2020 Oat and Barley Performance Tests

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The Wisconsin oat and barley performance trials are conducted each year to serve Wisconsin farmers. 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. Farmers can use this data to help choose the best varieties to plant, and breeders to decide on 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, good performing varieties from other states may be recommended and/or certified in Wisconsin.

Occasionally varieties are certified without being recommended to Wisconsin farmers. 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 records, while certification provides assurance of seed purity and seed quality.

Variety selection

Factors to consider when selecting oat and barley varieties include grain or biomass yield, maturity, straw strength (or resistance to lodging), disease resistance, and grain or forage quality. Barley farmers who are interested in selling their grain to the brewing industry should also consider whether a variety is acceptable for malting. Oat farmers who are interested in selling their grain to the milling industry should also consider grain quality in the form of test weight, grain size and plumpness, groat percentage, and percentage of thins. Test weight is also relevant for oats sold as feed.

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 five locations during the 2020 growing season using conventional tillage practices. The goal was to have a stand of 1.3 million plants per acre. Agronomic practices at all locations are listed in Table 1. All experiments were conducted in randomized complete block designs with four replications.

2020 Growing season

Wisconsin oat production in 2020 was estimated at 5.49 million bushels, the area planted with oat was 300,000 acres, and the area harvested was 131,000 acres, which was an increase of 13% and 9% respectively compared to 2019. During the last three years, the oat planted and harvested area have been increasing on average 18% and 11% respectively. Oat estimated grain yield was 63 bushels per acre, an increase of 17% in comparison to the production obtained in 2019 (Table 2).

Wisconsin barley planted area in 2020 was 26,000 acres and the estimated harvest area was 13,000 acres. The planted area had an increase of 8%, while the harvested area had an increase of 6% in comparison to 2019 (Table 2). Barley estimated yield was 46 bushels per acre in 2020 which was not different from the year 2019.

The 2020 growing season was characterized by a dry spring with lower precipitation and above average temperature. This created a larger variability in sowing dates among locations and in general, later planting dates than average. The precipitations in April (1.44"), May (4.8"), June (4.33"), and July (5.6") had deviations of -0.77", -1.6", +0.8", and +1.41" respectively in comparison to historical averages at Arlington WI. Lower precipitation combined with higher temperatures in April and May affected plant emergence and early development of the crop. The dryer weather in combination with several days of extreme high temperatures the last week of May were the most likely causes of reduced tillering in both barley and oat. There was also a lower infection rate of crown rust in oat.

The 2020 growing season was an unusual year due to the COVID-19 pandemic. Due to heavy restrictions in travel for research activities, several testing locations could not be planted. Therefore, only five of the eight locations could be evaluated. Additionally, forage testing trials could not be planted due to the labor required.

Table 1. Location and management practices of small grain variety trials in Wisconsin in 2020.

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	21-Apr	Huskie 13	31-Jul	40
Antigo	Langlade	S. Schumitsch	6 inches	Green Bean	50	11-May	MCPA + Harmony E.	6-Aug	40
Lancaster	Grant	D. Wiedenbeck	6 inches	Soybean	16	26-Apr	Harmony SG	29-Jul	40
Madison	Dane	J. Hedtcke	6 inches	Soybean	0	04-Apr	2-4-D + Low Vol 4	25-Jul	60
Spooner	Washburn	P. Holman	6.6 inches	Soybean	50	23-Apr	2.4D + Buctril	5-Aug	40

2019 season. Wisconsin oats production in 2019 was estimated at 6.48 million bushels, the area planted with oats was 265,000 acres, and the area harvested was 120,000 acres, which was an increase on area compared to 2018 (20%). Oats yield was 54 bushels per acre, which was 17% lower than production obtained in the last three years (Table 2). Wisconsin barley planted area in 2019 was 24,000 acres and the estimated harvest area is 8,000 acres. The planted area was 50% less than 2018 and the estimated harvest area was 76% less than in 2018 (Table 2). The 2019 growing season was characterized by a cold and wet spring with higher than average precipitation and lower than average temperature. Although average temperatures for April (46.6 °F), May (55.9 °F), June (66.6 °F) and July (75.2 °F) had small deviations of +0.3 °F, +1.4 °F, -0.4 °F and +3.9 °F respectively from historical values, lowest temperatures recorded during April were accompanied by snowfalls in several areas of the state which delayed or limited the start of emergence. This created a larger variability in sowing dates among locations and later planting dates than average. The precipitations in April (3.22"), May (6.17"), June (5.16"), and July (5.77") had deviations of -0.18", +2.62", +0.62", and +1.59" respectively in comparison to historical averages.

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

	Oats				Barley			
	Area planted (acres)	Area harvested (acres)	Total (million bushels)	Yield (bu/A)	Area planted (acres)	Area harvested (acres)	Total (million bushels)	Yield (bu/A)
2020	**300,000**	**131,000**	**5.49**	**63**	**26,000**	**13,000**	**0.59**	**46**
2019	265,000	120,000	6.48	54	24,000	8,000	0.37	46
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

-- 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[a] date	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	22	32.3	27	46	med/high	MR	S	--	MR	MR	yes	yes
Badger	WI	2010	yellow	22	31.1	34	42	med	S	R	MR	R	S	yes	yes
Betagene	WI	2014	yellow	25	33.5	30	42	--	MS	--	--	--	MR	yes	yes
Deon	MN	2013	yellow	29	36.6	35	43	med	R	--	R	R	R	yes	yes
Esker2020	WI	2020	yellow	23	34.6	26	42	med/high	MR	MR	--	R	MR	yes	inP
Hayden	SD	2014	white	27	33.9	35	44	med/high	MS	MS	--	R	MR	yes	yes
MN-Pearl	MN	2019	White	29	35.4	--	42	med/high	MR	MR	--	MR	MR	yes	yes
Ron	WI	2014	yellow	27	35.8	35	42	med	S	--	R	R	MR	yes	yes
Rushmore	WI	2014	yellow	25	34.6	--	46	high	MR	--	--	R	MR	yes	yes
Shelby 427	SD	2009	white	25	35.4	40	43	med/high	MS	MS	MR	MR	MR	yes	yes
Other varieties															
Esker	WI	2004	yellow	25	34.3	29	39	med	MS	MS	MR	R	R	yes	yes
Horsepower	SD	2012	yellow	25	33.5	54	38	med	S	R	MR	R	MR	yes	yes
Ogle	IL	1981	yellow	26	33.9	32	38	low	S	S	S	S	R	yes	yes
Vista	WI	1999	yellow	28	35.0	41	39	low	S	R	MS	R	MR	yes	yes

[a] Maturity (day in June) as indicated in 15 Wisconsin tests conducted 2018-2020. [b] Height (inches) at maturity in 15 Wisconsin tests conducted 2018-2020. Plants were significantly shorter in 2020 due to extreme environmental conditions. [c] Lodging in 21 Wisconsin tests conducted 2017-2019, no lodging was observed in 2020. [d] Test weight (lb per bu) in 5 Wisconsin tests conducted 2020. [e] Crown rust disease resistance: R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible. Due to the high mutation rate of the pathogen, 2018-2020 data were 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. [h] PVP=Plant Variety Protection or licensed seed production. A "yes" indicates that these varieties cannot be grown and sold as seed without certification. inP = PVP application in process. -- Information not available.

2018 season. Wisconsin oat production was estimated at 6.5 million bushels, which was 53.5% less than the record high in 2015. The area planted with oat was 210,000 acres, and the area harvested was 100,000 acres. Oat yield was 65 bushels per acre, up one bushel from 2017, but down 1 bushel from 2016, and 7 from 2015. Wisconsin area planted with barley was 48,000 acres, and the area harvested was 33,000 acres. This represented a record on the planted area for barley in Wisconsin. Source: USDA National Agricultural Statistics Service

Performance evaluation

Grain yield. Plots were harvested and threshed with a combine harvester in Antigo, Alma, and Madison; seed was dried and later cleaned. Lancaster and Spooner locations were harvested in bundles of plants that were dried and threshed. Yields are reported in bushels per acre at 12% moisture content. The analysis was conducted in bushels per acre. There are 32 pounds per bushel of oat and 48 lbs 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 and weighing in grams. All data was transformed to pounds per bushel following seed trade recommendations and all analyses were conducted in lb/bu. 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 all locations (Table 3).

Plant height. Plant height is measured from the base of the plant to the tip of the panicle after heading in oat and to the tip of the spike without awns in barley. The analysis was conducted in centimeters and transformed to inches. Plant height is reported in inches using the three-year average of all locations (Table 3).

Disease resistance. Disease resistance was evaluated as a combination between incidence and severity, where 0 is no disease present and 9 is all plants affected up to the flag leaf (Table 3). Disease severity is later transformed to disease resistance as follows: 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. Disease resistance in all varieties is eventually overcome by the pathogen variability, and therefore, only the most recent years are used for the report.

Lodging. Lodging was measured in percent, where 0% is no lodging and 100% is severe lodging (Table 3).

Table 4. Grain yield (bushels per acre) performance of oat cultivars in the 2020 growing season and an average for three years (2018, 2019, and 2020).

	Grain yield (bu/A)											
	Alma		Antigo		Lancaster		Madison		Spooner		Overall[b]	
Variety	2020[a]	3-yr[a]	2020[a]	3-yr[a]	2020[a]	3-yr[a]	2020[a]	3-yr[a]	2020[a]	3-yr[a]	2020[a]	3-yr[a]
Antigo	103.3	89.3	49.6	53.8	86.6	75.4	87.5	99.8	52.5	63.1	77.5	77.4
Badger	92.3	64.1	44.3	53.2	**104.7***	**94.7***	76.4	87.3	43.3	66.8	72.7	71.5
Betagene	101.7	94.9	52.5	61.3	**102.9***	89.5	107.9	96.9	63.0	78.2	86.2	86.3
Deon	89.2	93.7	**96.4***	**79.4***	90.7	87.2	**118.5***	**110.8***	67.2	**93.1***	86.1	93.2
Esker	**90.6***	**74.4***	56.1	57.0	**100.2***	93.7	83.1	**86.0***	52.3	73.4	75.7	**77.1**
Esker2020	**113.1***	**109.4***	56.9	70.2	**105.4***	**100.6***	107.9	**110.9***	48.7	79.1	85.5	**97.8***
Hayden	91.7	83.8	54.4	69.8	98.2	91.5	99.4	97.9	62.8	75.6	80.9	83.7
Horsepower	61.9	48.8	52.9	52.9	83.9	71.9	88.2	82.1	**76.0***	76.9	71.1	64.0
MN-Pearl	98.7	--	71.3	--	**109.8***	--	**112.8***	--	**72.3***	--	**93.1***	--
Ogle	83.0	77.6	46.4	48.5	94.1	84.9	81.0	79.7	70.6	75.8	75.9	74.1
Ron	97.1	81.2	65.3	70.2	98.5	87.5	94.5	93.8	**79.6***	75.4	86.1	83.8
Rushmore	102.0	--	50.6	--	**101.1***	--	**119.7***	--	66.1	--	90.8*	--
Shelby427	66.0	59.6	46.5	59.0	85.2	77.4	84.4	86.7	70.9	84.3	70.1	74.6
Vista	78.9	78.5	41.1	47.2	**105.3***	**97.8***	96.7	86.8	66.9	85.5	79.4	79.4
Trial mean[c]	98.1	87.6	59.3	66.3	96.4	87.6	101.2	99.4	61.4	77.2	82.7	85.3
Trial standard error	0.8	0.6	0.4	0.5	1.0	0.6	0.6	0.4	0.8	0.5	0.4	0.4
LSD	8.3	5.7	4.1	4.7	10.2	5.9	7.0	5.8	8.2	5.4	4.5	3.1

[a] Varieties that are not significantly different (P<0.05) from the highest yielding variety in the trial are marked with a star (*). These analyses refer to a Fisher's Least Significant Difference (LSD) test. [b] 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. [c] The trial mean average that includes the varieties in the table and additional elite experimental lines is provided. It is not just the average of these varieties. -- Information not available

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 oat. 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, Esker2020, Kame, Moraine, Ron, BetaGeneTM, Antigo, and Laker oat.

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.

Even though some of the varieties might be released without a certification requirement, PVP regulations protect those varieties. Therefore, proper tags and naming of the varieties, as well as royalty collection is required. A PVP variety cannot be legally sold as variety non-stated (VNS).

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.

Table 5. Grain yield (bushels per acre) performance and maturity date of barley varieties in the 2020 growing season at five locations in Wisconsin.

		Grain yield (bu/A)[a]										
		Alma	Antigo		Lancaster		Madison		Spooner		Overall	
Variety	Maturity[b]	2020	2020	2-yr	2020	2-yr	2020	2-yr	2020	2-yr	2020	2-yr
AAC Synergy	4-Jul	37.0	18.3	31.9	39.9	46.8	56.0	30.7	40.9	75.6	42.0	47.4
AC Metcalfe	4-Jul	33.5	11.4	21.7	34.4	42.2	44.9	21.8	28.4	63.3	34.3	35.8
CDC Copeland	5-Jul	21.8	12.8	19.8	26.3	35.8	41.5	21.1	21.3	58.3	30.1	30.2
Conlon	27-Jun	22.5	17.9	30.3	34.2	43.7	45.1	25.7	33.4	75.7	36.7	40.0
Kewaunee	**23-Jun***	42.6	23.1	**44.3***	45.4	**56.1***	**57.4***	**48.2***	**44.8***	**103.4***	**54.4***	**53.2***
LCS Genie	4-Jul	15.5	9.1	5.5	19.6	25.8	34.1	20.6	24.1	43.7	23.0	25.4
ND Genesis	2-Jul	35.3	**31.1**	32.6	41.6	41.9	46.6	42.3	39.9	96.6	49.6	47.1
Pinnacle	30-Jun	32.8	22.3	29.7	40.6	43.4	48.8	30.2	33.7	73.2	40.2	42.3
Quest	**24-Jun***	37.3	23.5	**44.6***	43.1	44.1	**57.1***	34.2	39.3	92.3	46.5	50.9*
Rasmusson	25-Jun	**54.7***	24.9	**41.8***	**58.5***	44.3	55.4	40.1	**46.4***	**101.0***	**52.6***	**54.5***
Trial Mean[c]	29-Jun	33.3	19.4	30.2	38.4	42.4	48.7	31.5	35.2	78.3	40.9	42.7
Trial Standard Error	0.3	0.8	0.4	0.9	0.8	0.7	0.1	0.6	0.8	0.6	0.0	0.5
LSD	1.3	4.1	2.2	6.6	4.0	5.4	0.6	4.4	4.2	4.3	3.5	6.7

[a] Varieties that are not significantly different ($P<0.05$) from the highest yielding variety in the trial are marked with a star (*). These analyses refer to a Fisher's Least Significant Difference (LSD) test. [b] Maturity (month-day) as indicated in 10 Wisconsin tests conducted 2019-2020. 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. [c] The trial mean that includes the varieties in the table and some additional elite experimental lines is provided. It is not just the average of these varieties. -- Information not available.

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