

# 2023 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 can use it to decide whether to release a new variety or not and to select parents to make new crosses.

The best varieties for yield, 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 from other states that perform well 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 assures seed purity and seed quality.

## Variety selection

Factors to consider when selecting grain oat and barley varieties include grain yield, maturity, straw strength (or resistance to lodging), disease resistance, and grain quality (Tables 3-6). 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. Finally, some oat and barley varieties are evaluated for forage yield and quality (Tables 7 and 8). Barley farmers who are interested in selling varieties for malt may also consider whether a variety is acceptable to the malting industry.

## 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 purposes.

Tests were conducted at six locations during the 2023 growing season using conventional tillage practices and a plant stand of 1.3 million plants per acre goal. Agronomic



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practices at all locations are listed in Table 1. All experiments were conducted in randomized complete block designs with four replications. The Spooner trial was lost due to severe drought conditions and data from that location is therefore not reported for the 2023 year.

## 2023 Growing season

Wisconsin oat production in 2023 was estimated at 4.6 million bushels, the area planted with oat was 135,000 acres while the area harvested was 75,000 acres, which represents a reduction of 4% and 33% respectively compared to 2022 and 2021. During 2023, the total harvested area of oats has increased by 15% and 23% on average in comparison to 2022 and 2021 respectively. The oat grain yield average was 61 bushels per acre, which represents an 18% reduction compared to 2022 and almost no difference from the 62 bushels per acre harvested on average in 2021 (Table 2).

Wisconsin barley planted area in 2023 was 12,000 acres with an estimated harvest area of 2,000 acres. The planted area was reduced by 14% and 20% in comparison to 2022 and 2021 planted acres. The harvest area follows the same trend with a reduction of 33% and 71% in comparison to 2022 and 2021 (Table 2). The barley grain yield average was 63 bushels per acre, which represents an increase of 15% and 19% compared to 2022 and 2021.

The 2023 growing season was unusually dry in the Madison location. Average temperatures for April (47.9°F), May (59.8°F), June (68.8°F), and July (72.4°F) had deviations of +1.0°F, +1.4°F, +0.4°F and 0°F from historical averages. The precipitations in April (2.34"), May (0.87"), June (1.14"), and July (6.21") had deviations of -1.17", -3.42", -3.91", and +1.93" from historical averages. Therefore, the early season was dry, which facilitated earlier planting dates in most locations, well-timed rains helped emergence and implantation. The late season was mostly dry which delayed the expression of crown rust disease, and water accumulated in soils helped the development of the crop.

## 2022 Growing season

Wisconsin oat production in 2022 was estimated at 4.8 million bushels, a 26% increase from 3.8 million bushels produced in 2021. The area planted with oats was 140,000 acres while the area harvested was 65,000 acres, which represents an increase in area of 7% compared to 2021 but still a reduction of 53% compared to the area harvested in 2020. The oat grain yield average was 74 bushels per acre, which represents a 19% increase from the average in 2021 (Table 2).

**Table 1.** Location and management practices of small grain variety trials in Wisconsin in 2023.

Location	County	Cooperators	Row Spacing	Previous Crop	Average N (lbs/acre)	Planting Date	Weed control	Harvest date	Number genotypes
Antigo	Langlade	<b>J. Schumitsch</b>	6 inches	Potatoes	100	18-May	MCPA + Harmony E	24-Aug	40
Arlington	Columbia	<b>M. Bertram</b>	6 inches	Soybean	50	13-Apr	Bromoxynil	1-Aug	60
Lancaster	Grant	<b>D. Wiedenbeck</b>	6 inches	Soybean	0	14-Apr	Harmony SG	1-Aug	40
Madison	Dane	<b>J. Hedtcke</b>	6 inches	Soybean	0	13-Apr	2.4D + Low Vol 4	2-Aug	60
Spoooner	Washburn	<b>P. Holman</b>	7 inches	Soybean	--	5-May	--	--	40
Sturgeon Bay	Door	<b>R. Wiepz</b>	6 inches	Soybean	0	18-May	2.4D	24-Aug	40

Wisconsin barley planted in 2022 was 14,000 acres with an estimated harvest area of 3,000 acres. The planted area was reduced by 7% and 46% in comparison to acres planted in 2021 and 2020. The estimated harvest area decreased by 57% and 77% in comparison to the 2021 and 2020 harvested areas (Table 2). The barley grain yield average was 55 bushels per acre, which represents an increase of 4% with the 53 bushels per acre harvested in 2021. The 2022 growing season was mostly dry in Wisconsin. Average temperatures for April (43.6 °F), May (62.4 °F), June (69.6 °F), and July (73.1 °F) had deviations of +1.0 °F, +4.9 °F, +1.6 °F and +2.1 °F from historical averages. The precipitation in April (3.3"), May (2.9"), June (4.0"), and July (5.4") had deviations of +1.3", -2.5", -1.0", and +2.1" from historical averages. Higher temperatures and lower levels of available water resulted in stress in the early stages of growth, accelerating the growing cycle and being particularly detrimental to early-season cultivars. On the other hand, dry weather reduced the incidence of diseases in both oat and barley, with positive impacts on general performance.

### 2021 Growing season

Wisconsin oat production in 2021 was estimated at 3.8 million bushels. The area planted to oat was 175,000 acres while the area harvested was 61,000 acres, which represents a reduction of 41% and 33% respectively compared to 2020 and 2019. During 2021, the total harvested area of oats was reduced by 53% and 49% on average in comparison to 2020 and 2019, respectively.

**Table 2.** Historical area, production, and grain yield of oat and barley in Wisconsin.

Year	Oat				Barley			
	Area planted (acres)	Area harvested (acres)	Total production (Million bu)	Grain Yield (bu/ac)	Area planted (acres)	Area harvested (acres)	Total production (Million bu)	Grain Yield (bu/ac)
2023	135,000	75,000	4.6	61	12,000	2,000	0.13	63
2022	140,000	65,000	4.8	74	14,000	3,000	0.17	55
2021	175,000	61,000	3.8	62	15,000	7,000	0.37	53

-- Information not available. Source: USDA National Agricultural Statistics Service [www.nass.usda.gov](http://www.nass.usda.gov)

The oat grain yield average was 62 bushels per acre, which represents almost no difference from the 63 bushels per acre harvested on average in 2020 (Table 2).

Wisconsin barley planted area in 2021 was 15,000 acres with an estimated harvest area of 7,000 acres. The planted area was reduced by 42% and 37% in comparison to acres planted in 2020 and 2019. The harvest area follows the same trend with a reduction of 46% and 12% in comparison to 2020 and 2019, respectively (Table 2). The barley grain yield average was 53 bushels per acre, which represents an increase of 15% compared to 2020 and 2019.

The 2021 growing season was unusually variable in the Madison field location. Average temperatures for April (47.2 °F), May (56.5 °F), June (70.6 °F), and July (69.2 °F) had deviations of +4.6 °F, -1.6 °F, +2.6 °F and -1.8 °F from historical averages, but with days of extreme heat during April and May. The precipitations in April (1.5"), May (2.6"), June (4.5"), and July (0.7") had deviations of -0.5", -2.8", +0.4", and -2.6" from historical averages. Therefore, the early season was dry, warmer, and with days of extremely hot temperatures, which facilitated earlier planting dates in most locations, but also created conditions for lower emergence and reduced tillering in both barley and oats. The late season was mostly dry which delayed the expression of crown rust disease, but some heavy storms caused high levels of lodging.

Source: USDA National Agricultural Statistics Service

**Table 3. Oat variety description.**

Genotype	Origin	Release year	Kernel color	Maturity date <sup>a</sup>	Ht (in) <sup>b</sup>	Lodging (%) <sup>c</sup>	Test Wt (lbs/bu) <sup>d</sup>	Kernel protein	Crown rust <sup>e</sup>	Stem rust <sup>f</sup>	Septoria <sup>f</sup>	Smut <sup>f</sup>	BYDV <sup>g</sup>	Licensed/PVP <sup>h</sup>	WI Cert.
<b>Recommended</b>															
Antigo	WI	2017	yellow	25	31	14	44	high	4	S	--	MR	3	yes	yes
BetaGene™	WI	2014	yellow	27	32	6	40	med/high	3	S	--	MR	2	yes	yes
Deon	MN	2013	yellow	31	35	11	40	High	2	S	R	R	2	yes	yes
Esker2020	WI	2020	yellow	27	33	13	40	med/high	3	MR	--	R	2	yes	yes
MN-Pearl	MN	2019	white	32	34	9	39	med/high	3	MR	--	MR	2	yes	yes
Ron	WI	2014	yellow	29	33	15	41	med	3	S	R	R	2	yes	yes
Rushmore	SD	2019	white	28	34	9	42	med/high	2	--	--	R	2	yes	yes
Mink	WI	2022	yellow	25	30	3	42	high	3	R	--	--	3	yes	yes
<b>Other varieties</b>															
Badger	WI	2010	yellow	26	28	3	40	med	5	R	MR	R	3	yes	yes
Esker	WI	2004	yellow	27	31	10	39	med	5	MS	MR	R	2	yes	yes
Hayden	SD	2014	yellow	29	32	12	40	med/high	4	MS	--	R	2	yes	yes
Reins	IL	2017	white	27	29	1	41	med/high	5	S	--	--	3	yes	yes
Saddle	SD	2018	white	26	32	1	42	med/high	2	--	--	--	2	yes	yes
Sumo	SD	2016	white	24	33	2	42	med/high	2	R	--	R	3	yes	yes
Vista	WI	1999	yellow	29	35	15	41	low	3	R	MS	R	2	yes	yes
Warrior	SD	2018	white	28	32	0	41	high	2	S	--	R	2	yes	yes

<sup>a</sup>Maturity (days after May 31st) as indicated in 16 Wisconsin tests conducted in 2021-2023. <sup>b</sup>Height (inches) at maturity in 16 Wisconsin tests conducted 2021-2023. <sup>c</sup>Lodging in 16 Wisconsin tests conducted in 2019 and 2021, no expression in the 2020,2022 or 2023 season. <sup>d</sup>Test weight (lbs/bu) in 16 Wisconsin tests conducted 2021-2023. <sup>e</sup>Crown rust disease resistance: R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible. Due to the high mutation rate of the pathogen, only 2019-2021 data were used for crown rust reports, with no expression on the season in 2022 or 2023. <sup>f</sup>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. <sup>g</sup>Barley yellow dwarf virus or red leaf disease resistance (BYDV): R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible. <sup>h</sup>PVP=Plant Variety Protection or licensed seed production. A “yes” indicates that these varieties cannot be grown and sold as seed without certification.



**Table 4.** Grain yield (bushels/acre) performance of oat varieties in the 2023 growing season and average of three years (2021, 2022, and 2023).

Genotype	Grain yield (cu/ac)											
	Antigo <sup>a</sup>		Arlington		Lancaster		Madison		Sturgeon Bay		Overall	
	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr
Antigo	81	84	153	136	74	73	116	105	49	53	98	89
Badger	81	87	157	111	77	62	139	100	63	61	105	84
BetaGene™	97	96	<b>192*</b>	<b>153*</b>	<b>89*</b>	84	132	<b>136*</b>	<b>75*</b>	<b>71*</b>	<b>121*</b>	<b>109*</b>
Deon	<b>117*</b>	<b>112*</b>	169	<b>157*</b>	87	84	160	<b>139*</b>	<b>79*</b>	<b>70*</b>	<b>121*</b>	<b>111*</b>
Esker	83	89	173	135	81	82	138	120	68	69	110	<b>98*</b>
Esker2020	104	95	170	150	<b>91*</b>	88	145	<b>126*</b>	64	65	114	<b>104*</b>
Hayden	<b>120*</b>	<b>106*</b>	178	<b>165*</b>	<b>93*</b>	<b>87*</b>	165	<b>137*</b>	<b>76*</b>	<b>73*</b>	<b>123*</b>	<b>109*</b>
Mink	64	67	152	140	77	61	149	<b>129*</b>	52	59	95	<b>95*</b>
MN-pearl	<b>122*</b>	<b>114*</b>	180	150	62	67	160	<b>139*</b>	<b>77*</b>	<b>75*</b>	119	<b>111*</b>
Ron	80	90	168	<b>153*</b>	77	<b>81*</b>	154	123	56	<b>67*</b>	104	<b>101*</b>
Rushmore	<b>112*</b>	108*	178	<b>154*</b>	<b>89*</b>	<b>79*</b>	<b>178*</b>	<b>136*</b>	<b>73*</b>	<b>77*</b>	<b>124*</b>	<b>112*</b>
Sumo	88	80	141	120	76	61	111	90	58	66	98	80
Vista	100	101	160	145	<b>100*</b>	<b>90*</b>	143	<b>129*</b>	<b>81*</b>	<b>75*</b>	116	<b>107*</b>
Warrior	109	<b>106*</b>	166	145	85	70	161	<b>132*</b>	68	65	<b>117*</b>	<b>103*</b>
Trial mean	109	98	168	150	87	82	146	128	72	71	116	104
Trial Standard error	1.0	0.6	0.7	0.4	1.0	0.6	0.7	0.5	0.7	0.6	0.3	0.3
LSD	11.4	12.2	10.2	13.2	12.1	12.4	11.1	14.3	8.4	9.4	12.5	18.3

<sup>a</sup>Varieties that are not significantly different ( $P < 0.05$ ) from the highest yielding variety in the trial using a Fisher's Least Significant Difference (LSD) test are marked with a star (\*). <sup>b</sup>Overall performance is provided for completeness; however, we advise caution in selecting varieties by the overall yield for all locations in Wisconsin because of the large genotype by environment interactions present. The three-year average for the location nearest your farm is probably a better predictor of the performance of a variety in a particular area. <sup>c</sup>The trial mean average includes the varieties in the table and some additional elite experimental lines. -- Information not available. <sup>e</sup>BLUP Best linear unbiased predictor, estimation of the genetic merit of the line based on the pedigree relationship matrix. <sup>f</sup> S.E. Standard error

**Table 5.** Barley variety description.

Genotype	Origin	Year	Rows	Objective <sup>a</sup>	Test Wt <sup>b</sup>	Plant Height <sup>c</sup>	Maturity date <sup>d</sup>	Net Blotch <sup>e</sup>	Spot Blotch <sup>f</sup>	BYDV <sup>g</sup>	FHB <sup>h</sup>	Lodging (0-9) <sup>i</sup>
AAC Synergy	CA	2012	2	Malting	48	28	30	MR	MS	MR	MR	0
AC Metcalfe	CA	1997	2	Malting	48	28	30	MS	S	MR	S	1
CDC Copeland	CA	1999	2	Malting	48	29	30	MS	S	MR	S	1
Conlon	ND	1996	2	Malting	47	28	24	S	S	MR	S	2
Kewaunee	WI	1994	6	Feed	46	31	24	MR	MS	MR	MR	1
LCS Genie	US	--	2	Malting	48	28	29	S	S	MR	S	0
ND Genesis	ND	2015	2	Malting	49	30	27	MS	MS	MR	MS	0
Pinnacle	ND	2008	2	Malting	48	28	26	S	MS	MR	S	0
Quest	MN	2010	6	Malting	47	31	23	MR	MS	MR	MR	2
Rasmusson	MN	2088	6	Malting	48	28	22	MR	MS	MR	MR	0

Suggested use stated in release and commercial information. <sup>b</sup>Test weight (lb per bu) in 16 Wisconsin tests conducted 2021-2023. Height (inches) at maturity in 15 Wisconsin tests conducted 2020-2022. Maturity (month-day) as indicated in 15 Wisconsin tests conducted in 2020-2022. Net Blotch disease resistance: R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible. 2019-2021 data were used for Net Blotch reports. Spot Blotch disease resistance: R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible. 2019-2021 data were used for Spot Blotch reports. <sup>g</sup>Barley yellow dwarf virus or red leaf disease resistance (BYDV): R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible. FHB Fusarium head blight based on natural expression in 2 Wisconsin tests conducted in 2019-2021, no expression in 2023. Lodging in 16 Wisconsin tests conducted in 2019 and 2021, no lodging in 2020, 2022, or 2023.

**Performance evaluation**

**Grain yield.** Plots were harvested and threshed with a combine harvester in Antigo, Arlington, Madison, and Sturgeon Bay; the 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 12% moisture content. There are 32 pounds per bushel of oat and 48 per bushel of barley (Tables 4 and 6).

**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 results are reported in pounds per bushel (Tables 3 and 5).

**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 (Tables 3, 5, 7, and 8).

**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 trait was measured in centimeters and transformed into inches. The analysis was conducted in inches. Plant height is reported in inches using the three-year average of all locations (Tables 3, 5, 7, and 8).

**Table 6.** Grain yield performance and heading date of barley varieties in 2023 at six locations in Wisconsin.

Variety	Grain Yield (bu/ac) <sup>a</sup>											
	Antigo		Arlington		Lancaster		Madison		Spooner		Overall <sup>b</sup>	
	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr
AAC Synergy	162	96*	157	106*	53*	54	153*	110*	67*	44*	121*	75*
AC Metcalfe	138	82	146	92	51*	52	150	101	60	41*	114	66
CDC Copeland	151	86	142	95	57*	57	153*	103	57	38*	118*	67
Conlon	124	70	159	99	46	48	150	97	37	38*	104	62
Kewaunee	178	101*	141	106*	46	47	132	100	72*	46*	117	72
LCS Genie	144	82	158	94	50*	49	141	93	63*	43*	114	65
ND Genesis	185*	103*	175*	114*	64*	69*	159*	116*	63*	42*	131*	82*
Pinnacle	187*	97*	150	98	62*	61*	140	103	62	41*	122*	73*
Quest	169	100*	151	106*	45	43	137	103	58	38*	113	73*
Rasmusson	166	101*	162	112*	58*	61*	163*	109*	70*	46*	125*	78*
Trial mean <sup>c</sup>	160	92	154	102	53	55	148	103	61	42	118	71
Trial S.E. <sup>d</sup>	0.97	0.95	1.50	0.81	2.5	0.97	2.12	1.12	1.61	0.96	1.13	0.40
LSD	5.62	9.86	8.87	8.36	15.1	11.2	11.7	10.0	9.69	8.04	13.36	9.82

<sup>a</sup>Varieties that are not significantly different (p<0.05) from the highest yielding variety in the trial using a Fisher's Least Significant Difference (LSD) test are marked with a star (\*). <sup>b</sup>Overall performance is provided for completeness; however, we advise caution in selecting varieties by the overall yield for all locations in Wisconsin because of the large genotype by environment interaction present. <sup>c</sup>Trial means include the varieties in the table and some additional elite experimental lines, is provided. <sup>d</sup>S.E. standard error

**Table 7.** Forage dry matter yield and quality of spring oat varieties harvested at Madison and Arlington, Wisconsin in 2023 an average of three years (2021, 2022, and 2023).

Genotype	Overall		Arlington								Madison							
			Dry Biomass (ton/ac) <sup>a</sup>		Crude protein (%)		Relative forage quality		Milk (ton/ac)		Dry Biomass (ton/ac)		Crude protein (%)		Relative forage quality		Milk (ton/ac)	
	Booting date	Heading date	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr
ForagePlus	19	28	<b>2168*</b>	<b>1861*</b>	9.9	<b>11.7*</b>	111	<b>132*</b>	2523	<b>2884*</b>	2169	<b>3754*</b>	9.3	9.9	113	112	2397	2491
George	17	26	1606	<b>1863*</b>	9.0	<b>11.3*</b>	115	<b>133*</b>	2589	<b>2921*</b>	2327	2683	8.5	9.9	<b>139*</b>	119	<b>2837*</b>	2622
Goliath	14	22	1938	<b>1772*</b>	9.6	<b>11.8*</b>	117	<b>137*</b>	2618	<b>2932*</b>	<b>2706*</b>	3049	9.3	<b>10.6*</b>	<b>143*</b>	<b>135*</b>	<b>2927*</b>	<b>2839*</b>
Laker	14	26	1295	1592	<b>10.3*</b>	<b>12.2*</b>	<b>141*</b>	<b>141*</b>	<b>2917*</b>	<b>2980*</b>	<b>2639*</b>	3154	<b>10.7*</b>	<b>10.6*</b>	<b>143*</b>	<b>124*</b>	<b>2918*</b>	2647
Vista	12	20	1541	1625	<b>10.8*</b>	<b>12.1*</b>	<b>138*</b>	<b>133*</b>	<b>2948*</b>	<b>2894*</b>	<b>2761*</b>	2358	9.6	<b>11.1*</b>	115	<b>127*</b>	2480	2660
Trial mean <sup>b</sup>	15	24	1593	1724	10	12.0	130	137	2820	2950	2499	2482	9.5	10.8	126	125	2684	2695
Trial S.E. <sup>c</sup>	0.1	0.1	16	12	0.1	0.1	1.8	1.0	24	13	42	27	0.1	0.1	1.4	0.8	23	11
LSD	1.7	1.6	162	216	1	1.0	18	18	252	232	376	419	0.9	0.8	13	13	209	165

<sup>a</sup>Varieties that are not significantly different (p<0.05) from the highest performing variety in the trial using a Fisher's Least Significant Difference (LSD) test are marked with a star (\*). <sup>b</sup>Trial means, which includes the varieties in the table and some additional elite experimental lines in the trial. <sup>c</sup>S.E. standard error -- Information not available. Forage evaluations were not performed during the year 2020 due to COVID-19 restrictions.

**Table 8.** Forage dry matter yield and quality of spring barley varieties harvested at Madison, Wisconsin in 2023 and an average for three years (2021, 2022, and 2023).

Genotype	Overall		Arlington								Madison							
			Dry Biomass (ton/ac) <sup>a</sup>		Crude protein (%)		Relative forage quality		Milk (ton/ac)		Dry Biomass (ton/ac)		Crude protein (%)		Relative forage quality		Milk (ton/ac)	
	Booting date	Heading date	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr	2023	3-yr
Hays	10	23	<b>1143*</b>	<b>1073*</b>	<b>10.5*</b>	<b>14.0*</b>	<b>169*</b>	<b>196*</b>	<b>3406*</b>	<b>3585*</b>	<b>3190*</b>	<b>2176*</b>	<b>9.6*</b>	<b>12.1*</b>	115	<b>134*</b>	2585	<b>2921*</b>
Kewaunee	7	16	1289	<b>1102*</b>	<b>11.4*</b>	<b>13.5*</b>	<b>152*</b>	<b>183*</b>	<b>3159*</b>	3427	2387	<b>1819*</b>	7.4	<b>12.3*</b>	111	<b>134*</b>	2493	<b>2821*</b>
Redrock	10	23	<b>1596*</b>	<b>1387*</b>	<b>10.2*</b>	12.1	<b>143*</b>	<b>169*</b>	<b>3040*</b>	<b>3351*</b>	<b>2442*</b>	<b>2049*</b>	<b>9.3*</b>	<b>11.1*</b>	<b>134*</b>	<b>142*</b>	<b>2861*</b>	<b>2958*</b>
Trial mean <sup>b</sup>	15	24	1593	1724	10.0	12.0	130	137	2820	2950	2499	2482	9.5	10.8	126	125	2684	2695
Trial S.E. <sup>c</sup>	0.1	0.1	15.7	12.0	0.1	0.1	1.8	1.0	24	13	42	27	0.1	0.1	1.4	0.8	23	11
LSD	--	--	162	216	0.7	1.0	18	18	252	232	376	419	0.9	0.8	13	13	209	165

<sup>a</sup>Varieties that are not significantly different (p<0.05) from the highest performing variety in the trial using a Fisher's Least Significant Difference (LSD) test are marked with a star (\*). <sup>b</sup>The trial means include the varieties in the table and some additional elite experimental lines in the trial. <sup>c</sup>S.E. Standard error. -- Information not available.

**Disease resistance.** Disease resistance was evaluated as a combination of 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 the resistance status of all varieties is provided using combined data from Wisconsin and 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 (Tables 3 and 5).

**Lodging.** Lodging was measured in a 0-9 ranking, where 0 is no lodging and 9 is severe lodging (Tables 3, 5, 7, and 8).

**Forage dry matter.** An area of 3x3.28 ft<sup>2</sup> was hand-harvested at 2 inches above the ground and dried. The weight of the sample was transformed into tons per acre before analysis. Yield is reported in tons per acre (Tables 7 and 8). Madison and Arlington are the only locations used for forage trials.

**Forage quality.** Forage quality was evaluated at the Soil and Forage Lab at UW-Madison. Relative forage quality (RFQ), percent of crude protein (CP%), and total milk production in tons per acre are reported (Tables 7 and 8).

### 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 to produce certified seeds 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 to produce certified seeds of Drumlin, Esker, Esker2020, Kame, Moraine, Ron, BetaGene™, Antigo, Laker, George, and Mink 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.

### Testing agencies

The cereals 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.

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