

2024 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 2024 growing season using conventional tillage practices and a



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plant stand of 1.3 million plants per acre goal. Agronomic practices at all locations are listed in Table 1. All experiments were conducted in randomized complete block designs with three replications.

2024 Growing season

Wisconsin oat production in 2024 was estimated at 4.29 million bushels, a reduction of 6% from the 4.6 million bushels produced in 2023. The area planted with oat was 140,000 acres while the area harvested was 64,000 acres, which represents a reduction of 15% and 1.5% respectively compared to the harvested area in 2023 and 2022. The oat grain yield average was 67 bushels per acre, which represents a 10% increase compared to 2023, but a 9% reduction compared to 2022 (Table 2).

Wisconsin barley planted area in 2024 was 15,000 acres with an estimated harvested area of 6,000 acres for grain. The planted area increased by 25% and 7% in comparison to 2023 and 2022 planted acres. Yet the harvested area increased by 200% and 100%, respectively compared to the harvested area in 2023 and 2022 (Table 2). The barley grain yield average was 45 bushels per acre, which represents a reduction of 29% and 18% compared to 2023 and 2022.

The 2024 growing season was warmer than usual with higher levels of precipitation in the Madison location. Average temperatures for April (49.0°F), May (61.9°F), June (70.4°F), and July (72.2°F) had deviations of +2.7°F, +3.8°F, +2.4°F and +0.3°F from historical averages. The precipitations in April (3.69"), May (5.51"), June (8.82"), and July (8.40") had deviations of -0.09", +1.41", +3.54", and +3.89" from historical averages. Therefore, the entire growing season was warmer and wetter. While during the early season, average precipitation allowed for adequate planting in most locations, above average rainfall from May, created difficult conditions for adequate crop growth. Disease expression was also favored with the higher temperatures and moisture.

2023 Growing season

Wisconsin oat production in 2023 was estimated at 4.6 million bushels, the area planted with oat was 135,000 acres, which represents a reduction of 4% and 23% respectively compared to 2022 and 2021, while the area harvested was 75,000 acres. During 2023, the total harvested area of oats 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).

Table 1. Location and management practices of small grain variety trials in Wisconsin in 2024.

Location	County	Cooperators	Row Spacing	Previous Crop	Average N (lbs/acre)	Planting Date	Weed control	Harvest date	Number genotypes (Oat/Barley)
Antigo	Langlade	J. Schumitsch	6 inches	Green beans	46	31-May	MCPA + Harmony E	29-Aug	40/10
Arlington	Columbia	M. Bertram	6 inches	Soybean	0	23-Apr	2.4 D + Biox 2EC	2-Aug	160/10
Lancaster	Grant	D. Wiedenbeck	7.5 inches	Soybean	5	15-Apr	Harmony SG	1-Aug	40/10
Madison	Dane	J. Hedtcke	6 inches	Soybean	0	16-Apr	2,4 D	27-Jul	160/10
Spooner	Washburn	P. Holman	6 inches	Soybean	19	25-Apr	2.4 D + Bromoxynil	14-Aug	40/10
Sturgeon Bay	Door	R. Wiepz	6 inches	Soybean	0	6-May	--	22-Aug	40/10

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).

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.

Source: USDA National Agricultural Statistics Service <https://climatology.nelson.wisc.edu/recent-wisconsin-climate/>

Table 2. Area in production, total production, and grain yield (bushels per acre) 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)
2024	140,000	64,000	4.3	67	15,000	6,000	0.27	45
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

Source: USDA National Agricultural Statistics Service www.nass.usda.gov

Table 3. Oat variety description. All varieties are licensed/PVP, and available as WI certified seed.

Genotype	Origin	Release year	Kernel color	Maturity date ^a	Ht (in) ^b	Lodging (%) ^c	Test Wt (lbs/bu) ^d	Kernel protein (%) ^e	Crown rust ^f	Stem rust ^{e, g}	Smut ^e (%)	BYDV ^h (0-9)	Licensed / PVP ⁱ	WI Cert.
Recommended														
ANTIGO	WI	2017	yellow	23	32	16	44	14.0	4	S ^j	17	3	yes	yes
BETAGENE™	WI	2014	yellow	26	34	13	40	12.6	3	S	1	2	yes	yes
DEON	MN	2014	yellow	31	37	18	41	13.6	2	S	1	2	yes	yes
ESKER2020	WI	2020	yellow	25	36	16	40	14.0	3	MS	2	2	yes	yes
MINK	WI	2022	yellow	24	28	4	43	13.3	4	R ^j	10	1	yes	yes
MN-PEARL	MN	2019	white	30	36	30	40	12.8	4	S	0	2	yes	yes
RON	WI	2014	yellow	26	32	14	42	14.2	3	MS	3	2	yes	yes
RUSHMORE	SD	2019	white	27	35	23	43	12.3	3	--	10	2	yes	yes
SD BUFFALO	SD	2021	white	26	38	29	42	13.8 ^k	3	--	--	--	yes	yes
WARRIOR	SD	2018	white	27	34	15	41	14.3	2	S	3	2	yes	yes
Other genotypes														
BADGER	WI	2010	yellow	23	29	18	41	13.2	5	S	0	3	yes	yes
HAYDEN	SD	2014	yellow	28	36	19	42	12.6	4	MR MS	0	2	yes	yes
ND HEART	ND	2020	white	27	35	34	42	13.8	3	R	43	4 ^e	yes	Yes
REINS	IL	2017	white	26	31	14	42	14.3	4	S	4	3	yes	yes
SADDLE	SD	2018	white	24	34	15	42	14.3	2	--	7	2	yes	yes
SUMO	SD	2016	white	22	34	13	42	14.8	2	R ^j	0	3	yes	yes

^aMaturity (days after May 31st) as indicated in 15 Wisconsin tests conducted in 2022-2024. ^bHeight (inches) at maturity in 15 Wisconsin tests conducted 2021-2024. ^cLodging in 15 Wisconsin tests conducted in 2020, 2021 and 2024, no expression in the 2022 or 2023 season. ^dTest weight (lbs/bu) in 15 Wisconsin tests conducted 2022-2024. ^eSource: T3/Oat, <https://oat.triticeatoolbox.org/>. ^fCrown rust disease resistance: 0 to 9 scale. Due to the high mutation rate of the pathogen, only 2020, 2021 and 2024 data were used for crown rust reports, with no expression on the season in 2022 or 2023. ^gStem rust disease: R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible. ^hBarley yellow dwarf virus or red leaf disease resistance (BYDV), 0 to 9 scale, recorded in Wisconsin tests conducted in 2021-2023. ⁱPVP=Plant Variety Protection or licensed seed production. A “yes” indicates that these varieties cannot be grown and sold as seed without certification. ^jBecause 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. ^kSource: South Dakota State University Extension, <https://extension.sdstate.edu/oat-variety-trial-results>

Table 4. Grain yield (bushels/acre) performance of oat varieties in the 2024 growing season and average of three years (2022, 2023, and 2024).

Genotype	Grain yield (bushel per acre)													
	Antigo ^a		Arlington		Lancaster		Madison		Spooners		Sturgeon Bay		Overall ^b	
	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr
Recommended														
ANTIGO	65	66	50	100	68	78	99	108	61	64	69	58	66	81
BETAGENE	86	83	88	128	73	87	110	128*	59	77	60	66	80*	97
DEON	83	91	85	133*	85*	96*	109	125*	66	80*	105*	83*	90*	104*
ESKER2020	76	75	63	112	67	88	120	132*	46	55	85	75	77	93
MINK	63	55	53	101	56	70	95	122*	49	58	55	55	61	79
MN-PEARL	69	90	28	116	67	78	52	114	22	46	100*	83*	59	90
RON	73	75	61	120	61	82	110	117	57	71	56	63	70	89
RUSHMORE	88	93	84	132	72	89	118	132*	32	52	96	84*	82*	100*
SD BUFFALO	106*	111*	69	114	92*	107*	95	104	41	51	99*	89*	84*	99*
WARRIOR	78	88	80	119	84*	84	140*	134*	70	74	64	65	84*	96*
WIX10680-3 ^c	86	92	100	141*	89*	106*	120	136*	86*	94*	108*	93*	96*	112*
WIX10466-7 ^c	85	90	120*	147*	80	97*	131*	137*	47	70	106*	92*	94*	109*
WIX10710-7 ^c	87	93	95	142*	90*	103*	130*	132*	80*	80*	98*	86*	95*	108*
Other genotypes														
BADGER	41	61	42	87	57	71	52	100	29	40	98*	76	55	76
HAYDEN	65	85	68	130	82	97*	89	125*	31	52	98*	80	73	98
ND HEART	60	66	56	106	73	88	106	116	18	30	59	51	62	77
REINS	--	75	70	110	65	77	116	114	60	64	76	73	79	88
SADDLE	--	76	77	124	--	90	125	137*	--	66	--	62	85*	95
SUMO	68	73	69	95	--	68	103	104	50	53	53	57	69	76
Trial mean ^d	80	87	83	125	74	87	113	124	52	63	83	75	81	95
Trial S.E. ^e	0.8	0.6	0.6	0.4	0.7	0.6	0.7	0.5	1.1	0.9	0.8	0.6	0.4	0.2
LSD	9.7	11.5	12.6	14.5	8.3	11.8	13.8	15.0	12.5	14.9	9.7	11.7	15.8	12.2

^aVarieties that are not significantly different (P<0.05) from the highest yielding variety in the table using a Fisher's Least Significant Difference (LSD) test are marked with a star (*). ^bOverall 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. ^cWill be evaluated for release. ^dThe trial mean average includes the varieties in the table and some additional elite experimental lines. ^eS.E. standard error – Information not available.

Table 5. Barley variety description.

Genotype	Orig.	Year	Row	Goal ^a	Test Wt ^b	Ht ^c	Maturity date ^d	Net Blot. ^e	Spot Blot. ^f	BYDV ^g	FHB ^h	Lod ⁱ
AAC SYNERGY	CA	2012	2	Malting	46	29	29	MR	MS	3	MR	6
AC METCALFE	CA	1997	2	Malting	47	29	29	MS	S	3	S	5
CDC COPELAND	CA	1999	2	Malting	47	30	29	MS	S	2	S	5
CONLON	ND	1996	2	Malting	46	29	23	S	S	3	S	7
KEWAUNEE	WI	1994	6	Feed	45	31	24	MR	MS	3	MR	3
LCS GENIE	US	--	2	Malting	46	30	27	S	S	3	S	4
ND GENESIS	ND	2015	2	Malting	47	31	27	MS	MS	2	MS	4
PINNACLE	ND	2008	2	Malting	46	30	26	S	MS	3	S	4
QUEST	MN	2010	6	Malting	46	31	24	MR	MS	3	MR	3
RASMUSSEN	MN	2008	6	Malting	47	29	23	MR	MS	2	MR	2

^aSuggested use stated in release and commercial information. ^bTest weight (lb per bu) in 15 Wisconsin tests conducted 2022-2024. ^cHeight (inches) at maturity in 15 Wisconsin tests conducted 2022-2024. ^dMaturity (month-day) as indicated in 15 Wisconsin tests conducted in 2022-2024. ^eNet Blotch disease resistance: R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible. 2019-2021 data were used for Net Blotch reports. ^fSpot Blotch disease resistance: R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible. 2019-2021 data were used for Spot Blotch reports. ^gBarley yellow dwarf virus or red leaf disease resistance (BYDV), 2021, 2023-2024 data were used for BYDV reports. ^hFHB Fusarium head blight based on natural expression in 2 Wisconsin tests conducted in 2019-2021. ⁱLodging (0 to 9 scale), 2021, 2022, 2024 data were used for lodging reports.

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

Table 6. Grain yield performance of barley varieties in 2024 at six locations in Wisconsin and average of three years (2022, 2023, and 2024).

Genotype	Grain Yield (bushel per acre) ^a													
	Antigo		Arlington		Lancaster		Madison		Spooner		Sturgeon Bay		Overall ^b	
	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr
AAC SYNERGY	58*	71*	42	70	20	35	43	72*	20	29	56*	41*	40	54*
AC METCALFE	53	63	32	60	16	34	31	61	15	34	48	37*	33	49
CDC COPELAND	49	64	40	66	16	36*	45	64	19	29	49	35*	36	50
CONLON	58*	58	25	62	18	30	40	62	24	36	48	32	34	48
KEWAUNEE	53	72*	51*	73*	30*	35	56	71*	31	40	51*	40*	46*	56*
LCS GENIE	51	64	35	65	16	32	37	57	13	32	46	37*	34	49
ND GENESIS	62*	75*	48	73*	25	43*	52	72*	27	39	51*	38*	44*	59*
PINNACLE	55	70*	46	67	23	43*	44	66	22	32	51*	37*	39	54*
QUEST	53	70*	56*	75*	30*	31	63*	75*	44*	51*	52*	36*	49*	57*
RASMUSSEN	52	71*	56*	78*	29*	41*	58	75*	31	40	45	38*	45*	58*
Trial mean ^c	54	68	43	69	22	36	47	67	25	36	50	37	40	53
Trial S.E. ^d	0.7	0.7	0.9	0.7	0.5	0.7	0.6	0.7	1.0	1.1	0.8	0.6	0.5	0.2
LSD	4.0	7.1	5.6	7.5	3.1	7.0	3.7	6.8	6.1	9.1	5.0	6.1	7.1	5.5

^aVarieties that are not significantly different ($p < 0.05$) from the highest yielding variety in the table using a Fisher's Least Significant Difference (LSD) test are marked with a star (*). ^bOverall 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. ^cTrial means include the varieties in the table and some additional elite experimental lines. ^dS.E. standard error

Table 7. Forage dry matter yield (tons per acre) and quality of spring oat varieties harvested at Madison and Arlington, Wisconsin in 2024 and average of three years (2022, 2023, and 2024).

Genotype	Overall		Arlington								Madison							
			Dry Biomass (ton/ac) ^a		Crude protein (%)		Relative forage quality		Milk (lb/ton)		Dry Biomass (ton/ac)		Crude protein (%)		Relative forage quality		Milk (lb/ton)	
			2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr
FORAGEPLUS	23	32	3.2*	1.6	8.8*	11.1	50	99	934	2071	--	2.6	8.2*	9.5	41	83	665	1721
GEORGE	21	30	2.3	1.5	9.3*	11.1	55	99	1134*	2135	3.3	2.2	8.1*	9.3	47*	88*	874*	1878*
GOLIATH	18	25	2.3	1.5	9.2*	11.0	60*	99	1212*	2133	2.7	2.3	7.3	9.1	48*	98*	923*	2030*
LAKER	19	28	2.8*	1.5	8.4*	11.1	45	102	757	2073	2.7	2.3	8.6*	10.2	49*	92*	883*	1887*
VISTA	17	25	2.6	1.5	9.1*	11.2	49	96	954	2052	3.5	2.3	8.0*	9.8	46*	81	858*	1758
WIX10979-19 ^b	20	29	3.0*	1.7	9.2*	11.2	45	101	782	2088	3.5	2.6	8.1*	9.4	48*	87*	925*	1856*
WIX11205-1 ^b	20	28	3.3*	1.9	8.0	10.9	46	96	803	2034	2.7	2.3	8.6*	10.0	49*	84	917*	1811
WIX11205-3 ^b	21	28	2.8*	1.7	9.2*	10.7	50	94	934	2040	3.3	2.6	7.9*	9.1	49*	91*	908*	1903*
Trial mean ^c	18	26	2.6	1.5	9.3	11.1	53	97	1043	2083	2.9	2.2	8.7	9.9	54	90	1072	1955
Trial S.E. ^d	0.1	0.1	0.03	0.01	0.1	0.1	0.4	0.8	11.0	12.8	0.09	0.03	0.1	0.1	0.6	0.7	14.7	12.3
LSD	--	--	0.3	0.3	0.9	0.9	4	15	114	225	0.9	0.4	1.1	1.1	6	11	152	195

^aVarieties that are not significantly different (p<0.05) from the highest performing variety in the table using a Fisher's Least Significant Difference (LSD) test are marked with a star (*). If no significant differences are found no stars are shown. ^bWill be evaluated for release. ^cTrial means include the varieties in the table and some additional elite experimental lines in the trial. ^dS.E. standard error. -- Information not available.

Table 8. Forage dry matter yield (tons per acre) and quality of spring barley varieties harvested at Madison, Wisconsin in 2024 and an average for three years (2022, 2023, and 2024).

Genotype	Overall		Arlington								Madison							
			Dry Biomass (ton/ac) ^a		Crude protein (%)		Relative forage quality		Milk (lb/ton)		Dry Biomass (ton/ac)		Crude protein (%)		Relative forage quality		Milk (lb/ton)	
			2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr	2024	3-yr
HAYS	14	25	2.4*	1.2*	8.1	11.0	55	123*	1186	2533*	2.5*	1.9*	8.0	10.4*	69	94	1404	2072
KEWAUNEE	12	22	1.8	1.0	10.9*	12.8*	60	118*	1267	2450*	1.9*	1.5*	10.4*	10.3*	73	96	1517	2098
REDROCK	14	26	2.3*	1.3*	9.1	11.4	65*	114*	1401*	2455*	2.3*	1.7*	9.5*	10.5*	82*	113*	1751*	2431*
Trial mean ^b	18	26	2.6	1.5	9.3	11.1	53	97	1043	2083	2.9	2.2	8.7	9.9	54	90	1072	1955
Trial S.E. ^c	0.1	0.1	0.03	0.01	0.1	0.1	0.4	0.8	11.0	12.8	0.09	0.03	0.1	0.1	0.6	0.7	14.7	12.3
LSD	--	--	0.3	0.3	0.9	0.9	4	15	114	225	0.9	0.4	1.1	1.1	6	11	152	195

^aVarieties that are not significantly different (p<0.05) from the highest performing variety in the table using a Fisher's Least Significant Difference (LSD) test are marked with a star (*). If no significant differences are found no stars are shown. ^bTrial means include the varieties in the table and additional elite experimental lines in the trial. ^cS.E. Standard error. -- Information not available.

reported in inches using the three-year average of all locations (Tables 3, 5, 7, and 8).

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, Crown rust and BYDV). Disease score for stem rust is as follows: R=excellent resistance, MR=moderate or good resistance, MS=moderate susceptible, and S = susceptible or poor resistance. Disease score for smut is reported in percentage (%). Please 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 6.46 ft² 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 using NIR. Relative forage quality (RFQ), percent of crude protein (CP%), and total milk production in pounds per ton 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 Plant and Agroecosystem Sciences, College of Agricultural and Life Sciences, University of Wisconsin-Madison in cooperation with the Wisconsin Crop Improvement Association.

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