

# 2019 Oat and Barley Performance Tests

Lucia Gutiérrez, Pablo Sandro and Shawn Conley



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 yield, maturity, straw strength (or resistance to lodging), disease resistance and grain quality. Barley farmers should also consider whether a variety is acceptable for malting, several varieties are also evaluated for forage yield and quality.

## Variety testing

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

Tests were conducted at eight locations during the 2019 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.

## 2019 Growing season

Wisconsin oat production in 2019 was estimated at 6.48 million bushels, the area planted with oat was 265,000 acres, and the area harvested was 120,000 acres, which was an increase on area compared to 2018 (20%). Oat 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 the emergency. 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.

**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 represent a record on the planted area for barley in Wisconsin.

**2017 season.** Wisconsin oat production was estimated at 6.1 million bushels, which was 57% less than the record high in 2015. The area planted with oat was 180,000 acres, and the area harvested was 95,000 acres. Oat yield was 64 bushels per acre, down 2 bushels from 2016, and 8 from 2015.

**2016 season.** Wisconsin oat production was estimated at 6.6 million bushels, which was 53% 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 66 bushels per acre, down six bushels from 2015.

**Table 1.** Location and management practices of small grain variety trials in Wisconsin in 2019.

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	3-May	Huskie 13	27-Aug	40
Antigo	Langlade	D. Marzu	6 inches	Potato	45	30-May	2.4D + Harmony E.	22-Aug	40
Arlington	Columbia	M. Bertram	6 inches	Soybean	0	25-Apr	2.4D + Harmony E.	05- Aug	60
Chilton	Calumet	R. Kolbe	6 inches	Soybean	0	15-May	None	15-Aug	40
Lancaster	Grant	D. Wiedenbeck	6 inches	Soybean	30	15-Apr	None	30-Jul	40
Madison	Dane	J. Hedtcke	6 inches	Soybean	0	21-Apr	2.4D + Harmony E.	25-Jul	60
Spooner	Washburn	P. Holman	6.6 inches	Soybean	45	25-Apr	2.4D + Buctril	13-Jul	40

**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)
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
2013	255,000	105,000	6.83	65	33,000	16,000	0.78	49

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

**Table 3.** Grain oats variety description.

Variety	Origin	Release year	Kernel color	Maturity <sup>a</sup> date	Ht <sup>b</sup> (in.)	Lodging (%) <sup>c</sup>	Test Wt <sup>d</sup> (lb/bu)	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>	Wis. cert.
<b>Recommended</b>															
Antigo	WI	2017	yellow	21-Jun	38.3	27.1	43.1	med/high	MR	S	--	MR	MR	yes	yes
Badger	WI	2010	yellow	22-Jun	35.6	33.9	39.2	med	S	R	MR	R	R	yes	yes
Betagene	WI	2014	yellow	24-Jun	38.2	29.8	38.1	--	MS	--	--	--	MR	yes	yes
Deon	MN	2013	yellow	30-Jun	42.0	34.7	40.4	med	R	--	R	R	R	yes	yes
Eske2020	WI	2020	yellow	24-Jun	40.4	26.0	38.7	med/high	MR	MR	--	R	MR	inP	inP
Hayden	SD	2014	white	26-Jun	41.2	35.3	41.0	--	MS	MS	--	R	MR	yes	yes
Ron	WI	2014	yellow	25-Jun	39.7	34.6	40.3	med	S	--	R	R	MR	yes	yes
Shelby 427	SD	2009	white	23-Jun	41.1	40.1	41.2	med/high	MS	MS	MR	MR	MR	yes	yes
<b>Other varieties</b>															
Eske	WI	2004	yellow	24-Jun	39.5	29.3	37.6	med	MS	MS	MR	R	R	yes	yes
Dane	WI	1990	yellow	19-Jun	37.2	26.9	36.4	med	S	MR	S	R	S	yes	yes
Horsepower	SD	2012	yellow	25-Jun	35.8	54.0	38.4	med	S	R	MR	R	MR	yes	yes
Ogle	IL	1981	yellow	24-Jun	38.2	31.7	36.8	low	S	S	S	S	R	no	yes
Vista	WI	1999	yellow	27-Jun	41.7	40.5	39.1	low	MS	R	MS	R	MR	yes	yes

<sup>a</sup> Maturity (month-day) as heading date evaluated in 20 Wisconsin trials in 2017-2019. <sup>b</sup> Plant height (inches) at maturity evaluated in 20 Wisconsin trials 2017-2019. <sup>c</sup> Lodging (percentage) evaluated in 21 Wisconsin trials in 2016-2018. <sup>d</sup> Test weight (lb per bu) in Arlington and Madison Wisconsin tests conducted 2017-2019. <sup>e</sup> Crown rust disease resistance based on Madison and Arlington trials in 2018: R=Resistant, MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible. Due to the high mutation rate of the pathogen, 2017-2019 data was used for crown rust reports. <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 can't be grown and sold as seed without certification. inP= PVP application in process. -- Information not available.

**2015 season.** Wisconsin oat production was estimated at 14 million bushels, which was 61% more than the record high in 2014. The area planted with oat was 280,000 acres, and the area harvested was 195,000 acres. Oat yield was 72 bushels per acre, up 10 bushels from 2014.

Wisconsin barley production was estimated at 0.8 million bushels, which was 11% more than in 2014. The area planted with barley was 28,000 acres, and the area harvested was 15,000 acres. Barley yield was 55 bushels per acre, up 17% from 2014.

*There were no trials conducted during the 2015 season.*

**2014 season.** Wisconsin oat production was estimated at 8.7 million bushels, which was 27% more than the 2013 year's record low. The area planted with oat was 255,000 acres, and the area harvested was 140,000 acres. Oat yield was 62 bushels per acre, down three bushels from 2013.

Wisconsin barley production was estimated at 0.75 million bushels, which was 4% less than in 2013. The area planted with barley was 26,000 acres, and the area harvested was 16,000 acres. Barley yield was 47 bushels per acre, down two bushels from 2013.

**2013 season.** Wisconsin oat production was estimated at 6.83 million bushels, which was record low since 1866 and 12% less than the 2012 year. The area planted with oat was 255,000 acres, and the area harvested was 105,000 acres. Oat yield was 65 bushels per acre, up five bushels from 2012.

Wisconsin barley production was estimated at 0.78 million bushels, which was 19% more than in 2012. The area planted with barley was 33,000 acres, and the area harvested was 16,000 acres. Barley yield was 49 bushels per acre, up five bushels from 2012. (Source: USDA National Agricultural Statistics Service)

## Performance evaluation

**Grain yield.** Plots were harvested and threshed with a combine harvester in Madison, Arlington, Chilton, Antigo, and Sturgeon Bay; seed was dried and later cleaned. The other locations harvested bundles of plants that were dried and threshed. Yields are reported in bushels per acre at 12% moisture content. All the analysis was conducted in bushels per acre. There are 32 pounds per bushel of oat and 48 per bushel of barley (Table 4 and 5).

**Table 4.** Grain yield performance of **oats varieties** for the 2019 growing season and an average for 3 years (2017, 2018, and 2019)<sup>a</sup>.

Variety	Grain yield (bu/A) <sup>a</sup>															
	Alma <sup>b</sup>		Antigo <sup>b</sup>		Arlington		Chilton		Lancaster		Madison		Spooner		Overall <sup>c</sup>	
	2019	2-yr	2019	2-yr	2019	3-yr	2019	2-yr <sup>a</sup>	2019	3-yr	2019	3-yr	2019	3-yr	2019	3-yr
<b>Antigo</b>	87.1	78.4	49.1	62.6	46.6	104.8	97.7	98.4	85.7	80.5	102.3	92.1	71.5	72.0	83.4	102.6
<b>Badger</b>	49.8	49.1	66.1	62.7	80.2	123.6	116.7*	115.4	82.1	92.9*	99.7	114.2	75.7	81.6	72.1	89.8
<b>Betagene</b>	92.8	90.9	55.0	65.1	57.4	99.7	106.0	108.5	86.4	83.4	89.6	103.1	96.9*	84.6	80.7	102.4
<b>Dane</b>	54.6	56.1	54.3	56.1	90.7	139.0	104.8	109.7	78.6	75.4	120.0*	131.8*	61.7	70.7	66.4	87.6
<b>Deon</b>	95.6	97.8	87.4*	90.8*	89.3	136.9	112.1*	125.2*	92.6*	84.1	108.1*	118.0*	123.2*	101.2*	95.7*	116.0*
<b>Esker</b>	65.8	64.1	54.4	57.6	67.5	112.3	112.9*	115.7	92.0*	92.6*	102.1	104.9	82.6	77.3	77.6	97.2
<b>Esker2020</b>	121.9*	122.9*	77.4*	82.0*	97.9*	148.5*	117.2*	121.8*	103.4*	100.7*	118.0*	129.8*	98.1*	96.0*	103.8*	121.8*
<b>Hayden</b>	75.6	81.4	70.2*	78.0*	55.3	117.2	105.9	100.7	80.6	87.9	97.8	110.9	77.7	78.8	77.7	98.8
<b>Horsepower</b>	33.3	33.1	72.9*	75.4	51.3	108.1	105.2	113.9	89.3	87.9	101.6	109.8	74.2	82.7	55.9	74.9
<b>Ogle</b>	67.5	72.4	48.3	54.8	41.9	87.0	111.8*	110.7	81.2	83.2	93.1	94.1	72.8	79.0	63.9	86.6
<b>Ron</b>	68.9	71.2	72.1*	68.5	13.8	64.9	90.7	100.3	71.3	77.0	93.8	85.1	69.3	77.8	75.1	96.6
<b>Shelby427</b>	61.1	55.0	51.7	63.5	61.3	118.0	103.8	107.4	99.0*	95.3*	109.9*	110.5	85.5	81.6	73.06	90.4
<b>Vista</b>	86.2	79.9	39.7	53.6	58.7	98.1	102.9	105.7	97.2*	96.6*	94.2	83.8	96.7*	85.5	78.29	92.6
Trial mean <sup>d</sup>	95.04	94.2	66.68	70.35	85.06	109.71	110.49	114.77	90.76	91.07	108.11	110.51	88.14	85.96	90.95	107.42
Trial standard error	0.94	0.96	2.77	1.95	0.41	0.58	1.58	1.49	2.49	1.94	1.28	1.48	2.24	2.00	1.54	1.48
LSD	9.55	8.11	20.76	13.44	5.61	5.72	8.06	5.91	12.25	10.60	17.40	14.66	26.23	12.81	15.53	10.58

<sup>a</sup>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. <sup>b</sup>Trials in Alma and Antigo locations started in 2018, therefore, evaluations are reported for two-year averages only (i.e. 2018 and 2019). <sup>c</sup>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. <sup>d</sup>The trial mean 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

**Test weight.** Test weight was measured with a Cox funnel using a 0.5 liter (L) measuring cup and weighting in grams. All data was transformed to pounds per bushel following seed trade recommendations and all analysis were conducted in lb per 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. All 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.

**Lodging.** Lodging was measured in percent, where 0% is no lodging and 100% is severe lodging. It was then transformed to weak=severe lodging, medium=intermediate lodging, low=low lodging (Table 3).

**Forage dry matter.** An area of 3x3.28 ft was hand-harvested at 2 inches above ground and dried. The weight of the sample was transformed to tons per hectare prior to analysis. Yield is reported in tons per acre (Table 6). Madison and Arlington are the only locations used for forage trials.

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

### 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

**Table 5.** Grain yield performance and heading date of **barley varieties** in the 2019 Wisconsin growing season at six locations.

Variety	Heading date <sup>b</sup>	Grain yield (bu/A) <sup>a</sup>						Overall <sup>c</sup>
		Arlington	Madison	Lancaster	Chilton	Antigo	Spooner	
AAC Synergy	29-Jun	49.6	74.6*	72.3*	46.2	51.0	54.8	49.2
AC Metcalfe	5-Jul	17.9	70.2	60.6	35.7	30.9	37.5	32.0
CDC Copeland	4-Jul	17.2	58.2	49.1	30.4	16.7	23.2	25.5
Conlon	20-Jun	39.5	66.5	66.5	45.8	42.1	44.1	41.4
Kewaunee	20-Jun	66.3*	65.2	71.3*	70.6*	76.4*	43.5*	62.1*
LCS Genie	8-Jul	9.5	79.6*	35.1	25.8	13.8	29.7	19.3
ND Genesis	25-Jun	52.1	60.4	70.8*	53.7	39.5	45.6	47.9
Pinnacle	24-Jun	41.6	62.4	72.3*	52.8	38.1	39.6	44.6
Quest	22-Jun	63.7*	87.3*	69.4	72.7*	67.3*	47.3	59.2*
Rasmusson	22-Jun	51.0	77.7*	84.2*	76.3*	58.0	52.2*	60.5*
Trial Mean <sup>d</sup>	29-Jun	40.9	70.2	65.2	51.0	43.4	41.7	44.2
Trial Standard Error	0.34	0.7	1.6	1.8	1.2	1.2	0.4	0.6
LSD	1.98	6.1	13.2	14.5	6.8	9.8	3.6	8.0

<sup>a</sup>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. <sup>b</sup> Heading date (month-day) as indicated in 20 Wisconsin tests conducted 2017-2019. <sup>c</sup>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. <sup>d</sup>The trial mean 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.

Drumlin, Esker, Esker2020, Kame, Moraine, Ron, BetaGene™, 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.

### 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 6.** Forage dry matter yield and quality of **spring oat varieties harvested at Madison, Wisconsin** in 2019 and an average for three years (2017, 2018, and 2019).

Variety	Booting date <sup>a</sup>		Heading date		Dry biomass (ton/A)		Relative forage quality		Crude protein (%)		Milk (ton/A)	
	2019	3-year	2019	3-year	2019	3-year	2019	3-year	2019	3-year	2019	3-year
<b>ForagePlus</b>	20-Jun*	22-Jun*	3-Jul*	3-Jul*	0.96*	0.94*	159.5	141.8*	8.5	10.3*	1.43*	1.30*
<b>Goliath</b>	14-Jun	16-Jun	29-Jun	27-Jun	0.78	0.72	169.7*	153.5*	9.2*	11.2*	1.18	1.02*
<b>Laker</b>	16-Jun	18-Jun	2-Jul	30-Jun	0.96	0.87*	157.6	144.1*	8.8*	11.3*	1.53*	1.23*
<b>Vista</b>	13-Jun	15-Jun	26-Jun	24-Jun	1.01*	0.86*	154.2	149.9*	8.8*	11.3*	1.50*	1.25*
Trial Mean <sup>b</sup>	16-Jun	19-Jun	29-Jun	30-Jun	0.85	0.99	162.0	134.3	8.9	10.2	1.31	1.31
Trial Standard Error	0.10	0.09	1.12	0.08	0.01	0.01	0.77	0.94	0.04	0.08	0.02	0.04
LSD	1.24	1.91	1.53	1.72	0.17	0.24	9.5	21.1	0.51	1.73	0.19	0.54

<sup>a</sup> 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. <sup>b</sup> The trial mean 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

**Table 7.** Forage dry matter yield and quality of **spring oat varieties harvested at Arlington, Wisconsin** in 2019 and an average for three years (2017, 2018, and 2019).

Variety	Booting date <sup>a</sup>		Heading date		Dry biomass (ton/A)		Relative forage quality		Crude protein (%)		Milk (ton/A)	
	2019	3-year	2019	3-year	2019	3-year	2019	3-year	2019	3-year	2019	3-year
<b>ForagePlus</b>	6-Jul*	2-Jul*	11-Jul*	10-Jul*	1.41	1.59*	102.7*	116.8*	9.0	10.8*	1.66*	2.04*
<b>Goliath</b>	2-Jul	27-Jun	7-Jul	4-Jul	1.46	1.42*	102.8*	123.8*	9.6*	11.5*	1.66*	1.82*
<b>Laker</b>	2-Jul	29-Jun	10-Jul	6-Jul	1.39	1.48*	104.1*	113.8*	10.0*	11.1*	1.62*	1.78
<b>Vista</b>	30-Jun	26-Jun	6-Jul	3-Jul	1.69*	1.51*	106.1*	114.1*	9.7*	11.5*	1.93*	1.73
Trial Mean <sup>b</sup>	2-Jul	19-Jun	9-Jul	6-Jul	1.35	1.47	112.2	118.3	10.0	11.4	1.63	1.81
Trial Standard Error	0.05	0.05	0.05	0.06	0.01	0.01	0.48	0.49	0.04	0.03	0.03	0.01
LSD	0.91	1.33	0.84	1.70	0.20	0.22	8.7	13.0	0.6	0.9	0.78	0.21

<sup>a</sup> 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. <sup>b</sup> The trial mean 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

**Table 8.** Forage dry matter yield and quality of **spring barley varieties harvested at Madison, Wisconsin** in 2019 and an average for three years (2017, 2018, and 2019).

Variety	Booting date <sup>a</sup>		Heading date		Dry biomass (ton/A)		Relative forage quality		Crude protein (%)		Milk (ton/A)	
	2019	3-year	2019	3-year	2019	3-year	2019	3-year	2019	3-year	2019	3-year
<b>Hays</b>	7-Jun	11-Jun	24-Jun*	23-Jun*	0.59*	0.61*	174.3*	155.9*	9.7	10.9*	0.93*	0.85
<b>Kewaunee</b>	5-Jun	7-Jun	15-Jun	15-Jun	0.51*	0.46	172.3*	162.1*	10.6*	12.3*	0.77	0.66*
<b>Westford</b>	12-Jun*	15-Jun*	24-Jun*	22-Jun*	0.66*	0.74*	168.5*	149.9*	9.5	10.5	1.02*	1.04*
Trial Mean <sup>b</sup>	15-Jun	19-Jun	29-Jun	30-Jun	0.85	0.99	162.0	134.3	8.9	10.2	1.31	1.31
Trial Standard Error	0.10	0.09	1.12	0.08	0.01	0.01	0.77	0.94	0.04	0.08	0.02	0.04
LSD	1.24	1.91	1.53	1.72	0.17	0.24	9.46	21.09	0.51	1.73	0.19	0.54

<sup>a</sup> 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. <sup>b</sup> The trial mean 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

**Table 9.** Forage dry matter yield and quality of **spring barley varieties harvested at Arlington, Wisconsin** in 2019 and an average for three years (2017, 2018, and 2019).

Variety	Booting date <sup>a</sup>		Heading date		Dry biomass (ton/A)		Relative forage quality		Crude protein (%)		Milk (ton/A)	
	2019	3-year	2019	3-year	2019	3-year	2019	3-year	2019	3-year	2019	3-year
<b>Hays</b>	27-Jun	25-Jun	1-Jul	1-Jul*	1.13*	1.19*	140.8*	131.5*	10.42*	11.86*	1.62*	1.64*
<b>Kewaunee</b>	25-Jun	22-Jun	27-Jun	26-Jun	0.926	1.00*	128.3	138.3*	10.66*	12.49*	1.26*	1.37
<b>Westford</b>	9-Jun*	27-Jun*	2-Jul*	1-Jul*	1.01*	1.14*	134.3*	135.7*	10.35*	11.64*	1.40*	1.59*
Trial Mean <sup>b</sup>	2-Jul	29-Jun	9-Jul	6-Jul	1.35	1.47	112.2	118.3	9.96	11.39	1.63	1.81
Trial Standard Error	0.05	0.05	0.05	0.06	0.01	0.01	0.48	0.49	0.04	0.03	0.03	0.01
LSD	0.91	1.33	0.84	1.70	0.20	0.22	8.65	13.0	0.62	0.89	0.78	0.21

<sup>a</sup> 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. <sup>b</sup> The trial mean 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



**Copyright © 2019** by the Board of Regents of the University of Wisconsin System doing business as the Division of Extension of the University of Wisconsin-Madison. All rights reserved.

**Authors:** Lucia Gutierrez is Assistant Professor in the Agronomy Department College of Agricultural and Life Sciences Department, University of Wisconsin-Madison. Dr. Gutierrez is currently cereals breeder and quantitative geneticist. Pablo Gonzalez-Barrios is graduate student in Dr. Gutierrez's lab. Shawn Conley is Professor in the Agronomy Department College of Agricultural and Life Sciences Department. University of Wisconsin-Madison. Division of Extension publications are subject to peer review.

**University of Wisconsin-Extension, Division of Extension**, in cooperation with the U.S. Department of Agriculture and Wisconsin counties, publishes this information to further the purpose of the May 8 and June 30, 1914, Acts of Congress. An EEO/AA employer, the University of Wisconsin-Madison Division of Extension provides equal opportunities in employment and programming, including Title VI, Title IX, and ADA requirements. If you have a disability and require this information in an alternative format, or if you would like to submit a copyright request, please contact Publishing Manager at 432 N. Lake St., Rm. 227, Madison, WI 53706; pubs@uwex.edu; or (608) 263-2770 (711 for Relay).

**This publication is available** from your Wisconsin county Extension office (yourcountyextensionoffice.org) or from Extension Publishing. To order, call toll-free 1-877-947-7827 or visit our website learningstore.extension.wisc.edu.