2018 Wisconsin Oats & Barley Performance Tests

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The Wisconsin oat and barley performance trials are conducted each year to serve Wisconsin growers. Trials include released varieties, experimental lines from Wisconsin and Midwestern states, and lines from private companies. The main objective of these trials is to obtain data on how varieties perform in different locations and years. Growers can use this data to choose the best varieties to plant in their area. Breeders use this information to decide whether to release a new variety and to select parents to make new crosses.

The best varieties for yield performance, disease resistance and quality are entered into the Wisconsin Certification Program. As new varieties are released to the public, older varieties with inferior qualities are removed from the recommended list and eventually dropped from the certified list as seed production declines. Additionally, varieties that perform well from other states may be recommended and/or certified in Wisconsin.

Occasionally varieties are certified without being recommended to Wisconsin growers. These varieties may include commercial varieties developed by private seed companies or varieties where there is a substantial market for Wisconsin-produced seed. Thus, in Wisconsin, recommendation and certification are different things. Recommended varieties are those with superior in-state production performance

Variety Selection

Factors to consider when selecting oat and barley varieties include grain yield, maturity, straw strength (or resistance to lodging), disease resistance and grain quality characteristics such as test weight. Barley growers should also consider whether a variety is acceptable for malting, Several varieties are also evaluated for forage yield and quality.

Variety Testing

Varieties in the trials are selected based on current demand, availability, and adaptation to Wisconsin's climate. Most of these varieties are commercially available. Several commercial and public varieties are regularly tested for comparison.

Tests were conducted at eight locations during the 2018 growing season using conventional tillage practices. The goal is to have a stand of 1.3 million plants per acre for both species. Therefore, the seeding rate was 1.47 million seeds per acre. Agronomic practices at all locations are listed in Table 1. All experiments were conducted in randomized complete block designs with four replications for grain yield and three for forage.

Growing conditions

2018 season. Wisconsin oat production was estimated at 6.5 million bushels. The area planted with oats was 210,000 acres, while the area harvested was 100,000 acres, which was a slight increase compared to 2017 (5.2%). Oat yield was 65 bushels per acre, which was similar to the average yield obtained in the last three years (Table 2). However, most of our trials had lower grain yields than in previous years.

Wisconsin barley planted area was 48,000 acres and the estimated harvest area was 33,000 acres. The planted area was 72% more than 2015 and the estimated harvest area is 120% higher than in 2015 (Table 2).

The weather was characterized by being wetter than usual, with a cold spring but with heat stress at the end of May. Higher precipitation was recorded for Wisconsin with twice the normal amount of rain in May and June (4.6 and 3.6 inches above normal in Madison). Low temperatures were recorded during April accompanied by snowfall after mid-April in several areas of the State, which delayed or limited planting and emergence. This was followed by extremely hot temperatures at the end of May (above 90 F in Madison) which caused heat stress.

2017 season. Wisconsin oats production was estimated at 6.08 million bushels, which was 57% less than the record high in 2015. The area planted with oats was 180,000 acres, and the area harvested was 95,000 acres. Oats yield was 64 bushels per acre, down 2 bushels from 2016, and 8 from 2015.

2016 season. Wisconsin oats production was estimated at 6.6 million bushels, which was 53% less than the record high in 2015. The area planted with oats was 210,000 acres, and the area harvested was 100,000 acres. Oats yield was 66 bushels per acre, down six bushels from 2015. Source: USDA National Agricultural Statistics Service

Performance evaluation

Grain yield. Plots were harvested and threshed with a combine harvester in Madison, Arlington, Chilton, Antigo, and Sturgeon Bay; seed was dried and later cleaned. The other locations harvested bundles of plants that were dried and threshed. Yields are reported in bushels per acre at 14% moisture content and corrected for individual plot plant stand counts. All the analysis are reported in bushels per acre. There are 32 pounds per bushel of oats and 48 pounds per bushel of barley (Table 4 and 5).

Test weight. Test weight was measured with a Cox funnel using a 0.5 liter (L) measuring cup. All analysis were conducted in g 0.5 L^{-1} and transformed to pounds per bushel following seed trade recommendations. Test weight is reported in pounds per bushel (Table 3).

Maturity. Maturity was evaluated by recording the date that 50% of the plants in a plot headed. Maturity is reported by date using the three-year average of the eight locations (Table 3).

Plant height. Plant height is measured from the base of the plant to the tip of the panicle after heading. All analysis were conducted in centimeters and transformed to inches. Plant height is reported in inches using the three-year average of the eight locations (Table 3).

Disease resistance. Disease resistance was evaluated as a combination of incidence and severity for crown rust where 0

is no disease present and 9 is all plants affected up to the flag leaf (Table 3). Disease resistance is evaluated on a categorical scale: R=excellent resistance, MR=moderate or good resistance, MS=moderate susceptible, and S = susceptible or poor resistance. Please note that the reporting method changed from previous reports to make them comparable to other states' reports. Please also note that an update of resistance status of all varieties is provided using combined data from Wisconsin and from other States.

Lodging. Lodging was measured in percentage, where 0% is no lodging and 100% is severe lodging where all the plants in the plot are lodged (Table 3). We now report lodging percentages instead of a scale to make varieties comparisons easier.

Forage dry matter. An area of 2x3 ft. was hand-harvested at 2 inches above ground and dried. The weight of the sample was transformed to tons per hectare prior to analysis. Yield is reported in tons per acre (Table 6 and 7). Madison and Arlington are the only locations used for forage trials.

Forage quality. Forage quality was evaluated at the UW Soil and Forage Analysis. Relative forage quality (RFQ), percent of crude protein (CP%), and total milk production in tons per acre is reported (Table 6 and 7).

Licensed varieties

The Wisconsin Agricultural Experimental Station and/or the UW-Madison Department of Agronomy has granted sole authority to the Wisconsin Crop Improvement Association to issue formal licenses for the production of certified seed of Kewaunee barley, Spooner rye; and Badger, Dane, ForagePlus, Gem, and Vista oats. The Wisconsin Alumni Research Foundation has granted sole authority to the Wisconsin Crop Improvement Association to issue formal licenses for the production of certified seed of Drumlin, Esker, Kame, Moraine, Ron, BetaGene™, Antigo, and Laker oats.

These grants of sole authority are intended to reinforce Plant Variety Protection (PVP) regulations and to generate research and development funds for the Wisconsin cereals breeding program. These varieties are PVP protected and a license is required for seed production. Each bag of seed will have a special red and white PVP/Licensed Variety tag attached or preprinted on the bag.

Testing agencies

The cereal breeding variety tests were conducted by the Department of Agronomy, College of Agricultural and Life Sciences, University of Wisconsin-Madison in cooperation with the Wisconsin Crop Improvement Association.

Authors

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Table 1. Location and management practices of cereal grain variety trials in Wisconsin in 2018.

Location	County	Cooperators	Row spacing	Previous crop	Average N (lb /A)	Planting date	Weed control	Harvest date	Number of genotypes
Alma	Buffalo	C. Duley	7 inches	Soybean	30	29-Apr	Affinity BroadSpec	9-Aug	30
Antigo	Langlade	S. Zimmerman	6 inches	Potato	0	15-May	2.4D + Harmony Extra	8-Aug	30
Arlington	Columbia	P. Lemahieu, M. Bertram	6 inches	Alfalfa	0	26-Apr	2.4D + Harmony Extra	29-Jul	45
Chilton	Calumet	R. Kolbe	6 inches	Barley	0	16-May	2.4D + Harmony Extra	9-Aug	30
Lancaster	Grant	D. Wiedenbeck	6 inches	Soybean	30	15-Apr	None	24-Jul	30
Madison	Dane	J. Hedtcke	6 inches	Soybean	0	12-Apr	2.4D + Harmony Extra	25-Jul	45
Spooner	Washburn	P. Holman	6.6 inches	Soybean	22.5	25-Apr	2.4D + Buctril	31-Jul	30
Sturgeon Bay	Door	M. Stasiak	6 inches	Oat/Pea mix	0	16-May	2.4D + Harmony Extra	9-Aug	30

Table 2. Historical areas, production, and yield of oats and barley in Wisconsin.

	Oats				Barley			
	Area planted (acres)	Area harvested (acres)	Total (million bu)	Yield (bu/A)	Area planted (acres)	Area harvested (acres)	Total (million bushels)	Yield (bu/A)
2018	210,000	100,000	6.50	65	48,000	33,000	--	--
2017	180,000	95,000	6.08	64	--	--	--	--
2016	210,000	100,000	6.60	66	--	--	--	--
2015	280,000	195,000	14.00	72	28,000	15,000	0.83	55
2014	255,000	140,000	8.68	62	26,000	16,000	0.75	47
2013	255,000	105,000	6.83	65	33,000	16,000	0.78	49

-- Information not available. Source: USDA National Agricultural Statistics Service www.nass.usda.gov

Table 3. Grain oats variety description.

Variety	Origin	Release year	Kernel color	Maturity date[a]	Ht[b] (in.)	Lodging (%)[c]	Test Wt[d] (lb/bu)	Kernel protein	Crown rust[e]	Stem rust[f]	Septoria[f]	Smut[f]	BYDV[g]	Licensed/ PVP[h]	Wis. cert.
Recommended															
Antigo	WI	2017	yellow	19-Jun	35	17	41.9	med/high	MR	S	--	MR	MR	yes	yes
Badger	WI	2010	yellow	19-Jun	33	21	37.5	med	S	R	MR	R	R	yes	yes
Betagene	WI	2014	yellow	22-Jun	32	24	37.3	--	MR	--	--	--	MR	yes	yes
Deon	MN	2013	yellow	27-Jun	34	29	39.3	med	MR	--	R	R	R	yes	yes
Esker	WI	2004	yellow	22-Jun	34	22	36.9	med	MS	MS	MR	R	R	yes	yes
Hayden	SD	2014	white	23-Jun	35	39	39.7	--	MS	MS	--	R	MR	yes	yes
Horsepower	SD	2012	yellow	22-Jun	31	38	36.6	med	S	R	MR	R	MR	yes	yes
Ron	WI	2014	yellow	25-Jun	34	23	35.0	med	MR	--	R	R	MR	yes	yes
Shelby 427	SD	2009	white	21-Jun	37	37	37.7	med/high	MS	MS	MR	MR	MR	yes	yes
Other varieties															
Dane	WI	1990	yellow	18-Jun	35	32	35.6	med	S	MR	S	R	S	yes	yes
Vista	WI	1999	yellow	26-Jun	35	32	37.8	low	MS	R	MS	R	MR	yes	yes
Ogle	IL	1981	yellow	22-Jun	36	28	35.4	low	S	S	S	S	R	no	yes

[a] Maturity (month-day) as heading date evaluated in 21 Wisconsin trials in 2016-2018. [b] Plant height (inches) at maturity evaluated in 21 Wisconsin trials 2016-2018. Note that 2018 was an unusual year for plant height and several locations had shorter plants. [c] Lodging (percentage) evaluated in 21 Wisconsin trials in 2016-2018. [d] Test weight (lb/bu) evaluated in 21 Wisconsin trials in 2016-2018. [e] Crown rust disease resistance based on Madison and Arlington trials in 2018: R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible. Due to the high mutation rate of the pathogen, only 2018 data was used for crown rust reports. [f] Because disease expression varies from year to year, and cannot be scored every single year, historical data was used to assign disease resistance to stem rust, septoria, and smut. [g] Barley yellow dwarf virus or red leaf disease resistance (BYDV): R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible. Please note that the labels have changed from previous year evaluations. Additionally, please note that none of the varieties were labeled as fully resistant. BYDV scores are based on evaluations conducted in Illinois. [h] PVP=Plant Variety Protection or licensed seed production. A "yes" indicates that these varieties can't be grown and sold as seed without certification. inP= PVP application in process. -- Information not available.

Table 4. Grain yield performance of oats varieties for the 2018 growing season and an average for 3 years (2016, 2017, and 2018)[a].

	Grain yield (bu/A)[b]																	
	Alma		Antigo		Arlington		Chilton		Lancaster		Madison		Spooner		Sturgeon Bay		Overall[c]	
Variety	2018	3-yr	2018	3-yr	2018	3-yr	2018	2-yr[a]	2018	3-yr	2018	3-yr	2018	3-yr	2018	3-yr	2018	3-yr
Antigo	72	-	67	-	168*	166*	77*	118*	58	59	121*	130*	69	63	56	54	86*	98*
Badger	49	-	75*	-	125	140	66	123*	78	79	71	97	48	56	62*	69*	72	94
Betagene	95*	-	65	-	129	170*	83*	128*	80*	80*	97	110	91*	82*	65*	69*	88*	107*
Dane	91*	-	80*	-	124	126	58	100	82*	80*	64	75	74	61	59	62*	79	84
Deon	104*	-	70*	-	184*	167*	88*	136*	77	75	133*	118*	88*	86*	73*	68*	102*	108*
Esker	66	-	69*	-	138	150*	67	126*	65	63	80	104	81*	76	68*	68*	79	98*
Hayden	90*	-	80*	-	119	147	76*	132*	72	70	106	114*	79	82*	65*	69*	86*	102*
Horsepower	58	-	65	-	68	96	57	115	56	55	46	86	63	67	69*	59*	60	80
Ogle	77	-	59	-	84	115	64	106	81*	79*	70	94	92*	80*	64*	65*	74	90
Ron	73	-	76*	-	152	158*	59	98	93*	91*	92	110	74	71	64*	66*	85*	99*
Shelby427	62	-	76*	-	114	124	72	111	61	60	85	104	80	66	66*	62*	77	88
Vista	69	-	71*	-	115	104	86*	110	96*	92*	56	75	102*	68	68*	62*	83	85
Trial mean[d]	81.0	-	67.8	-	133.6	143.7	74.5	120.3	78.5	75.4	89.7	104.6	81.2	69.0	65.5	63.5	84.0	95.7
Trial standard error	19.9	-	6.6	-	6.6	11.1	6.4	14.5	6.3	5.9	6.9	13.3	7.0	7.0	4.9	5.7	7.6	11.3
LSD	26.1	-	12.9	-	18.6	21.6	16.6	20.4	19.6	19.7	23.1	17.6	21.6	15.7	12.6	13.9	20.2	11.5

[a] Chilton trials were conducted recently in only two years (i.e. 2017 and 2018), therefore, 2-Year means are presented instead of 3-Year means. [b] Varieties that are not significantly different ($P<0.05$) from the highest yielding variety in the trial are marked with an asterisk (*). These analyses refer to a Fisher's Least Significant Difference (LSD) test. [c] The overall performance is provided for completeness; however we advise caution in selecting varieties by the overall yield for Wisconsin because of the large genotype by environment interaction present. The three-year average for a nearby location is probably a better predictor of the performance of a variety in a particular area. [d] This is the trial's mean average that includes the varieties in the table and some additional elite experimental lines. It is not just the average of these varieties. -- Information not available

Table 5. Grain yield performance and heading date of **barley varieties** in the 2018 Wisconsin growing season at seven locations.

		Grain yield (bu/A)[a]							
Variety	Heading date	Antigo	Arlington	Chilton	Lancaster	Madison	Spooner	Sturgeon Bay	2018
Kewaunee	14-Jun	79	120*	19	34*	88*	46	44	61*
Pinnacle	16-Jun	74	88	14	25	71	41	29	49
Quest	14-Jun	77	110	26*	35*	95*	47	33	60*
Rasmusson	13-Jun	77	122*	18	33*	88*	45	35	60*
Trial Mean	--	76.7	110.1	19.6	31.5	85.2	44.8	35.0	57.6
Trial Standard Error	--	4.0	4.0	4.1	4.0	4.0	4.0	4.0	2.0
LSD	--	14.5	10.0	4.7	8.6	11.8	11.2	16.8	8.1

[a] Varieties that are not significantly different (P<0.05) from the highest yielding variety in the trial are marked with an asterisk (*). These analyses refer to a Least Significant Difference test.
-- Information not available.

Table 6. Forage dry matter yield and quality of **spring oat varieties** harvested at the booting stage at two locations in 2018.

	Arlington[a]						Madison[b]					
Variety	Booting date	Heading date	Dry biomass (ton/A)	Relative forage quality	Crude protein (%)	Milk (ton/A)	Booting date	Heading date	Dry biomass (ton/A)	Relative forage quality	Crude protein (%)	Milk (ton/A)
ForagePlus	11-Jul	17-Jul	2.8	119	12	2.8*	27-Jun	6-Jul	1.3*	141	12.4	3.1
Goliath	3-Jul	10-Jul	2.6	126*	13*	2.9*	20-Jun	1-Jul	0.8*	151	13.2*	3.2
Laker	8-Jul	12-Jul	2.8	109	12	2.6	23-Jun	3-Jul	1.0*	150	14.1*	3.2
Trial Mean	7-Jul	12-Jul	2.8	113.3	12.1	2.7	23-Jun	2-Jul	1.3	131.6	11.5	2.9
Trial Standard Error	0.7	0.7	0.5	9.5	1.0	0.17	0.8	0.9	0.5	4.6	0.7	0.07
LSD	2.1	2.1	0.4	10.2	1.0	0.20	2.1	2.4	0.5	11.5	1.5	0.23

[a] The Arlington trial was planted on May 17th. An experiment planted April 19th was lost due to flooding.
[b] The Madison trial was planted on April 10th. The first replication of this experiment was lost due to lodging.
Varieties that are not significantly different (P<0.05) from the highest performing variety in the trial are marked with an asterisk (*). These analyses refer to a Least Significant Difference test.

Table 7. Forage dry matter yield and quality of **spring barley varieties** harvested at the booting stage at two locations in 2018.

	Arlington[a]						Madison[b]					
Variety	Booting date	Heading date	Dry biomass (ton/A)	Relative forage quality	Crude protein (%)	Milk (ton/A)	Booting date	Heading date	Dry biomass (ton/A)	Relative forage quality	Crude protein (%)	Milk (ton/A)
Hays	5-Jul	12-Jul	2.1	125	12.8*	2.9	16-Jun	01-Jul	0.9	162	14.8	3.4*
Kewaunee	1-Jul	6-Jul	1.8	131	13.7*	3.0	12-Jun	18-Jun	0.6	181*	16.4*	3.6*
Westford	8-Jul	12-Jul	2.3	130	11.8	3.0	19-Jun	30-Jun	1.7	118	9.5	2.7
Trial Mean	7-Jul	12-Jul	2.8	113.3	12.1	2.7	23-Jun	2-Jul	1.3	131.6	11.5	2.9
Trial Standard Error	0.7	0.7	0.5	9.5	1.0	0.17	0.8	0.9	0.5	4.6	0.7	0.07
LSD	2.1	2.1	0.4	10.2	1.0	0.20	2.1	2.4	0.5	11.5	1.5	0.23

[a] The Arlington trial was planted on May 17th. An experiment planted April 19th was lost due to flooding.
[b] The Madison trial was planted on April 10th. The first replication of this experiment was lost due to lodging.
Varieties that are not significantly different (P<0.05) from the highest performing variety in the trial are marked with an asterisk (*). These analyses refer to a Least Significant Difference test.