebucon application did not reduce FDK or DON. The combining of Prosaro or Tebucon with any of the biocontrols neither enhanced nor diminished the fungicide's ability to suppress FHB, FDK, or DON. Taegro applications not combined with either fungicide resulted in no significant reduction of FDK or DON. Only treatments including Prosaro resulted in significantly lower FDK than the non-treated control. There were no statistically significant differences in DON or yield among any of the treatments. Only treatments including Prosaro and the treatment with Tebucon at flowering followed by Taegro resulted in higher test weights than the non-treated control.

Product, rate/A, growth stage at application	Leaf Blotch (%)	Powdery Mildew (%)	FHB incidence (%)	FHB index	FDK (%)	DON (ppm)	Yield (Bu/A)	Test weight (lb/Bu)
Non-treated control	2.8 a*	5.5 a	24.0 a	6.9 a	3.8 ab	1.27	97.0	58.8 c
Prosaro SC, 6.5 fl oz, FGS 10.5.1	0.1 f	0.1 d	8.0 def	0.9 de	2.0 b	1.19	108.6	60.0 ab
Tebucon, 4 fl oz, FGS 10.5.1	0.8 de	2.0 c	10.5 cdef	1.8 cde	3.5 ab	1.90	102.8	59.0 c
Taegro, 5.2 oz, six days after FGS 10.5.1	1.8 b	3.0 bc	12.5 bcd	2.2 bcd	6.3 a	1.95	95.0	58.7 c
Prosaro SC, 6.5 fl oz, FGS 10.5.1, then Taegro, 5.2 oz	0.1 f	0.1 d	6.0 ef	0.6 e	1.5 b	1.25	104.5	60.1 a
Tebucon, 4 fl. oz, FGS 10.5.1, then Taegro, 5.2 oz	1.0 cd	2.3 bc	15.0 bc	3.1 bc	3.8 ab	1.67	102.2	59.9 ab
Taegro, 5.2 oz and canola oil, 1% v/v, and nitrogen, 2770 ppm, six days after FGS 10.5.1	1.5 bc	4.0 ab	15.0 bc	2.9 bc	5.8 a	1.56	95.0	58.4 c
Prosaro SC, 6.5 fl oz, FGS 10.5.1, then Taegro, 5.2 oz, canola oil, 1% v/v, and nitrogen, 2770 ppm	0.3 ef	0.0 d	5.0 f	0.5 e	2.0 b	1.22	103.4	60.0 ab
Tebucon, 4 fl oz, FGS 10.5.1, then Taegro, 5.2 oz, canola oil, 1% v/v, and nitrogen, 2770 ppm	0.1 f	1.8 cd	11.0 cde	1.9 cde	3.8 ab	1.47	98.4	59.2 bc
Canola oil, 1% v/v, and nitrogen, 2770 ppm, six days after FGS 10.5.1	1.8 b	2.8 bc	17.0 b	3.4 b	5.0 a	1.74	97.8	58.9 c
LSD (P = 0.05)	0.57	1.85	5.74	1.34	0.89	NS	NS	0.89
CV (%)	93.88	96.14	52.19	81.83	1.38	50.59	7.99	1.38

*Column numbers followed by the same letter are not significantly different at P=0.05 as determined by Fisher's protected LSD

Effects of Local Corn Debris Management on FHB and DON Levels in Seventeen U.S. Wheat Environments in 2011 to 2013

Gary C. Bergstrom[1*], Jaime A. Cummings[1], Katrina D. Waxman[1], Carl A. Bradley[2], Stephen N. Wegulo[3], Ann L. Hazelrigg[4], Donald E. Hershman[5], Martin Nagelkirk[6], and Laura E. Sweets[7]

[1]Cornell University, Ithaca, NY 14853; [2]University of Illinois, Urbana, IL 61801; [3]University of Nebraska, Lincoln, NE 68583, [4]University of Vermont, Burlington, VT 05405; [5]University of Kentucky, Princeton, KY 42445; [6]Michigan State University Extension, Sanilac County, Sandusky, MI 48471; and [7]University of Missouri, Columbia, MO 65211

***Corresponding author email: gcb3@cornell.edu**

Objective:
To quantify reductions in head infection by ***Fusarium graminearum***, Fusarium head blight (FHB) symptoms, and deoxynivalenol (DON) contamination that result from within-field corn debris management under a range of commercial wheat production conditions in regions where overwintered corn debris is common in the landscape.

Materials and Methods:
Moldboard-plowing of corn residues was used as a proxy for planting wheat after a non-cereal crop to compare directly with wheat planted no-till into corn debris in commercial scale wheat plots in seven states. Following corn grain harvest, replicated (4x) wide (60 ft) strips were moldboard-plowed or left non-plowed prior to sowing seed of an FHB-susceptible wheat cultivar over each entire field with a no-till drill. FHB was rated at soft dough stage in three sampling areas along the central axis of each replicate strip. Heads from these same sampling areas were harvested at maturity. A subsample of heads was threshed and the grain assayed for DON in the USWBSI Mycotoxin Lab of Dr. Dong. Another subsample of heads was surface-sterilized and cultured to determine incidence of head infection by ***Fusarium graminearum***.

Acknowledgement and Disclaimer: This material is based upon work supported in part by the USDA under agreement Nos. 59-0206-9-056, 50-0206-9-076, 59-0206-2-084, 59-0206-9-078 and 50-0206-2-085. This is a cooperative project with the USWBSI. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the USDA.

Figure 2. Location (red dot) of wheat following corn, strip trials (plowed vs. no-till) with winter wheat (IL, KY, MI, MO, NE, NY) and spring wheat (VT). Pie charts show *F. graminearum* isolate proportion of trichothecene genotypes 15-ADON (orange) and 3-ADON (purple) as identified by PCR using *Tri3* and *Tri12* primers.

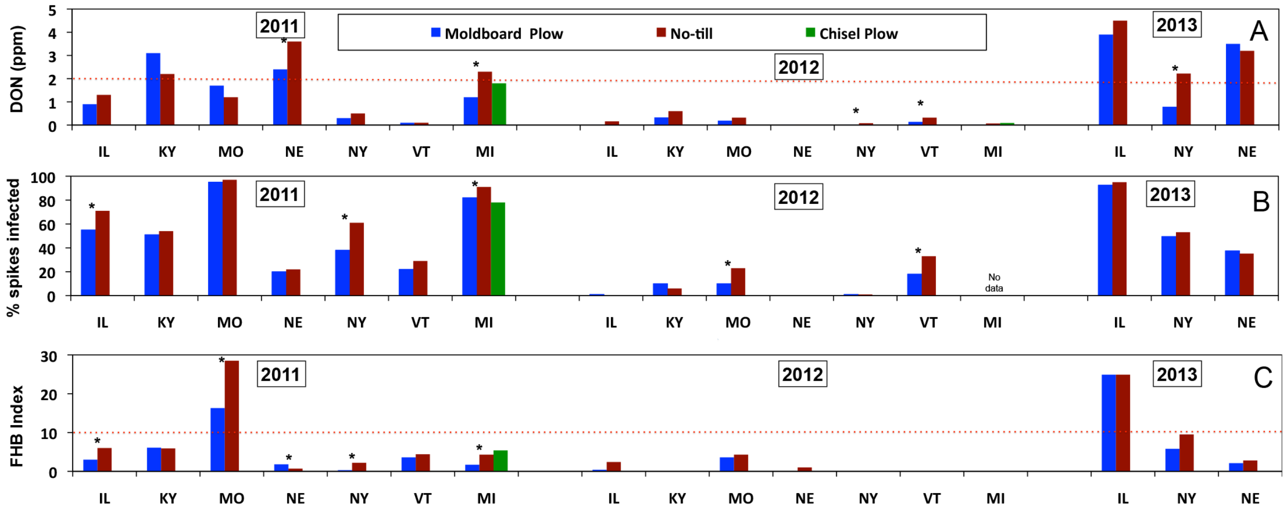


Figure 3. Effect of local corn debris on DON concentration in mature grain (A), incidence of recovery of *F. graminearum* from mature spikes (B), and FHB index at soft dough (C) in seventeen wheat environments in 2011-13. Significant differences (P = 0.05) between treatment means for a location are indicated by *.

Results and Discussion:

•Moldboard plowing of corn debris resulted in a statistically significant (P = 0.05) decrease in FHB index in IL, MO, NY, and MI in 2011, but in no location in 2012 or 2013. Moldboard plowing was associated with a small but significant decrease in recovery of *F. graminearum* from mature spikes in IL, MI, and NY in 2011 and in MO and VT in 2012, but no effect in 2013. Chisel tillage had no significant effect on FHB or DON in MI.

•FHB index at soft dough was a poor predictor of DON contamination level. It appears that post-flowering (asymptomatic) infections contributed to DON contamination in several environments.

•Moldboard plowing resulted in a statistically significant (P = 0.05) decrease in DON level (- 1.20 ppm) in NE in 2011 and (-1.43 ppm) in NY in 2013, and significant decreases in already low levels of DON in NY (- 0.07 ppm) and VT (- 0.18 ppm) in 2012.

•Across the 17 wheat environments, the presence of within-plot corn stubble (i.e., no-till) was associated with an average 22% (0.24 ppm) increase in DON contamination of grain over background (plowed) level; for the eight environments with background levels of at least 0.5 ppm DON, presence of corn stubble was associated with an average 17% (0.38 ppm) increase in DON.

• There is a strong trend in three years of data suggesting that inoculum from area atmospheric sources exerts a greater effect on DON level than does inoculum from within-field corn residue. This is especially true in years/locations with severe epidemics.

Frequencies of 3-ADON and 15-ADON *Fusarium graminearum* from corn stubble, atmosphere, and wheat heads in three agricultural regions in New York in 2013

P. R. Kuhnem[1,2], E. M. Del Ponte[2], and G. C. Bergstrom[1*]

[1]Department of Plant Pathology and Plant-Microbe Biology, Cornell University, Ithaca, NY 14853 USA and [2]Departamento de Fitossanidade, Universidade Federal do Rio Grande do Sul, Porto Alegre RS, Brazil

*Corresponding Author: gcb3@cornell.edu

INTRODUCTION

In North America, Fusarium Head Blight (FHB) in cereals is caused mostly by *Fusarium graminearum* of the 15-acetyl(A) deoxynivalenol (DON) trichothecene genotype. However, recent population shifts have been reported in some northern areas in the United States and in Canada where 15-ADON isolates are being displaced by 3-ADON isolates. Still lacking is any information on trichothecene genotypes obtained from saprophytic, airborne, and pathogenic phases of the life cycle of *F. graminearum*.

OBJECTIVE

To expand our understanding of the dynamics of *F. graminearum* genotypes associated with different niches, by conducting intensive sampling of isolates from corn stubble, the lower atmosphere, and wheat heads in diverse agricultural regions in New York

MATERIAL AND METHODS

Sampling

● Belmont, southwestern NY, Allegany Plateau

▲ Aurora, central NY, Central Plain

■ Willsboro, northeastern NY, Champlain Valley

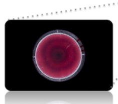
Populations / niches

Corn stubble with perithecia

Lower atmosphere

Symptomatic wheat heads

Purification



Single spore and purification

Collection

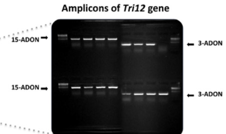
Mycelia production and DNA extraction

Molecular identification

Singleplex PCR *Tri3* and *Tri12*

Trichothecene genotype

Amplicons of *Tri12* gene



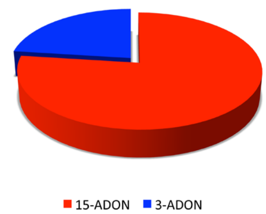
Data analysis

Chi-squared analysis ($P<0.05$) was carried out to compare the frequencies of 15-ADON and 3-ADON genotypes within and between fields.

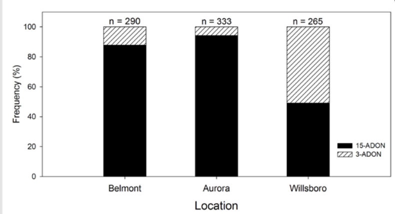
RESULTS

Number of isolates

Of a total of 888 isolates analyzed, (683/888) 77% were of the 15-ADON genotype, and (205/888) 23% were of the 3-ADON genotype.



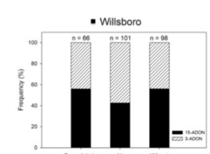
Genotype frequency by location



Overall frequency of the 3-ADON isolates differed across the locations ($\chi^2= 179$; $P<0.001$)

Genotype frequency by niche

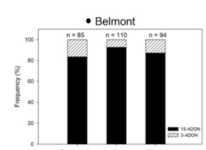
No significant differences were found in the trichothecene genotype frequency among the three niches in any location

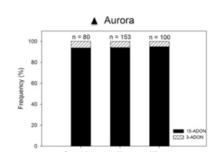


● Belmont, χ^2=3.236; P=0.198

▲ Aurora, χ^2=0.145; P=0.930

■ Willsboro, χ^2=3.662; P=0.160





CONCLUSION

As viewed by the frequency of trichothecene genotypes, local populations of *F. graminearum* appear not be structured by the three niches analyzed.

Acknowledgemets: to CNPq for the research fellowship and funding

Cornell University
College of Agriculture
and Life Sciences

Department of Plant Pathology
and Plant-Microbe Biology

Tebuconazole Resistant Isolate of *Fusarium graminearum* in New York

Further information and insights on an article in the May 2014 issue of Plant Disease: Spolti, P., Del Ponte, E.M., Dong, Y., Cummings, J.A., and Bergstrom, G.C. 2014. Triazole sensitivity in a contemporary population of *Fusarium graminearum* from New York wheat and competitiveness of a tebuconazole-resistant isolate. Plant Dis. 98:607-613.

Questions & Answers

Q1. What is the finding that has generated interest and concern?

In a laboratory study of 50 field isolates of the wheat head blight fungus, *Fusarium graminearum*, from commercial wheat fields in New York State, one of these isolates was found to be highly resistant to the fungicide tebuconazole. The other 49 isolates were sensitive to tebuconazole and all 50 isolates were sensitive to the fungicide metconazole.

Q2. Is tebuconazole less effective in head blight suppression against the resistant isolate?

Yes. In a growth chamber study, tebuconazole provided much less control of head blight caused by the tebuconazole-resistant isolate as compared to a tebuconazole-sensitive isolate.

Q3. Is the tebuconazole-resistant isolate less competitive in the absence of tebuconazole application?

No. In the absence of tebuconazole application, the tebuconazole-resistant isolate produced the same severity of head blight as inoculation with a sensitive isolate or a 50:50 mixture of the resistant and sensitive isolates.

Q4. Is the tebuconazole-resistant isolate sensitive to other triazole fungicides labeled for head blight control?

Yes. The fungicide metconazole (in Caramba, Headline AMP, and Twinline) controlled head blight caused by the tebuconazole-resistant isolate. Dr. Kiersten Wise and graduate student Anna Noveroske at Purdue University are also testing the tebuconazole-resistant isolate and they report (personal communication): “Preliminary laboratory experiments using technical grade prothioconazole do not indicate that the New York isolate is resistant to prothioconazole.” Prothioconazole is the sole active ingredient in Proline and is combined with tebuconazole in Prosaro.

Q5. Is the finding of a fungicide-resistant isolate surprising?

No, it isn't. It is not uncommon to find low frequencies of fungicide resistance in native fungal populations even before any exposure to a particular fungicide. The investigators just happened to find a highly resistant isolate in a fairly small sample and they suggested that more isolates with resistance to this or other fungicides are likely to be found as larger surveys are conducted. Natural variation in fungicide sensitivity should be expected in this fungus that is known for its high degree of genetic variability.

Q6. Has a Fusarium head blight fungicidal control failure been observed in the field?

No. There has been no report of failed control of Fusarium head blight due to resistance to tebuconazole or other triazole fungicides in North or South America. Control can be reduced by many factors, including timing of application and weather conditions, so a partial reduction in control due to fungicide resistance build-up would be difficult to discern.

Q7. Where does *Fusarium graminearum* exist in agricultural and natural landscapes and can isolates spread?

Fusarium graminearum is a ubiquitous fungus in many parts of North America. It is the principle cause of corn stalk rot and ear rot in northern U.S. states and Canada and of wheat and barley head blight throughout the U.S. It infects nearly all species of cereals and grasses and a number of other plants that are cultivated or present in natural landscapes. It survives between growing seasons in soil and in plant debris, and it produces huge numbers of spores on overwintered residues of corn and other cereals. Some of these spores become airborne and can be carried considerable distances by air currents to infect plants in distant locations. Spores that infect local wheat, barley or corn crops can come from within the field and from sources outside of the field. If fungicide-resistant isolates increase in proportion due to continual fungicide use in one field, they can be blown to other fields. Conversely, spores of fungicide-sensitive isolates will also be blown into a field and thereby dilute the fraction of resistant isolates in that field.

Q8. Should control strategies for Fusarium head blight change because of the finding of tebuconazole resistance?

Integrated management of Fusarium head blight utilizing moderately resistant wheat and barley varieties and judicious application of triazole fungicides at the onset of crop flowering when there is risk of infection will continue to be a successful strategy.

Multiple applications of the same fungicide active ingredient at different crop stages and over wide geographic areas, however, are a significant risk factor for selection of resistance in fungal populations that should be reduced. This is especially true if early growth stage applications of fungicides are made that hit crop residues that harbor large populations of the pathogen and represent an important source of spores for infections at flowering. Generic tebuconazole products are now in wide use as preventative sprays for foliar diseases at spring herbicide timing. Applying different fungicide active ingredients in alternation or combination should help delay selection for resistance based on research with other plant pathogens.

Q9. What should occur as a consequence of the findings in New York?

All involved in North American cereal production should realize that decreased effectiveness of important head blight control fungicides could occur if these materials are not managed carefully to reduce selection pressure on *Fusarium* populations. It is hoped that the New York findings will spur more routine screening of populations of *Fusarium graminearum* and other important cereal crop pathogens for sensitivity to important fungicides in order to detect fungicide resistance early and put in place resistance management strategies that prevent disease control failures in the future.

For further information or comments, contact:

Dr. Gary C. Bergstrom, Professor
Department of Plant Pathology and Plant-Microbe Biology
Cornell University
334 Plant Science Building
Ithaca, NY 14853-5904

Email: gcb3@cornell.edu
Phone: (607) 355-7849

2013 Soft White Winter Wheat Summaries – Cornell University

		Grain Yield (kg/h)						Test		Lodging	Head	Winter		Preharvest				FHB	FHB	FHB
		Regional Locations						Weight		Score	Date	Surv.	Height	Sprouting		WSSMV	WSbMV	Incid.	Sev.	Index
	Entry	Ith-Ket	DutCo	LivCo	MonCo	Mean	Rank	kg/hl	Rank	0-9	2 Loc	%	cm	0-9	Rank	0-9	0-9	%	%	
1	Houser	5301	2591	4413	5374	4420	16	72.3	30	3.0	5/25	N	92	5.2	25	2.0	0.3	na	na	na
2	Caledonia	4892	2505	3784	6412	4398	18	71.4	35	2.3	5/25	O	73	7.1	36	2.0	0.0	59	23	13
3	Cayuga	4841	2450	4148	4196	3909	35	75.6	2	3.7	5/27		94	1.9	4	1.7	0.3	na	na	na
4	Jensen	5196	3010	4212	3649	4017	31	72.7	27	6.8	5/28	W	89	3.1	10	0.7	2.7	66	20	13
5	Medina	5325	2416	4551	5336	4407	17	73.1	21	3.3	5/26	I	88	2.9	9	1.0	0.3	44	25	11
6	Hopkins	5294	2855	3979	5022	4287	23	72.7	28	3.3	5/25	N	82	4.8	22	1.7	0.3	48	11	5
7	NY99045-3110	5829	3121	4550	4484	4496	13	72.2	33	3.5	5/27	T	91	6.1	29	4.3	0.3	38	17	7
8	Otsego	5988	3357	3328	5323	4499	12	73.9	9	4.7	5/25	E	86	1.2	2	0.5	0.0	48	11	5
9	NY99059-249	5817	3106	4713	4615	4563	7	74.4	3	3.7	5/26	R	79	5.5	26	0.7	2.3	37	9	3
10	NY94046-150	5564	3388	4463	4560	4494	15	72.8	26	3.5	5/26		91	6.5	32	2.0	2.7	37	24	9
11	NY99056-161	5331	2793	4381	5586	4523	8	72.7	29	2.8	5/27	K	87	3.4	12	1.3	1.7	39	10	4
12	NY94063-117	5176	3624	4340	4000	4285	24	71.7	34	5.0	5/19	I	82	5.0	24	1.0	1.0	68	35	24
13	NY01016-AN	5773	3011	5243	6486	5128	1	74.3	4	1.2	5/25	L	87	3.8	14	0.7	0.3	50	16	8
14	NY07104-141	4368	2998	4425	3302	3773	37	73.8	11	6.3	5/26	L	88	3.1	11	1.3	2.3	24	5	1
15	NY99069-WC	4869	2930	5103	3833	4184	28	74.3	6	5.3	5/27		91	2.2	5	7.0	4.3	37	20	8
16	NY94025-136	5033	3345	4090	5566	4508	11	73.7	12	2.7	5/25		75	2.4	6	1.0	0.3	55	15	8
17	NY96153-167	5187	2637	4081	6470	4594	5	74.0	8	2.5	5/24		79	4.2	16	2.7	0.0	70	18	13
18	94046-174	5462	2933	3808	5851	4514	10	72.2	32	1.2	5/26		91	6.7	34	3.0	2.3	47	24	11
19	94052-207	6133	3360	4449	5027	4742	3	73.1	23	2.8	5/20		90	4.6	19	2.3	0.0	45	21	9
20	96028-318	5047	2854	4313	3805	4005	32	70.8	36	3.0	5/27		96	1.7	3	2.3	0.3	66	30	20
21	NY07020-147	5922	2476	4001	6030	4607	4	73.4	17	2.0	5/24		77	3.4	13	4.0	0.7	68	17	11
22	NY07023-150	5467	2708	3386	4338	3975	34	73.7	14	3.8	5/26		92	6.8	35	0.7	0.3	62	25	16
23	NY01066-118	5184	3431	4859	4863	4584	6	70.1	37	1.3	5/28		85	2.5	7	1.0	0.0	67	60	40
24	NY03093&94-150	4864	2881	3525	4645	3979	33	73.1	22	4.5	5/27		86	4.9	23	1.7	1.0	76	38	29
25	NY03010-157	4996	2721	3635	5614	4242	27	74.3	5	2.2	5/25		74	4.5	18	1.3	0.3	71	24	17
26	NY03082-183	4962	3297	4000	3136	3849	36	72.9	24	4.8	5/19		83	6.4	30	2.3	0.7	43	25	11
27	NY03008-200	5265	2853	2372	6693	4296	22	73.8	10	1.5	5/25		82	4.1	15	0.0	0.0	71	24	17
28	NY99069-249	6009	2835	4932	5342	4779	2	74.2	7	4.0	5/25		74	6.4	31	1.3	3.0	41	10	4
29	NY01066-278	5077	2496	4344	5137	4264	26	73.2	20	2.8	5/25		86	5.8	28	1.3	1.0	44	18	8
30	NY99069-326	5767	2742	4252	4584	4336	20	72.3	31	7.0	5/25		80	5.5	27	2.3	1.3	55	16	9
31	NY99069-352	5236	3128	3978	5737	4520	9	73.3	18	4.2	5/25		72	4.6	20	1.0	0.3	51	14	7
32	NY03087&88-649	4711	2855	2766	5792	4031	30	73.5	16	3.5	5/24		75	4.2	17	1.0	0.3	na	na	na
33	NY03092-652	5287	3115	4098	4824	4331	21	72.8	25	4.3	5/25		77	4.6	21	1.0	0.0	na	na	na
34	NY03087&88-658	4918	2907	4539	5616	4495	14	73.3	19	3.5	5/25		76	6.6	33	1.0	0.7	na	na	na
35	7388xD8006 - 18	5331	2700	4291	3840	4040	29	73.7	13	6.3	5/25		91	2.8	8	1.3	0.0	na	na	na
36	NY01002-AN	4918	2275	4938	5214	4336	19	73.6	15	2.2	5/26		76	7.9	37	1.0	0.0	na	na	na
37	NY06073-46	4694	2921	3743	5779	4284	25	75.6	1	2.3	5/24		74	0.0	1	1.0	0.0	na	na	na
	Mean	5271	2909	4163	5029	4343		73.2		3.5	5/25		83	4.4		1.7	0.9	53	21	12
	CV	4.4	11.9	12.5	16.3															

Cumulative Summary

		Grain Yield										Lodging		Head	FHB	FHB	Preharv	WSSMV	WSbM	Height
		4 Year		3 Year		2 Year		Test Weight				0-9	0-9	Date	%Inc	%Sev	Sprout	Rating	Rating	cm
	Entry	kg/h	b/a	kg/h	b/a	kg/h	b/a	3 Yr	lb/b	2 Yr	lb/b	3 Yr	2 Yr	2 Yr	2 Yr	2 Yr	2 Yr	2Yr	2Yr	2 Yr
1	Houser	4809	72	4548	68	4596	68	73.7	58.0	73.4	57.8	2.0	3.0	5/24	na	na	4.6	1.8	0.3	96
2	Caledonia	4872	72	4574	68	4630	69	73.8	58.1	73.6	58.0	1.1	1.6	5/24	51	34	5.9	1.5	0.2	76
3	Cayuga	4333	64	3999	59	4060	60	76.5	60.2	75.8	59.7	2.3	3.4	5/26	na	na	1.7	1.4	0.2	101
4	Jensen	4719	70	4441	66	4471	66	74.8	58.9	74.4	58.6	2.7	4.0	5/27	46	19	3.0	0.4	3.8	93
5	Medina (NY88046-7088	4941	73	4648	69	4732	70	74.9	59.0	74.3	58.5	1.8	2.6	5/25	33	17	2.8	1.1	0.2	90
6	Hopkins (NY03180FHB-	4815	72	4582	68	4672	69	74.0	58.3	73.5	57.9	1.7	2.6	5/24	34	19	4.1	1.2	0.5	86
7	NY99045-3110	4981	74	4635	69	4724	70	73.8	58.1	73.1	57.6	2.0	3.0	5/26	25	12	5.1	4.8	0.8	94
8	Otsego			4735	70	4712	70	74.6	58.7	73.8	58.1	2.4	3.7	5/24	36	11	0.8	0.5	0.2	88
9	NY99059-249			4659	69	4861	72	75.6	59.5	75.0	59.1	1.8	2.8	5/25	28	10	4.8	0.7	2.3	83
10	NY94046-150			4610	69	4738	70	74.2	58.4	73.9	58.2	1.9	2.9	5/25	24	18	5.3	2.6	2.3	93
11	NY99056-161					4904	73			74.2	58.4		3.5	5/25	26	10	3.3	1.3	2.6	87
12	NY94063-117					4700	70			73.3	57.7		3.9	5/22	47	27	4.0	1.1	0.5	84
13	NY01016-AN					5218	78			75.3	59.3		1.6	5/24	30	21	3.3	0.6	0.2	88
14	NY07104-141					4359	65			75.2	59.2		3.7	5/25	15	4	2.4	1.3	3.3	91
15	NY99069-WC					4487	67			76.1	59.9		3.2	5/26	23	13	2.6	6.8	4.7	94

M.E. Sorrells, D. Benscher, J. Shiffer, J. Tanaka - Department of Plant Breeding & Genetics, Cornell University

2013 Red Winter Wheat Summaries - Cornell University

		Grain Yield (kg/h) Regional Locations						Test Weight				Preharvest Sprouting		Winter				FHB		
	Entry	Ith-Ket	DutCo	LivCo	MonCo	Mean	Rank	kg/hl	Rank	Lodg. 0-9	Head Date	0-9	Rank	Surv. %	Height cm	WSSMV 0-9	WSbMV 0-9	Incid. %	Sev. %	Index
1	Otsego	5212	3835	2759	5746	4388	23	74.9	8	2.8	5/26	1.3	18	N	79	0.3	1	48	11	5
2	Emmit	5272	3442	4543	6982	5060	11	73.9	20	2.8	5/26	0.2	3	O	79	7.0	0	40	17	7
3	Pioneer 25R39	5764	3199	3141	6562	4666	19	73.8	21	3.7	5/26	0.7	14		75	4.3	0	35	14	5
4	HY116-SRW	5471	3499	4290	5608	4717	18	72.1	25	4.8	5/26	3.6	24	W	79	0.7	5	66	18	12
5	OH02-12686	6800	3377	4839	6561	5394	6	74.2	14	1.5	5/28	5.7	25	I	81	0.7	0	35	21	7
6	Bromfield	5169	3718	4801	5744	4858	16	74.1	15	2.3	5/27	3.1	23	N	81	2.0	0	41	10	4
7	OH04-268-39	6320	4442	4564	5670	5249	7	73.2	24	3.3	5/28	1.0	17	T	85	1.0	3	38	13	5
8	DF55	6351	3687	4012	5704	4939	13	75.4	6	1.8	5/26	0.9	16	E	73	1.7	0	58	13	8
9	DF75	5688	3880	3262	7095	4981	12	74.8	9	2.8	5/25	0.1	1	R	74	2.0	0	57	18	10
10	Pioneer 25R34	7373	3447	5570	5548	5484	4	74.1	17	1.8	5/25	1.6	19		77	7.7	1	40	10	4
11	FSX815	6459	3836	4906	4333	4884	15	73.4	22	2.5	5/24	0.6	10	K	74	7.0	3	81	15	12
12	IL05-4236	6311	4310	2474	4139	4309	25	75.8	5	5.7	5/21	0.4	7	I	77	3.3	0	67	17	12
13	DANW1001	6426	4478	4893	4999	5199	9	74.0	18	3.8	5/29	1.8	20	L	82	4.7	0	44	22	10
14	DANW1002	6464	3941	4623	7451	5620	3	73.2	23	2.8	5/27	0.3	6	L	78	1.0	0	25	14	4
15	Pioneer 25R46	8384	4104	5344	6866	6174	1	74.1	16	1.3	5/25	1.9	21		69	1.7	0	37	9	3
16	Pioneer 25R40	8930	4298	5388	5677	6073	2	74.7	11	2.8	5/26	0.8	15		68	3.3	0	61	14	8
17	05SH15.030	6264	3815	4462	2884	4356	24	74.4	13	3.7	5/26	0.1	2		87	6.7	4	37	13	5
18	Brome	4621	2729	3910	6313	4393	22	74.7	12	3.5	5/31	0.6	13		98	6.7	5	49	15	7
19	MO081652	6228	3418	4480	6706	5208	8	77.6	1	1.3	5/25	0.4	8		77	1.7	1	36	9	3
20	MO080104	6120	4168	4853	6787	5482	5	77.5	2	1.2	5/25	0.6	11		78	1.7	0	37	11	4
21	OH08-180-48	5846	3320	3239	5672	4519	20	74.8	10	3.5	5/27	0.2	4		72	4.3	0	42	14	6
22	VA08MAS-369	6315	3459	4074	5256	4776	17	76.4	3	2.7	5/25	0.4	9		71	0.7	2	43	19	8
23	KY03C-1237-32	4226	3050	4777	7634	4922	14	75.9	4	0.5	5/24	0.2	5		68	1.3	0	58	12	7
24	P05222A1-7	3063	2905	4946	6861	4444	21	74.0	19	0.5	5/27	0.6	12		75	2.0	4	33	9	3
25	VA09W-73	6749	3576	3241	7172	5184	10	75.2	7	2.3	5/27	1.9	22		73	5.7	5	55	17	9
	Mean	6073	3677	4296	5999	5011		74.7		2.6	5/26	1.2			77	3.2	1.3	47	14	7
	CV	11.8	8.3	19.3	13.0															

Cumulative Summary

		Grain Yield 4 Year		3 Year		2 Year		Test Wt(2Yr)		Lodg. 0-9	Height cm	Head Date	Winter Surv.	Preharv Sprout 0-9	WSSMV Rating	WSbMV Rating	FHB Incid. %	FHB Sev. %	FHB Index
	Entry	kg/h	b/a	kg/h	b/a	kg/h	b/a	kg/hl	lb/b	2 Yr	2 Yr	2 Yr	2 Yr	2 Yr	2Yr	2 Yr	2 Yr	2 Yr	2 Yr
1	Otsego	5014	75	4757	71	4600	68	75.1	58.7	2.8	77	5/26	99	0.8	0.4	0.7	36	11	3.9
2	Emmit	5278	78	5035	75	5068	75	75.4	58.9	0.4	77	5/27	98	0.9	6.8	2.3	26	24	5.1
3	Pioneer 25R39	5027	75	4870	72	4859	72	75.3	58.8	2.5	74	5/27	99	1.1	5.4	2.5	21	9	2.6
4	HY116-SRW	5193	77	4991	74	4996	74	74.0	57.8	2.3	77	5/27	96	2.8	0.7	2.3	41	13	6.5
5	OH02-12686	5556	83	5271	78	5238	78	76.0	59.4	1.3	81	5/29	99	3.5	0.7	0.2	22	15	4.0
6	Bromfield	5092	76	4936	73	4932	73	75.9	59.3	2.3	81	5/28	98	1.9	1.6	0.0	28	10	2.7
7	OH04-268-39	5361	80	5076	75	5131	76	74.8	58.4	1.5	84	5/29	99	0.7	1.3	2.0	26	14	3.4
8	DF55			5093	76	5052	75	76.1	59.5	1.5	73	5/27	100	2.4	1.5	0.3	46	13	5.9
9	DF75			5242	78	5304	79	76.5	59.7	2.0	75	5/26	99	0.3	3.3	0.5	43	24	9.2
10	Pioneer 25R34			5334	79	5328	79	74.7	58.3	1.3	76	5/26	98	2.5	6.9	2.8	25	7	2.2
11	FSX815					5175	77	74.3	58.1	1.5	73	5/24	99	1.8	6.4	2.7	56	12	7.3
12	IL05-4236					4580	68	76.7	59.9	5.4	80	5/21	98	1.9	3.9	0.8	39	15	6.5

M.E. Sorrells, D. Benscher, J. Shiffer, J. Tanaka - Department of Plant Breeding & Genetics, Cornell University

2013 Spring Oat Regional and Cumulative Summaries - Cornell University

	Entry	Grain Yield (kg/h) Ith-Sny	Ith-Hel	MontCo.	SteuCo.	Mean	Rank	Test Wt (kg/hl) Mean	Rank	Lodging	Head Date	Height cm
1	OGLE	2833.2	2416.4	3261.2	3012.4	2880.8	18	39.0	19	3.4	6/23	88
2	NEWDAK	3635.5	2439	3257.2	3350.5	3170.6	14	41.3	11	6.0	6/22	90
3	Corral (IL00-7267)	4500.8	3208.1	3391.6	2806.2	3476.7	2	41.6	8	2.0	6/24	93
4	IL02-8658	3882.1	2605.2	3333.6	3323.4	3286.1	10	40.9	13	2.6	6/22	88
5	IL04-7077	2684.1	2840.1	2901.4	2904.2	2832.4	19	43.6	2	2.6	6/23	80
6	IL05-9931	3953.9	2907.5	3023.4	3142.4	3256.8	13	41.6	9	1.3	6/26	88
7	SD081936	4020.1	2849.4	2838	3327.6	3258.8	12	42.0	6	2.6	6/22	85
8	SD081107	4547.3	3267.4	3089.5	3098.7	3500.7	1	39.8	15	5.7	6/23	88
9	SD081108	4153.2	3116.2	3242.8	3000.2	3378.1	5	42.9	3	4.8	6/23	80
10	MN09255	3629.4	3513.8	3117.9	3004.7	3316.4	8	41.5	10	5.5	6/25	93
11	OA1286-1	3420.5	2688.1	2225.4	2899.5	2808.4	20	42.5	4	4.8	6/26	96
12	IL06-5433	3433	2351.2	2606.4	3512	2975.7	17	44.1	1	0.3	6/23	85
13	IL07-8721	3555.1	2385.7	3461.2	2527.8	2982.4	16	39.8	16	0.2	6/25	71
14	P021A1-66-2	4064.8	2374.1	3438.8	3215.4	3273.3	11	42.4	5	3.2	6/24	83
15	P0216A1-1-45	3853.6	2190.2	3190.9	2926.4	3040.3	15	40.8	14	2.2	6/24	81
16	SD090965	3972	3290.1	3446.2	3135.6	3461	3	39.1	18	5.6	6/27	85
17	SD090248	4584.4	3121.5	2624.7	3126.6	3364.3	6	41.8	7	5.3	6/26	78
18	MN10209	3626.4	2959.3	3593.9	3156.3	3334	7	39.4	17	7.4	6/27	93
19	WIX9509-3	3576.8	3364.5	3538	3293.7	3443.3	4	41.1	12	3.8	6/24	83
20	WIX9562-5	4094.9	2749	3284.3	3110.5	3309.7	9	38.9	20	5.1	6/22	83
	Mean	3801	2832	3143	3094	3217		41.2			6/24	85
	CV	8.3	16.1	8.6	13.7							

	Cumulative Summary	Grain Yield								Test Weight		Head	Lodging	Height
		7 Years		6 Years		3 Years		2 Years		2 Years		Date	0-9	cm
	Entry	kg/h	b/a	kg/h	b/a	kg/h	b/a	kg/h	b/a	kg/hl	lbs/b	2 Yr	2 Yr	2 Yr
1	OGLE	2890	81	2994	83	2727	76	3094	86	42.7	33.4	6/19	1.7	89
2	NEWDAK	3018	84	3094	86	2889	81	3218	90	46.5	36.4	6/17	3.0	98
3	Corral (IL00-7267)	3390	95	3495	97	3346	93	3850	107	46.8	36.6	6/20	1.0	91
4	IL02-8658			3209	89	3044	85	3621	101	46.0	35.9	6/18	1.3	93
5	IL04-7077					3072	86	3406	95	48.3	37.7	6/19	1.3	83
6	IL05-9931					3112	87	3662	102	46.1	36.1	6/20	0.7	84
7	SD081936					3318	93	3754	105	47.6	37.2	6/17	1.3	86
8	SD081107							3784	106	45.3	35.4	6/19	2.8	84
9	SD081108							3646	102	47.8	37.3	6/19	2.4	86
10	MN09255							3783	105	47.3	37.0	6/19	2.8	90
11	OA1286-1							3410	95	47.4	37.1	6/20	2.4	98

M. E. Sorrells, D. Benscher, and J. Shiffer - Department of Plant Breeding & Genetics - Cornell University

2013 Winter Malting Barley Regional Trial Summary - Cornell University

		Grain Yield (kg/h)							Test					Net	Wint
		Regional Locations							Weight		Lodg.	Height	Head	Blotch	Surv
	Entry	Ith-Ket	DutCo	LivCo	MonCo	Mean	bu/ac	Rank	kg/hl	Rank	0-9	cm	Date	0-9	%
1	Charles	4540	1812	2855	N	3069	57	18	52.6	20	N	62	5/21	5.3	92
2	Strider	5591	2164	4080	O	3945	73	6	58.5	13	O	79	5/21	4.3	95
3	McGregor	4188	1726	2664		2859	53	19	57.7	18	N	73	5/20	4.7	96
4	Saturn	6363	2837	4423	D	4541	84	1	57.1	19	E	69	5/20	4.3	99
5	10467p2	6182	1835	3222	A	3746	70	7	58.5	14		67	5/19	3.0	97
6	10467r2	6155	2641	3485	T	4094	76	3	59.5	9		69	5/19	3.3	95
7	10467r4	6856	1873	3829	A	4186	78	2	58.1	16		69	5/20	4.3	90
8	03/220/158	5525	1361	3438		3441	64	14	58.1	17		72	5/25	3.3	96
9	04/153/2	4838	1804	3390		3344	62	15	60.9	1		78	5/26	1.0	94
10	04/002/23	5850	1274	3262		3462	64	12	58.6	12		60	5/18	3.7	97
11	VA09B-34	4870	1926	2658		3151	59	17	60.8	4		70	5/14	7.3	96
12	VA10B-43	5586	2474	2644		3568	66	10	59.6	7		63	5/16	4.3	91
13	KWS Scala	4858	2050	2967		3291	61	16	58.3	15		69	5/22	3.3	96
14	Mystic	5381	1837	3230		3482	65	11	60.1	5		63	5/18	3.5	94
15	Salanandre	5476	2216	4190		3961	74	5	59.8	6		65	5/19	5.7	97
16	Etincel (1205 1H23)	6769	2307	3181		4086	76	4	59.6	8		72	5/20	6.0	98
17	Sytepee (SY209-66)	5593	1386	3836		3605	67	8	60.8	2		74	5/23	4.0	96
18	SY209-72	5124	2106	3485		3572	66	9	59.1	11		70	5/25	3.3	95
19	Endeavor	5208	1846	3324		3460	64	13	60.8	3		77	5/24	4.3	74
20	WintMalt	3667	1448	3226		2781	52	20	59.5	10		76	5/26	2.7	94
	Mean	5431	1946	3369		3582	67		58.9			70	5/21	4.1	94
	CV	8.8	19.7	30											

Cumulative Summary

		Grain Yield				Lodg.	Height	Head	Winter	Kernel	on	Malt	Barley		
		2 Year		Test Wt(2Yr)		0-9	cm	Date	Surv.	Wt	6/64"	Extract	Protein	DP	Quality
	Entry	kg/h	b/a	kg/hl	lb/b	2 Yr	2 Yr	2 Yr	2 Yr	(mg)	(%)	(%)	(%)	°ASBC	Score
1	Charles	3735	69	52.2	40.8	1.8	76	5/17	83	30.1	92.2	78.8	12.6	142	59
2	Strider	5123	95	57.3	44.8	1.8	90	5/19	89	32.8	74.9	76.4	11.1	55	17
3	McGregor	4774	89	60.2	47.0	2.8	82	5/17	95	33.3	80.5	76.6	11.6	60	24
4	Saturn	6103	113	58.2	45.4	1.3	77	5/17	88	35.8	88.8	75.0	10.5	96	15
5	10467p2	5550	103	59.8	46.7	1.8	81	5/16	92	30.3	87.5	78.4	10.7	95	35
6	10467r2	5753	107	61.8	48.3	1.5	82	5/16	92	34.3	93.2	81.4	9.8	103	39
7	10467r4	5705	106	61.0	47.6	2.3	79	5/17	91	32.8	93.0	80.9	10.6	101	46
8	03/220/158	5282	98	58.6	45.8	1.2	84	5/22	89	33.5	90.2	78.4	11.3	157	38
9	04/153/2	5021	93	62.5	48.8	0.7	92	5/23	88	40.1	96.9	79.9	10.9	122	35
10	04/002/23	4660	87	58.8	45.9	2.7	75	5/16	93	29.8	79.3	78.9	11.2	119	26
11	VA09B-34	4800	89	64.0	50.0	2.5	83	5/11	92	33.9	93.2	75.8	12.6	70	26
12	VA10B-43	4815	89	62.2	48.6	3.0	79	5/14	82	28.3	77.4	76.1	12.7	47	24
13	KWS Scala	4977	93	60.9	47.6	0.7	80	5/19	83	42.3	98.2	80.9	12.0	178	62
14	Mystic	4817	90	62.5	48.8	1.0	79	5/16	90	42.9	96.7	80.2	12.6	138	47
15	Salanandre	4932	92	62.0	48.4	1.3	78	5/17	89	40.8	94.4	79.8	12.0	121	49
16	Etincel (1205 1H23)	5740	107	61.5	48.0	1.7	86	5/17	89	32.4	92.8	78.2	10.6	114	24
17	Sytepee (SY209-66)	5060	94	63.0	49.2	0.7	82	5/19	83	42.3	97.1	82.3	10.4	188	55
18	SY209-72	5034	94	60.9	47.6	1.2	85	5/22	86	38.9	89.7	81.2	10.4	120	41

M.E. Sorrells, D. Benscher, J. Shiffer, J. Tanaka - Department of Plant Breeding & Genetics, Cornell University

2013 Spring Malting Barley Regional Summary - Cornell University

		Grain Yield (kg/h)					Test Wt (kg/hl)			Head	Height	Foliar
	Entry	Ith-Sny	MonCo.	MontCo.	Mean	Rank	Mean	Rank	Lodging	Date	cm	Disease (0-9)
1	Herta	3687	3933	1983	3201	8	62.4	4	1.7	6/27	75	6.0
2	Conlon	3639	3436	1718	2931	12	60.3	7	3.5	6/17	68	1.7
3	18-20	3161	3419	1043	2541	17	56.0	17	4.5	6/27	63	4.7
4	Odyssey	2967	3503	634	2368	21	55.3	19	4.3	6/28	60	5.3
5	Overture	3039	3175	950	2388	19	53.9	22	5.0	6/29	63	4.3
6	Genie	3098	3246	784	2376	20	55.1	20	2.7	6/27	60	4.7
7	Lacey	3928	3948	3054	3643	2	60.2	9	1.8	6/19	70	1.7
8	Quest	4063	3878	2344	3429	3	60.3	8	2.5	6/19	80	2.3
9	M145	3892	3906	2390	3396	5	60.8	6	1.8	6/21	90	3.3
10	M150	4076	3454	2464	3332	7	60.1	10	2.5	6/21	80	2.7
11	M152	3386	4107	2552	3348	6	59.8	11	1.7	6/21	78	2.0
12	KWS Asta	2939	3929	677	2515	18	53.1	23	3.8	6/28	63	4.0
13	KWS Irina	2613	3706	663	2328	22	54.8	21	3.0	6/29	50	3.3
14	KWS Thessa	3088	3964	1134	2728	16	55.9	18	3.3	6/27	53	3.7
15	KWS Atrika	3509	3770	1314	2865	13	57.2	16	2.8	6/27	66	4.3
16	Cerveza	3518	3413	2123	3018	11	59.1	13	2.0	6/28	70	7.3
17	Newdale	3851	4128	2256	3411	4	59.2	12	0.5	6/28	75	5.7
18	AAC Synergy	3848	4526	2690	3688	1	58.7	14	0.7	6/27	71	6.3
19	AC Metcalfe	3090	3375	1730	2732	15	58.2	15	3.2	6/29	70	3.7
20	HYCA172	2955	3367	2177	2833	14	62.2	5	1.0	6/14	63	2.3
21	HYCA244	3536	3447	2354	3112	9	64.9	2	0.7	6/18	68	3.0
22	HYCA284	2340	2563	1628	2177	23	67.7	1	0.3	6/22	65	3.3
23	HYCA302	3535	3372	2375	3094	10	62.9	3	0.5	6/28	95	7.0
	Mean	2933	2933	2933	2933		59.0			6/24	69	
	CV	8.5	13.8	13.1	13.8							

M. E. Sorrells, D. Benscher, and J. Shiffer - Department of Plant Breeding & Genetics - Cornell University

2012-13 OREI Organic Winter Wheat Trial - All Locations

		Grain Yield (kg/h)					Test Weight		Lodg.	Ht (cm)	Head Date
Entry	Variety	FV	PA	WB	Mean	Rank	(kg/hl)	Rank	Mean	Mean	Mean
1	Red Fife *	2199	1571	*2901*	2224	39	74.0	16	0.9	116	5/27
2	Arapahoe *	*1860*	2903	4021	2928	24	73.8	19	1.3	81	5/29
4	American Banner	2686	2383	3465	2845	28	73.1	22	1.6	115	5/31
5	Fulcaster	2696	2246	3471	2804	30	73.9	17	2.1	118	5/31
6	Gold Coin	2544	2260	3580	2795	31	72.2	30	0.6	111	6/2
7	Genesee Giant	2691	2134	3994	2940	23	73.1	24	1.3	103	5/31
8	Pride of Genesee	2334	2239	3605	2726	33	75.9	4	0.8	120	6/2
9	Vermont Winter Reeds	2323	2091	3522	2645	36	71.0	34	1.6	109	6/2
10	Grandprize	2477	2287	3404	2723	34	72.9	26	0.4	114	6/2
11	Forward	2746	2439	3872	3019	14	73.3	21	1.5	105	6/2
12	Honor	2554	2493	3640	2896	26	71.4	33	2.2	111	5/31
13	Valprize	2564	2601	3839	3001	15	72.7	28	1.8	112	6/2
14	Golden	2328	2053	3436	2606	37	70.5	36	0.1	105	6/3
15	Clark's Cream	2497	2475	3987	2987	18	73.4	20	1.7	101	5/29
16	Yorkwin	2620	2462	3851	2978	21	72.5	29	1.7	113	6/3
17	Genesee	2756	2816	4165	3246	6	71.5	32	1.2	109	6/1
18	Yorkstar	2608	2784	4264	3219	7	70.4	37	0.2	107	5/31
19	Frederick	2931	2573	3651	3051	12	73.1	23	0.1	101	5/30
20	Arrow	3181	2880	4643	3568	1	71.6	31	0.2	103	5/29
21	Susquehanna	2672	2802	4358	3277	4	70.7	35	0.1	89	6/1
22	NXO5M4180-6 (waxy)	2169	2907	3880	2986	19	69.7	38	0.0	82	5/28
23	NXO4Y2107 (waxy)	2319	2578	3974	2957	22	75.1	8	0.1	85	5/26
24	AC Morley	2585	2648	3948	3060	11	75.2	6	0.1	96	5/29
25	Warthog	2901	2932	3999	3277	3	75.1	7	0.0	89	5/29
26	NuEast	2065	3069	4190	3108	10	76.8	1	0.0	78	5/27
27	Appalachian White	2346	3030	4097	3158	9	75.3	5	0.0	79	5/27
28	ARS05-1044	2114	2500	4489	3034	13	74.7	12	0.4	79	5/20
29	ARS07-0785 *	2482	2618	4808	*3303*	2	74.6	13	0.0	71	5/24
30	ARS07-1214	2925	2625	3990	3180	8	75.0	9	0.0	79	5/28
31	ARS08-0161	2637	2851	3487	2992	16	72.8	27	0.0	71	5/29
32	ARS08-1059 *	2184	2578	3942	*2901*	25	76.0	3	0.0	78	5/24
33	ARS09-173	2317	3243	4182	3247	5	76.4	2	0.1	76	5/26
34	Jaggar (HRWW)	2396	2754	3812	2987	17	74.8	11	0.1	73	5/23
35	Expedition	2290	2539	4128	2986	20	74.8	10	0.2	80	5/26
36	Maxine	2008	2580	3527	2705	35	73.8	18	0.2	79	5/27
37	Harvard	2588	2278	3602	2822	29	74.4	15	0.1	87	5/28
38	Zorro	2609	2075	3939	2874	27	73.0	25	0.3	98	6/2
39	Redeemer	2585	2398	3384	2789	32	74.4	14	0.0	89	5/30
40	Alauda (2013 only)	*2196*	*2782*	*2794*	*2591*		*76.6*		0.0	103	6/9
	Mean	2487	2551	3842	2960		73.6		0.6	95	5/30

Note there is no entry #3 because it was a local check that could not be summarized over locations

* 100% winterkill in either 2012 or 2013

Financial support provided by USDA NIFA Organic Research and Extension Initiative grant number 2011-51300-30697

2012-13 OREI Organic Spring Wheat Trial - Freeville

		Grain Yield (kg/h)					Test Weight		Lodg.	Ht (cm)	Head Date
Entry	Variety	FV	PA	WB	Mean	Rank	(kg/hl)	Rank	Mean	Mean	Mean
1	Stoa	2755	1693	3500	2649	12	68.5	17	0.0	83	6/13
2	Red Fife	2432	1208	2803	2148	19	68.8	15	1.2	119	6/11
3	RB07	3138	1742	3853	2911	6	70.2	12	0.3	83	6/17
4	ND735	3137	1668	3944	2917	5	71.8	4	0.1	92	6/11
5	Ada	2587	1623	3634	2615	14	72.3	3	0.0	82	6/10
6	MN00261-4	3292	1797	3807	2965	3	71.5	5	0.0	85	6/12
7	Tom	2997	1804	4201	3001	1	73.0	2	0.0	91	6/14
8	MN06078W	2875	1484	3734	2698	9	69.6	13	1.4	90	6/13
9	Steele	3343	2050	3357	2917	4	71.2	7	0.0	89	6/13
10	Rollag (MN05214-3)	2737	1550	3673	2654	11	71.4	6	0.3	80	6/13
11	Sabin	3332	2022	3599	2984	2	71.1	8	0.2	84	6/11
12	Louise	2570	1308	3576	2485	17	66.7	21	1.3	91	6/10
13	MN06079W	2719	1533	3323	2525	16	67.4	20	1.4	81	6/10
14	Glenn	2873	1840	3634	2783	8	74.1	1	0.0	89	6/12
15	Ulen	3098	1835	3684	2872	7	70.4	11	0.2	89	6/12
16	Reed	2568	1204	3113	2295	18	63.9	22	1.1	79	6/14
17	Grandin	3078	1292	3609	2660	10	69.5	14	0.0	90	6/10
18	McNeal	2928	1548	3388	2621	13	70.4	10	0.0	91	6/11
19	Thatcher	2004	903	2760	1889	20	67.5	19	1.2	111	6/11
20	AC Barrie	2665	1368	3619	2551	15	70.9	9	0.6	99	6/15
21	Mida	1900	914	2709	1841	22	68.8	16	0.9	113	6/12
22	Ceres	1879	1329	2352	1853	21	68.1	18	1.3	108	6/11
23	Marquis (2013 only)	2986	1358	2878	2407		76.2		0.5	94	6/10
24	Dylan (2013 only)	2536	1200	2833	2190		71.4		0.3	88	6/10
	Mean	2768	1511	3399	2560		70.2		0.5	92	6/12

Financial support provided by USDA NIFA Organic Research and Extension Initiative grant number 2011-51300-30697

2012-13 OREI Organic Winter Spelt Trial - All Locations

		Grain Yield (kg/h)					Test Weight		Lodg.	Ht (cm)	Head Date
Entry	Variety	FV	PA	WB	Mean	Rank	(kg/hl)	Rank	Mean	Mean	Mean
1	*Comet***	*1822*	*2936*	*5316*	*3358*		*31.06*		*0.2*	*74.611*	*6/2*
2	Frank	2653	1701	4319	2891	4	37.0	1	0.5	110	6/8
3	Maverick	2928	2289	6096	3771	1	33.5	4	0.9	103	5/29
4	*Oberkorn***	*2854*	*na*	*3660*	*3257*		*31.3*		*0.0*	*114*	*6/2*
5	*Oberkulmer*	*2499*	*2107*	*4538*	*3048*	*2*	*34.3*	*3*	*0.0*	*119*	*6/5*
6	PI348159	2425	1666	4643	2911	3	35.9	2	0.5	110	6/9
7	*Sungold***	*1914*	*2751*	*6619*	*3761*		*31.3*		*0.0*	*103.78*	*6/10*
	Mean	2442	2242	5027	3285		33.5		0.3	105	6/5

* Oberkorn yield, lodging, height, and heading date means are for two locations

**Comet and Sungold tested in 2013 only. Oberkorn tested only in 2012.

Financial support provided by USDA NIFA Organic Research and Extension Initiative grant number 2011-51300-30697

2012-13 OREI Organic Spring Spelt Trial - All Locations

		Grain Yield (kg/h)					Test Weight		Lodg.	Ht (cm)	Head Date
Entry	Variety	FV	PA	WB	Mean	Rank	(kg/hl)	Rank	Mean	Mean	Mean
1	*94-288**	*2202*	*1125*	*na*	*1664*		*38.4*		*2.8*	*94*	*6/12*
2	AC Boveria	2096	783	3758	2212	2	33.0	2	4.4	122	6/24
3	CDC Zorba	2533	1256	4553	2781	1	33.2	1	1.6	118	6/23
4	*Forage Spelt**	*2250*	*1152*	*na*	*1701*		*45.9*		*3.0*	*135*	*6/19*
5	*Red Chaff**	*2036*	*1059*	*na*	*1548*		*43.2*		*1.5*	*105*	*6/13*
	Mean	2223	1075	4155	1981		38.7		2.7	115	4/6

*These three varieties were only tested in 2013 at Freeville and in Pennsylvania.

Financial support provided by USDA NIFA Organic Research and Extension Initiative grant number 2011-51300-30697

2012-13 OREI Organic Spring Emmer Trial - All Locations

		Grain Yield (kg/h)						Test Weight		Lodg.	Ht (cm)	Head
Entry	Variety	FV	PA	WB	ND	Mean	Rank	kg/hl	Rank	Mean	Mean	Date
1	Bowman	2022	578	1907	2756	1816	11	44.7	9	4.4	107	6/23
2	*Bread 4**	*918*	*452*	*766*	*na*	*712*		*28.7*		*6.8*	*90*	*6/19*
3	Common-H	2019	598	2058	2505	1795	12	44.8	8	4.6	106	6/23
4	Common-M	2293	601	2263	2943	2025	8	46.0	7	3.5	110	6/23
5	Common-MC	2393	687	2193	3018	2073	6	46.8	5	3.4	110	6/23
6	Common-R	2222	508	2133	2621	1871	10	44.2	10	4.2	107	6/24
7	Debra	1554	1089	2747	2096	1872	9	69.1	1	0.6	65	6/15
8	Lucille	2820	802	3216	3581	2605	1	46.8	6	3.7	112	6/22
9	ND Common	2658	891	2984	3382	2479	4	47.7	3	4.4	112	6/23
10	*Neigel**	*751*	*448*	*1000*	*na*	*733*		*28.1*		*4.1*	*105*	*6/29*
11	PI254148	1693	669	3217	2643	2055	7	37.8	13	3.0	73	6/15
12	PI254162	1523	410	1778	3127	1709	13	39.1	12	5.8	87	6/17
13	*PI306535**	*2983*	*1223*	*4418*	*na*	*2875*		*46.6*		*2.8*	*113*	*6/21*
14	*PI538722**	*1108*	*352*	*1178*	*na*	*879*		*31.9*		*3.9*	*108*	*6/25*
15	Red Vernal	2550	839	3206	3589	2546	2	47.3	4	3.5	115	6/23
16	TM23	2255	438	2340	3757	2197	5	42.8	11	2.0	103	6/22
17	Vernal	2699	917	3050	3500	2541	3	48.1	2	3.0	111	6/22
18	*Yaroslav**	*1788*	*605*	*1194*	*na*	*1196*		*33.8*		*6.2*	*104*	*6/25*
	Mean	2014	673	2314	3040	1888		43.0		3.9	102	8/1

*PI306535 tested in 2012 only. Bread4, Neigel, PI538722, and Yaroslav tested in 2013 only.

Financial support provided by USDA NIFA Organic Research and Extension Initiative grant number 2011-51300-30697

2013 KWS Hybrid Rye Regional Trial

		Grain Yield (kg/h)						Test Wt (kg/hl)		Lodging	Height	Head	Wint	Septoria
	Entry	Sny	Ket	KgFy	OntCo	Mean	Rank	Mean	Rank	0-9	cm	Date	Surv.	0-9
1	Guttino	5583	5307	3053	4363	4576	14	65.3	11	2.0	113	5/22	87	2.7
2	Gonello	5935	5804	3162	6359	5315	10	66.4	4	2.0	109	5/22	94	2.3
3	Bellami	7259	6302	2607	6842	5752	4	66.1	5	2.0	114	5/23	96	2.0
4	Palazzo	6673	6037	3285	6974	5742	6	65.6	9	2.0	121	5/22	97	3.0
5	KWS Magnifico	6350	5639	3904	7331	5806	3	67.3	3	2.3	119	5/22	93	1.7
6	Brasetto (180 k/m2)	6211	5326	3918	5706	5290	12	65.2	12	2.0	115	5/22	91	3.3
7	Brasetto (200 k/m2)	6728	6222	3683	6355	5747	5	65.3	10	2.0	115	5/22	96	2.3
8	Brasetto (250 k/m2)	6253	5890	4440	6665	5812	1	65.7	8	2.0	117	5/22	96	2.0
9	KWS-H 119	6607	5950	3286	6668	5628	7	65.9	7	2.0	118	5/22	94	2.3
10	KWS-H 120	6963	5237	4422	6609	5808	2	67.8	1	2.0	118	5/22	97	2.0
11	KWS-H 124	6003	5729	3802	6818	5588	8	66.0	6	2.0	119	5/23	78	2.3
12	KWS-H 131	5911	5078	3522	6726	5309	11	65.1	13	2.0	118	5/22	90	3.0
13	KWS-H 132	6310	6260	3280	6382	5558	9	63.9	15	2.0	113	5/22	92	2.7
14	KWS-H 134	5545	5721	2458	6613	5084	13	63.4	16	2.0	119	5/23	86	3.0
15	Aroostok (Local ck)	2024	2461	1687	2436	2152	16	65.1	14	7.7	132	5/20	83	3.7
16	Medina (wheat ck)	4037	4176	1351	4115	3420	15	67.3	2	6.0	107	5/30	99	5.3
	Mean	5899	5446	3241	6060	5162		65.7		2.6	117	5/22	92	2.7
	CV	10.2	9.1	18.9	9.3									

M. E. Sorrells, D. Benscher, and J. Shiffer - Department of Plant Breeding & Genetics - Cornell University

Cornell University
Cooperative Extension
NWNY & CNY Teams, CCE Ulster County

Factors Influencing Malting Barley Winter Survival in 2014

Bill Verbeten, Kevin Ganoe, & Justin O'Dea: Agronomists Cornell Cooperative Extension
Gary Bergstrom: Professor of Plant Pathology, Cornell University
Mark Sorrells: Professor of Plant Breeding and Genetics, Cornell University

Figure 1: Malting Barley Winterkill

Source: Bill Verbeten

In 2014, approximately 50% of the winter malting barley suffered from partial or complete winterkill, *Figure 1*. Observations from Cornell Cooperative Extension agronomists across New York helped to ascribe the associations and causal factors listed below. When disease (primarily snow mold) was suspected, the presence or absence was confirmed in the Bergstrom lab. Barley is the weakest of the winter small grains other than oats and variability in winter survival was evident in subtle patterns within many fields.

Varietal tolerance: Heritability of barley to winter hardiness, like yield and quality, is a complex trait so it requires at least 3 years to make an accurate assessment of varietal tolerance. However, some winter malting varieties such as Archer, California, KWS Ariane, KWS Liga, KWS Scala, and experimental 6Ab08-X03W012-5 showed initial promise in one year of data by surviving relatively well through this past harsh winter.

Poor drainage: "Barley does not like wet feet." This was especially evident on heavier soils. In some cases winter malting barley survived only over the tile lines and died out in between, *Figure 2.*

Figure 2: Malting Barley Over Tile Lines

Source: Bill Verbeten

Lack of snow cover during extreme cold: Many fields that were sheltered by tree lines had improved survival and areas that had persistent snow cover. This trend appeared to be more common on north-facing slopes of winter malting barley fields. The extreme drops in temperatures well below 0°F without snow cover in January & February as well as below freezing temperatures during the early spring green up were very hard on all small grains, especially winter malting barley. Additionally, high winds likely dried out the plants, further weakening the winter malting barley stands.

Too early planting dates: A number of farmers had tall (over 6 inches) malting barley heading into the winter. This resulted in the barley smothering itself and, in a number of cases, snow mold (*Microdochium* nivale) was confirmed in these fields. Winter malting barley should be planted between September 15th and October 1st to minimize the fall growth of the crop while still having enough growing season to establish a good root system for winter survival.

Planting depth: Especially for barley sown late, planting depths greater than 1 inch were associated with better winter survival. Conversely, if planted deeply *too late*, there may not be sufficient fall barley growth due to the extra time needed to emerge from depth. Generally, Planting at 1-1.5 inch depth provides an opportunity to develop a better root system in fall. Deeper seeding can also help assure that there is adequate soil moisture for better establishment in dry fall soil conditions.

Shallow soils: Winter survival appeared worse for winter barley on coarser soils that contained more gravel or stones that prevented drills from achieving adequate seeding depth or where there may not have been enough soil for an extensive root system to form in fall.

Implications for farmers:

This past winter reiterated the importance of many factors influencing the potential of winter malting barley as a viable crop to support the emerging NY based-craft brewing and distilling industry. The occurrence of winterkill was considerably less in 2012 and 2013 due to milder conditions and/or greater snow cover across much of NY during those years. While research will continue to search for malting barley varieties that can consistently survive and thrive under our winter conditions, farmers should do everything they can to plant at the proper time, depth, and in better drained fields to increase the chances of winter survival. Additions of phosphorous fertilizer with the barley seed at planting, removing excess fall vegetative growth, and tiling of fields or wetter areas of fields will all improve the likelihood of winter survival. Furthermore farmers should only plant a portion of their malting barley acres to winter varieties and plan to also plant spring malting barley varieties to manage the risk associated with the winter survival.

Fungicides Registered for Control of Important Barley Diseases in New York

*Compiled by Gary C. Bergstrom, Cornell University (June 2014)

Fungicide(s)				Powdery mildew	Stagonospora blotch	Net blotch	Spot blotch	Scald	Rusts *(Puccinia spp.)*	Suppression of Fusarium head blight[1] Rate/A (fl. oz.)	Latest growth stage or days to harvest restriction / Aerial application in NYS?
Class	Active ingredient	Product	Rate/A (fl. oz) Foliar / stem diseases								
Strobi -lurin	Pyraclostrobin 23.3%	Headline SC	6.0 - 9.0	√	√	√	√	√	√	NL	Feekes 10.3 Yes, aerial appl.[2]
Triazole	Metconazole 8.6%	Caramba 0.75 SL	10.0 - 14.0	√	√	√	√	√	√	Good efficacy[1] 13.5 - 17.0	30 days Yes, aerial appl.
	Propiconazole 41.8%	Fitness 3.6 EC PropiMax 3.6 EC Tilt 3.6 EC	4.0 2.0 – 4.0 (early season suppression)	√	√	√	√	√	√	Poor efficacy[1] 4.0	45 days Yes, aerial appl.
	Prothioconazole 41%	Proline 480 SC	2.8 - 4.3	√	NL	√	√	√	√	Good efficacy[1] 5.0 - 5.7	32 days Yes, aerial appl.
	Prothioconazole19% Tebuconazole 19%	Prosaro 421 SC	6.5 - 8.2	√	NL	√	√	√	√	Good efficacy[1] 6.5 – 8.2	30 days No aerial appl.
Mixed class	Metconazole 7.4% Pyraclostrobin 12%	TwinLine 1.75 EC	7.0 – 9.0	√	√	√	√	√	√	NL	Feekes 10.5 No aerial appl.
	Fluxapyroxad 14.3 % Pyraclostrobin 28.6%	Priaxor	4.0 – 8.0	√	√	√	√	√	√	NL	Feekes 10.5 No aerial appl.
	Propiconazole 11.7% Azoxystrobin 7.0%	Avaris 200 SC Quilt 200 SC	10.5 - 14.0 7.0 – 14.0 (early season suppression)	√	√	√	√	√	√	NL	45 days Yes, aerial appl.
	Propiconazole 11.7% Azoxystrobin 13.5%	Quilt Xcel 2.2 SE	10.5 - 14.0 7.0 – 14.0 (early season suppression)	√	√	√	√	√	√	NL	45 days Yes, aerial appl.
	Prothioconazole 10.8% Trifloxystrobin 32.3%	Stratego YLD	2.3	√	√	√	√	√	√	NL	40 days No aerial appl.
	Tebuconazole 22.6% Trifloxystrobin 22.6%	Absolute 500 SC	3.3	√	√	√	√	√	√	NL	40 days No aerial appl.

[*] This information is provided as a guide for the convenience of barley producers in New York. Registrations are granted and withdrawn and labels are changed continuously. No endorsement is intended for products listed, nor is criticism meant for products not listed. It is the responsibility of the pesticide applicator by law to read and follow all current label directions and restrictions. A √ mark indicates that control of a disease is included on the product label whereas NL indicates it is not a labeled use.

[1] Statements of relative efficacy for suppression of Fusarium head blight severity and reduction of contamination of grain by the mycotoxin, deoxynivalenol, are based on consensus research observations by members of the USDA-NIFA Committee on Management of Small Grain Cereals (NCERA-184); members of NCERA-184 assume no liability resulting from use of these products.

[2] Aerial application is allowed except within 100 feet of an aquatic habitat.

[3] A supplemental Special Local Needs label must be in the possession of the applicator for use of Priaxor in New York; this product is not for sale, distribution, or application in Nassau or Suffolk Counties.

2014 Wintmalt Barley Fungicide/ Biocontrol Test
Musgrave Farm, Aurora, NY

J.A. Cummings, G.C. Bergstrom, R.J. Richtmyer, and R.R. Hahn

	Treatment:	Appl @ GS 9 (Flag Lf ligule)	Appl @ GS 10.5 (Heads emerged)
1	Nontreated	none	none
2	Caramba	none	Caramba 13.5 fl oz & NIS 0.125%
3	Aproach followed by Caramba	Aproach 9 fl oz	Caramba 13.5 fl oz & NIS 0.125%
4	Priaxor followed by Caramba	Priaxor 4 fl oz	Caramba 13.5 fl oz & NIS 0.125%
5	Twinline followed by Caramba	Twinline 9 fl oz	Caramba 13.5 fl oz & NIS 0.125%
6	Prosaro	none	Prosaro 6.5 fl oz & NIS 0.125%
7	Champ WG followed by Champ WG	Champ WG 1.06 lb	Champ WG 1.06 lb
8	Taegro followed by Taegro	Taegro 5.2 g	Taegro 5.2 g

USWBSI UFT Protocol, four reps
Inoc all plots with F. graminearum conidia at GS 10.5