2022 Oat and Barley Performance Tests

Lucia Gutierrez, Pablo Sandro, Samantha Zimmerman, and Julie Dawson

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 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 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 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 2022 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.

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 increment 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 2021 and 2020 planted acres. 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. f

Table 1. Location and management practices of small grain variety trials in Wisconsin in 2022.

Location	County	Cooperators	Row Spacing	Previous Crop	Average N (lb per A)	Planting Date	Weed control	Harvest date	Number genotypes
Antigo	Langlade	**J. Schumitsch**	6 inches	Potatoes	50	17-May	MCPA + Harmony E	11-Aug	40
Arlington	Columbia	**M. Bertram**	6 inches	Soybean	50	16-Apr	Bromoxynil	8-Aug	60
Lancaster	Grant	**D. Wiedenbeck**	6 inches	Soybean	6.3	27-Apr	Harmony SG	1-Aug	40
Madison	Dane	**J. Hedtcke**	6 inches	Soybean	0	11-Apr	2.4D + Low Vol 4	26-Jul	60
Spooner	Washburn	**P. Holman**	7 inches	Soybean	40	5-May	2.4D + Buctril	11-Aug	40
Sturgeon Bay	Door	**R. Wiepz**	6 inches	Soybean	0	17-May		12-Aug	40

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

	Oat				Barley			
Year	Area planted (acres)	Area harvested (acres)	Total production (Million bu)	Grain Yield (bu per A)	Area planted (acres)	Area harvested (acres)	Total production (Million bu)	Yield (bu per A)
2022	140,000	65,000	4.8	74	14000	3000	0.17	55
2021	175,000	61,000	3.8	62	15,000	7,000	0.37	53
2020	300,000	131,000	5.49	63	26,000	13,000	0.59	46

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

The 2022 growing season was mostly dry in the Wisconsin area. 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 growing accelerating the growing cycle and being particularly detrimental in 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 with oat was 175,000 acres while the area harvested was 61,000 acres, which represents a reduction in 41% and 33% respectively compared to 2020 and 2019. During 2021, the total harvested area of oat has been reduced a 53% and 49% on average in comparison to 2020 and 2019 respectively. 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 2020 and 2019 planted acres. The harvest area follows the same trend with a reduction of 46% and 12% in comparison to 2020 and 2019 (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 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.

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 acreage planted and harvested has been increasing on average by 18% and 11% respectively. Oat estimated grain yield was 63 bushels per acre, an increase of 17% in comparison to 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 increased 8%, while the harvested area increased 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 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 extremely 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 also an unusual year due to the COVID-19 pandemic. Due to heavy restrictions on 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.

Source: USDA National Agricultural Statistics Service

Table 3. Grain oat variety description.

Genotype	Origin	Release year	Kernel color	Maturity date [a]	Ht (in)[b]	Lodging (%) [c]	Test Wt (lb/bu)[d]	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	31	14	44	high	4	S	--	MR	3	yes	yes
BetaGene™	WI	2014	yellow	24	33	6	39	--	3	--	--	--	2	yes	yes
Deon	MN	2013	yellow	27	35	11	40	med	2	--	R	R	2	yes	yes
Esker2020	WI	2020	yellow	23	33	13	39	med/high	3	MR	--	R	2	yes	yes
MN-Pearl	MN	2019	white	28	34	9	39	med/high	3	MR	--	MR	2	yes	yes
Ron	WI	2014	yellow	27	33	15	40	med	3	--	R	R	2	yes	yes
Rushmore	SD	2019	white	24	34	9	42	high	2	--	--	R	2	yes	yes
MINK	WI	2022	yellow	27	30	3	40	high	3	R	--	--	3	yes	yes
Other varieties															
Badger	WI	2010	yellow	23	29	3	39	med	5	R	MR	R	3	yes	yes
Esker	WI	2004	yellow	24	32	10	39	med	5	MS	MR	R	2	yes	yes
Hayden	SD	2014	yellow	26	32	12	40	med/high	4	MS	--	R	2	yes	yes
Reins	IL	2017	white	23	30	1	41	med/high	5	--	--	--	3	yes	yes
Saddle	SD	2018	white	23	32	1	42	med/high	2	--	--	--	2	yes	yes
Sumo	SD	2016	white	21	33	2	42	med/high	2	R	--	R	3	yes	yes
Vista	WI	1999	yellow	26	35	15	40	low	3	R	MS	R	2	yes	yes
Warrior	SD	2018	white	25	32	0	40	high	2	--	--	R	2	yes	yes

[a] Maturity (days after May 31st) as indicated in 16 Wisconsin tests conducted in 2020-2022. [b] Height (inches) at maturity in 16 Wisconsin tests conducted 2020-2022.
[c] Lodging in 16 Wisconsin tests conducted in 2019 and 2021, no expression on the 2020 or 2022 season. [d]Test weight (lb per bu) in 16 Wisconsin tests conducted 2020-2022.
[e]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. [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.

Table 4. Grain yield (bushels per acre) performance of oat varieties in the 2022 growing season and average of three years (2020, 2021, and 2022).

	Grain yield (bu per A)																			
	Antigo [a]			Arlington			Lancaster			Madison			Spooner			Sturgeon bay		Overall [b]		
Genotype	2022	3-yr	BLUP	2022	3-yr	BLUP	2022	3-yr	BLUP	2022	3-yr	BLUP	2022	3-yr	BLUP	2022	BLUP	2022	3-yr	BLUP
ANTIGO	49	95	84	114	114	114	78	78	78	92	88	89	56	46	45	57	68	66	77	78
BADGER	59	85	82	70	82	93	96	68	72	78	77	81	51	36	35	67	70	62	68	70
BETAGENE	69	**110***	93	111	125	124	116	**89***	88	94	**121***	123	**94***	**65***	65	66	69	**81***	**92***	95
DEON	**77***	**113***	108	**135***	132	132	105	**86***	86	**119***	**123***	122	**96***	**61***	64	58	59	**87***	**91***	94
ESKER	64	98	92	93	108	109	99	**89***	89	**110***	94	96	62	51	52	**72***	72	73	80	84
ESKER2020	58	**104***	98	120	127	126	104	**92***	93	**109***	105	103	63	51	50	**79***	73	**77***	**88***	90
HAYDEN	67	**107***	102	**136***	**144***	145	119	**88***	88	**110***	**114***	113	**88***	**61***	63	67	68	**86***	**89***	93
MN-PEARL	**77***	**112***	109	**129***	127	126	124	**83***	81	99	**123***	122	76	**64***	64	**73***	71	**85***	**92***	94
REINS	57	92	85	102	106	110	80	77	81	94	84	87	65	38	45	**73***	70	69	76	79
RON	68	**108***	90	123	129	132	97	**89***	88	105	105	103	**86***	**74***	71	**80***	75	**80***	**91***	93
RUSHMORE	**74***	**110***	101	**129***	128	127	110	**82***	83	106	**120***	123	68	59	56	**80***	74	**83***	**92***	94
SADDLE	62	**113***	89	**129***	**139***	140	116	**83***	84	99	**124***	127	73	**61***	59	64	67	**79***	**93***	96
SUMO	58	84	75	68	98	98	71	62	64	74	84	80	48	42	40	**77***	80	60	66	68
VISTA	69	**108***	97	120	123	122	113	**94***	94	**107***	**114***	112	80	**64***	65	67	77	**82***	**90***	93
WARRIOR	73	**106***	98	111	119	98	111	67	77	84	**119***	121	77	60	60	64	66	**76***	**86***	89
MINK	42	**101***	69	107	119	120	**145***	65	69	69	**123***	130	60	**63***	62	**70***	69	64	81	85
Trial mean	67	107	--	125	126	--	107	85	--	102	111	--	74	57	--	70	--	80	86	--
Trial S.E.[f]	0.6	0.7	--	0.9	0.4	--	1.0	0.6	--	0.8	0.5	--	1.1	0.6	--	0.8	--	0.6	0.3	--
LSD	6.9	13.7	--	13.4	11.3	--	12.0	12.4	--	11.8	13.4	--	13.1	13.1	--	9.7	--	10.7	10.6	--

[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. [d]The trial means average 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. [e]BLUP Best linear unbiased predictor, estimation of the genetic merit of the line based on the of pedigree relationship matrix. [f] S.E. Standard error

Table 5. Grain barley variety description.

Genotype	Origin	Year	Rows	Objective[a]	Test Wt[b]	Plant Height[c]	Maturity date[d]	Net Blotch[e]	Spot Blotch[f]	BYDV[g]	FHB[h]	Lodging (0-9)[i]
AAC Synergy	CA	2012	2	Malting	**47***	28	**30***	MR	MS	MR	MR	0
AC Metcalfe	CA	1997	2	Malting	**47***	28	**30***	MS	S	MR	S	1
CDC Copeland	CA	1999	2	Malting	**47***	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	46	28	**29***	S	S	MR	S	0
ND Genesis	ND	2015	2	Malting	**47***	**30***	27	MS	MS	MR	MS	0
Pinnacle	ND	2008	2	Malting	46	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

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

Performance evaluation

Grain yield. Plots were harvested and threshed with a combine harvester in Madison, Arlington, Antigo, 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. All the analyses were conducted in bushels per acre. 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 were transformed to pounds per bushel following seed trade recommendations and all analyses were conducted in pounds per bushel. Test weight is 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 analysis was conducted in centimeters and transformed into 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 the 2022 growing season at six locations in Wisconsin.

	Grain Yield (bu per A)[a]												
	Antigo		Arlington		Madison		Lancaster		Spooner		Sturgeon Bay	Overall[c]	
Variety	2022	3-yr	2022	3-yr	2022	3-yr	2022	3-yr	2022	3-yr	2022	2022	3-yr
AAC Synergy	**52***	**48***	81	**81***	**84***	**74***	**48***	46	46	33	**25***	**55***	55
AC Metcalfe	47	37	64	63	70	64	37	38	**56***	27	**23***	50	45
CDC Copeland	48	39	64	71	70	64	33	34	40	24	**20***	46	44
Conlon	38	35	70	71	71	62	37	37	48	28	**23***	47	46
Kewaunee	47	**50***	83	**82***	**85***	**76***	37	43	45	42	**21***	53	**58***
LCS Genie	49	38	69	62	62	57	39	34	**54***	29	**22***	49	42
ND Genesis	49	**52***	**89***	**85***	**88***	**79***	**49***	**50***	61	**47***	**21***	**60***	**62***
Pinnacle	**51***	**47***	69	73	79	69	**52***	46	38	34	**20***	52	52
Quest	**53***	**53***	**82***	**83***	81	71	37	41	**59***	41	13	**55***	**57***
Rasmusson	**50***	**52***	86	**86***	**86***	72	**51***	**55***	**51***	40	**20***	**57***	**60***
Trial mean	48	45	76	76	78	69	42	43	50	34	21	52	52
Trial S.E.[b]	0.3	0.6	0.5	0.6	0.6	0.6	0.5	0.6	0.6	0.3	0.6	0.5	0.5
LSD	3.5	6.7	5.3	6.7	5.9	5.9	5.1	6.7	6.1	3.0	6.2	5.7	5.6

[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] [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. [c]The trial mean, which includes the varieties in the table and some additional elite experimental lines, is provided. [b]S.E. standard error

Table 7. Forage dry matter yield and quality of spring oat varieties harvested at Madison and Arlington, Wisconsin in 2021 and average of three years (2019, 2021 and 2022).

			Arlington								Madison							
	Overall		Dry Biomass (ton/A) [a]		Crude protein (%)		Relative forage quality		Milk (ton/A)		Dry Biomass (ton/A)		Crude protein (%)		Relative forage quality		Milk (ton/A)	
Genotype	Booting date	Heading date	2022	3-yr	2022	3-yr	2022	3-yr	2022	3-yr	2022	3-yr	2022	3-yr	2022	**3-yr**	**2022**	**3-yr**
ForagePlus	21	30	1247	**2504***	**15.5***	11.5	**127***	**124***	**2714***	**2824***	2408	**3025***	11.3	10.1	92	129	2051	**2743***
George	19	28	**1458***	**2512***	**15.0***	**11.7***	**125***	**131***	**2720***	**2893***	2060	2587	10.9	9.9	83	130	1970	**2816***
Goliath	16	25	**1519***	2229	14.5	**11.9***	**118***	**134***	**2565***	**2865***	**3265***	**2706***	10.8	**10.8***	**106***	**143***	**2340***	**2722***
Laker	18	28	1305	2229	14.6	**12.4***	**117***	**126***	2476	**2789***	2685	**2943***	10.7	10.5	78	127	1799	**2763***
Vista	15	22	1207	2208	12.6	**11.9***	94	119	2136	2692	1820	2230	**12.3***	**11.1***	81	138	1914	**2890***
Trial mean[b]	18	27	1331	2185	14.0	12.1	115	131	2359	2859	1999	2292	11.8	10.8	92	136	2110	2761
Trial S.E.[b]	0.1	0.1	9.6	30.3	0.1	0.1	1.6	1.6	20.4	19.3	57.9	39.2	0.1	<0.1	<0.1	0.8	14.5	23.6
LSD	--	--	87	273	0.8	0.8	14	14	183	174	522	353	0.5	0.5	1	7	131	213

[a] Varieties that are not significantly different (p<0.05) from the highest performing variety in the trial are marked with a star (*). These analyses refer to a Fisher's Least Significant Difference (LSD) test. [b]The trial mean, which includes the varieties in the table and some additional elite experimental lines, is provided. [b] 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 2022 and an average for three years (2019, 2021, and 2022).

			Arlington								Madison							
	Overall		Dry Biomass (ton/A) [a]		Crude protein (%)		Relative forage quality		Milk (lb./A)		Dry Biomass (ton/A)		Crude protein (%)		Relative forage quality		Milk (lb./A)	
Genotype	Booting date	Heading date	2022	3-yr	2022	3-yr	2022	3-yr	2022	3-yr	2022	3-yr	2022	3-yr	2022	3-yr	2022	3-yr
Kewaunee	12	23	**977***	**1539***	**15.3***	**14.1***	**118***	**193***	**2492***	**3428***	**1418***	**1558***	**13.5***	**12.2***	92	**153***	2161	2630
Hays	9	15	894	**1296***	**15.5***	13.2	101	169	2261	3259	1088	**1423***	12.6	**12.8***	97	152	2223	2492
Redrock	12	26	**1026***	**1505***	**15.7***	12.3	**119***	**181***	**2543***	**3450***	**1230***	**1681***	**13.0***	**11.3***	**117***	**159***	**2589***	**3091***
Trial Mean	18	27	1331	2185	14.4	12.1	115	131	2491	2859	1999	2292	11.8	10.8	92	136	2110	2761
Trial S.E.[b]	0.1	0.1	9.6	30.3	0.1	0.1	1.6	1.6	20.4	19.3	57.9	39.2	0.1	0.1	<0.1	0.8	14.5	23.6
LSD	--	--	87	273	0.8	0.8	14	14	183	174	522	353	0.5	0.5	7	7	131	213

[a] Varieties that are not significantly different (p<0.05) from the highest performing variety in the trial are marked with a star (*). These analyses refer to a Fisher's Least Significant Difference (LSD) test. [b]The trial mean, which includes the varieties in the table and some additional elite experimental lines, is provided. [b] S.E. Standard error. -- Information not available. Forage evaluations were not performed during year 2020 due covid restrictions.

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 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 was hand-harvested at 2 inches above the ground and dried. The weight of the sample was transformed into tons per hectare 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.

Authors: Dr. Lucia Gutierrez is an associate professor in the Department of Agronomy, College of Agricultural and Life Sciences, University of Wisconsin – Madison. Dr. Gutierrez is currently the Cereals Breeder and Quantitative Geneticist. Pablo Sandro is a research specialist in the Cereals Breeding and Quantitative Genetics group in the Agronomy Department College of Agricultural and Life Sciences Department, University of Wisconsin – Madison led by Dr. Gutierrez. Dr. Julie Dawson is an associate professor and extension specialist in the Department of Horticulture, College of Agricultural and Life Sciences. University of Wisconsin – Madison. Division of Extension publications are subject to peer review.

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