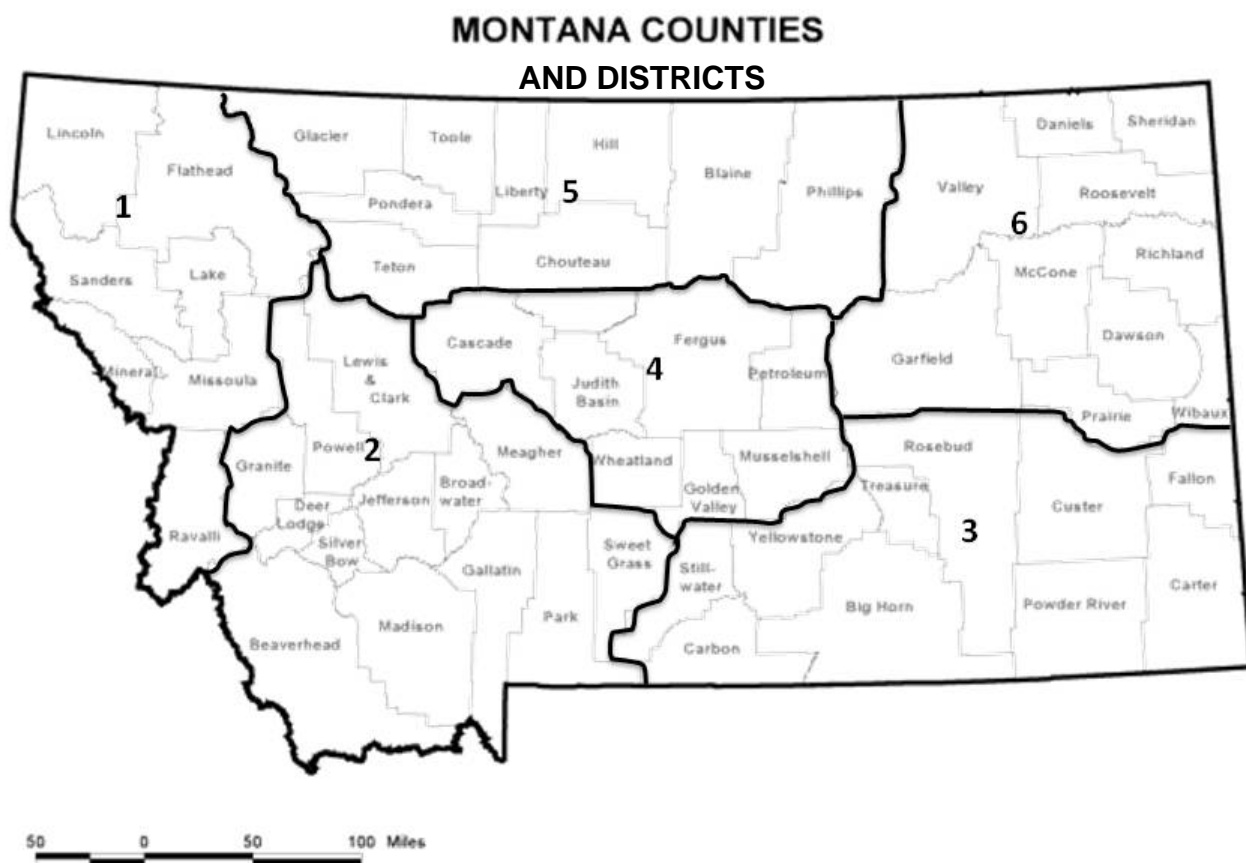


2019

WINTER WHEAT VARIETIES

Performance Evaluation (2018 Data)



by the Montana State University
Agricultural Experiment Station

The information in this publication can also be found at a link on:
<http://plantsciences.montana.edu/crops>

Another variety selection tool is available at :
<http://www.sarc.montana.edu/php/varieties.html>

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WINTER WHEAT VARIETY PERFORMANCE SUMMARY IN MONTANA

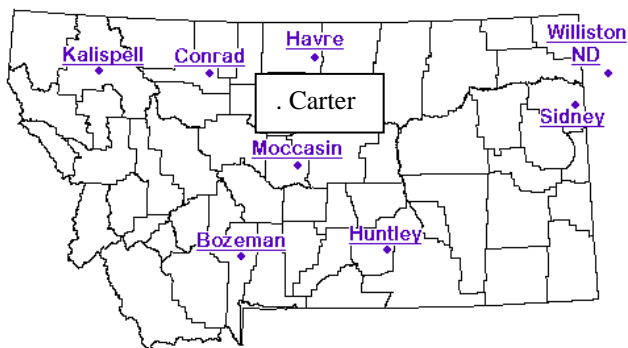
J. E. Berg, P. L. Bruckner, P. Carr, C. Chen, C. Cook, J. Eberly, Z. T. Fang, K. D. Kephart, K. Kowatch-Carlson, P. Lamb, A.T. Link, K. McNamara, J. H. Miller, G. Pradhan, V. Smith, J. A. Torrion, D. Holen, D. Nash, and H. Unverzagt

Introduction

The agronomic characteristics of winter wheat varieties recently developed or evaluated by the Montana Agricultural Experiment Station are compared in this publication with other varieties grown in the state. A brief description of each variety is given which may include a variety's particular advantages or disadvantages. The information was extracted from the Intrastate Winter Wheat Nursery. This data is prepared by research personnel of the Montana Agricultural Experiment Station. Where available, up to four years of yield data are shown for the varieties. In some years data are not available because of hail, winter-kill, or other unavoidable causes.

Variety Testing Procedures

Fig. 1. Test Locations for Montana winter wheat performance tests in 2018.



Entries

Names of commercially available varieties and experimental lines evaluated in 2018 are listed with their origins, experimental designation, release year, and pedigrees in Table 2 for the hard winter wheats. Forty-nine hard wheats are included in this summary comprising 33 varieties (15 public and 18 private) and 16 experimental lines (15 public and 1 private). Numbered entries preceded by a state designation [e.g. MT1642 (Montana) or private company, PSB13NEDH-7-140, (Limagrain)] are experimental lines provided by the breeder.

Experimental Design and Seeding Methods

The Intrastate Winter Wheat Test consists of a 49 entry test with 3 replicates. These tests are planted as 7x7 lattices or a randomized complete block design at each location. Plot size varied by location, from 35 ft² at Conrad to 60 ft² at Havre. Row number varies: Bozeman and Havre are 3-row, Conrad, Huntley, Carter, and Sidney are 4-row, Moccasin (5-row), Kalispell (7-row), and Williston (8-row) Row spacing at all locations was on 1 ft. centers, except at Williston and Kalispell (6" centers). All plots were seeded at 1 million seeds/acre, except at Kalispell (1.25 million) and Williston (1.17 million seeds/acre). Information on previous crop, planting date, fertilizer use and harvest date is available in Table 1.

All seed, for each nursery, was treated with Cruiser Maxx Cereals seed treatment, at recommended rates, before planting.

Locations

Hard winter wheats were planted at 8 Montana and 1 North Dakota location (Fig. 1) including Carter/Ft. Benton, Conrad and Havre in the North Central district, Moccasin in the Central district, Huntley in the Southern district, Sidney and Williston, ND representing the Northeast district, Kalispell in the Northwest and Bozeman in the Southwest districts of the state.

Description of Data Collected

Yield

All rows of each plot were trimmed and measured and harvested using an experimental plot combine. Grain yields are reported in bushels per acre based on a 60 pound standard bushel weight. In addition to yields obtained in 2018, data is provided for two (2017-2018), three (2016-2018) and four (2015-2018) year averages for hard wheat entries tested during previous cropping seasons

Table 1. Summary of agronomic practices used on hard winter wheat performance trials in Montana in 2018. Fall nitrogen (N), phosphorus (P₂O₅) and potassium (K₂O) were preplant applied and incorporated.

Location	2017 Crop	2016 Crop	2017 Planting Date	Fertilizer				2018 Harvest Date
				N		P ₂ O ₅	K ₂ O	
				Fall	Spring			
----- Pounds per acre -----								
Kalispell	spring wheat	peas	Sep 26	0	-	0	0	Aug 2
Bozeman	fallow	barley	Oct 6	210	-	35	10	Aug 15
Huntley	chem. fallow	barley	Oct 6	10	-	6	7	Aug 1
Moccasin	pea/lentil	fallow	Oct 9	10	180	15	10	Aug 8
Conrad	chem. fallow	barley	Sep 25	41	182	23	20	Aug 7
Havre	fallow	barley	Sep 21	125	50	20	10	Jul 24
Carter	chem. fallow	na	Oct 12	-	-	-	-	Aug 7
Sidney	fallow	spring wheat	Sep 13	80	-	0	0	Jul 31
Williston, ND	cover crop mix	winter wheat	Sep 12	6	70	20	0	Jul 23

Test Weight

Test weights (pounds per bushel) were obtained for each plot by using Dickey-John Grain Analysis Computer (GAC) at some locations. Other locations use a Seedburo test weight apparatus. In this case, a sample is dropped through a funnel at a given height into a quart brass bucket, excess grain is removed by a flat stick then weighed on a gram scale, and grams per quart are converted into pounds per bushels.

Heading Date

Heading date is taken when 50% of the heads in a plot were extended above the flag leaf collar. Heading dates are recorded both in ordinal date (number of days from January 1) and the actual calendar date.

Plant Height

Plant height was measured, in inches, from the soil surface to the top of the head, excluding the awns.

Grain Protein

Grain protein is sampled from a composite of all 3 replicated plots at each location. It is determined as a % by NIR (near infrared reflectance) on the Infratec whole grain analyzer. Samples are adjusted to a 12% moisture basis.

Winter Survival

Percent winter survival is estimated for each plot after initial spring green-up at locations where significant winter injury occurred. There was differential winter-kill at Sidney, resulting in winter survival ranging from 0-63% (average = 40%) on May 8th, in 2018.

Table 12 contains information on % winter survival and associated yield in winter-kill environments from 2013 to 2018. The data summarizes 4 tests in which significant winter-kill occurred (test average for winter survival was less than 90%). All sites with winter-kill were in District 6 (Sidney and Williston) which are the most severe location for winter wheat survival of our testing locations.

Wheat Stem Sawfly

Wheat stem sawfly (WSS) is a persistent and economic problem for wheat growers in Montana. Currently, Montana wheat acreage infested by WSS is primarily in the north central (District 5), central (District 4) and south central (District 3) cropping districts. Host plant resistance in the form of stem solidness has been effective in reducing sawfly losses in both spring and winter wheat. Current solid-stemmed winter wheat varieties include: Judee, (released in 2011), Bearpaw (2011), Warhorse (2013), Loma (2016), and WB4483 (2016).

Table 13 contains information on yield and % sawfly cutting at 13 testing locations where sawfly pressure was present during the years 2013-2018.

The data is from Carter (13 miles west of Ft. Benton), Choteau, Fly Creek (about 25 east-southeast of Huntley), Havre, Loma (15 miles northeast of Ft. Benton), Shelby/Devon area, and The Knees (35 miles east-southeast of Conrad). Solidness scores (rated on a 5-25 scale) are shown for solid and semi-solid varieties in Table 15.

Coleoptile Length

Coleoptile length evaluation is performed in Bozeman under controlled (growth chamber) conditions. Twenty-five seeds per variety were planted in wetted vermiculite. After 15 days the coleoptile (sheath covering the emerging shoot that helps penetration to the soil surface) is measured. This test is replicated 3 times for each variety. Results from previous years are reported in Table 15. Long coleoptiles are generally longer than 3.5 inches, medium from 2.7-3.5 in, and short are under 2.7 in. Care should be taken not to plant short coleoptile varieties too deep.

Other Agronomic Characters

Table 15 contains information on grain maturity, chaff color, relative winter survival and straw strength for the hard wheat varieties listed in this publication.

Cereal Quality

Milling and baking characteristics for varieties are presented in Table 15. They are rated for each variety on a 1-5 scale (5 = superior). A quantitative polyphenol oxidase (PPO) has been determined for varieties since the 2006 mill and bake evaluation. These varieties are reported in Table 15 as low to high. A lower value is associated with better Asian noodle quality.

Disease Reactions

Disease reactions for hard red wheat varieties are listed in Table 15. There is information on dwarf smut, stripe rust, stem rust and leaf rust.

Statistical Analyses and Interpretation

The data collected at each winter wheat location was analyzed as a three-replication lattice or randomized complete block design. Least significant difference at the 0.05 probability level (LSD, $p = 0.05$) and coefficients of variation (CV)

were calculated from analysis of variance at each location. The LSD is used to compare the performance of two specific varieties at a time. If the difference between two varieties exceeds the LSD this is interpreted as a true difference, because a difference between two varieties this large will only occur 5% of the time due to chance.

Tables 3 through 11 show 2018 data for hard winter wheat collected at all harvested experiment station sites. Where a variety has been in the test for two, three or four years, combined analyses of the yield data over years are presented.

Variety selection should be based on yield stability at a particular location over a period of years. Selection should also consider test weight, winter-hardiness, heading date, plant height, protein and disease resistance.

2018 Test Conditions

Statewide winter wheat yields were projected by the Montana Agricultural Statistics Service at 50 bushels per acre (bu/a), for 2018. This is a new record, 1 bushel above the previous record, set in both 2010 and 2016, of 49 bu/a. This is also an increase over the 42 bu/a for the 2017 harvest year. The harvested acreage in 2018 was 1.57 million acres (total production = 78.5 million bu) compared 1.59 million acres in 2017 (total production = 66.8 million bu).

Rainfall for the 2017-2018 crop year was above average at all locations except Conrad (average) and both Carter/Fort Benton and Kalispell (below average, with a range of -2.87 inches at Kalispell to +8.38 at Huntley (Table 14). Average yearly temperatures were below long term at all locations, except Kalispell, ranging from -3.8°F (Conrad) to +2.6°F at Kalispell (Table 14).

In 2017, 'Yellowstone' was miss-planted. No 2 year through 4 year comparisons could be made at any of the locations, except Kalispell and Williston, which were not harvested in 2017.

Yields, for the 9 locations harvested averaged 77 bu/a {range 44 (Willison, hail impacted) to 132 bu/a (Bozeman)}. Yields of named varieties, across the 7 harvested locations, ranged from a low of 68 bu/a (Bearpaw) to a high of 86 bu/a for Keldin.

Test weight averaged 61.6 lb/bu across all locations. Kalispell (58.4 lb/bu, heat and stripe

rust), Williston (59.8), and Carter/Fort Benton (59.9) were below 60 lb/bu, while the other 6 locations were above.

Heading dates were earlier in 2018 than long term averages at the 8 harvested locations where comparisons are available. Bozeman at -6 days had the greatest difference, while the least change occurred at Huntley (-2 days). Heading dates for all these stations averaged 6 days later than 2017.

Stripe rust at Bozeman, typically a yield reducing factor the previous 3 years (2015-2017), was practically non-existent in 2018. Stripe rust at Kalispell (data not recorded) was a factor in yield and test weight reduction for highly susceptible varieties (Bearpaw, Byrd CL Plus, Decade, Incline AX, SY 517 CL2, and WB4575).

There was sawfly cutting recorded at the Northern Seeds Carter/Ft. Benton site averaging 53%, ranging from 0 (Warhorse) to over 75% (Langin, LCS Zoom, SY Clearstone 2CL, and Yellowstone) of stems cut, across all entries. Sawfly cutting was also recorded at Havre (average = 6%, range 0 – 15%) and Conrad (average = 18%, range 1 – 42%).

Protein content averaged 12.6% across all locations (location range = 11.2 – 14.2%) tested. The range of named varieties across all locations was from a low of 11.5% (Langin) to a high of 13.7% (WB4623CLP).

Dwarf Smut (TCK)

Dwarf smut (TCK) can be controlled with 'Dividend' seed treatment (see page 5). Dwarf smut or dwarf bunt (*Tilletia controversa* Kuhn) is a fungal disease that occurs in areas where winter wheat is subjected to prolonged snow cover or unfrozen ground. The planting of dwarf smut resistant varieties (Promontory and SY Clearstone 2CL are resistant) is a practical means of control.

The amount of wheat lost each year because of dwarf smut is small in relation to the state's total crop, but individual operators may experience severe losses in heavily infested, localized areas.

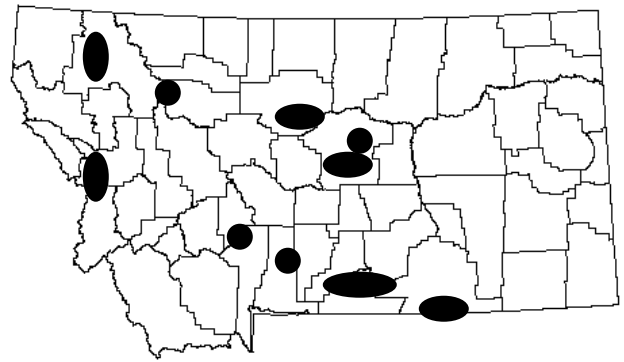


Fig. 2. Known areas of dwarf smut (TCK) infestations.

If you farm in the vicinity of one of the shaded areas in the map (Figure 2.), you would be well advised to observe closely your winter wheat crop and consider using seed treatment.

Producing Winter Wheat

Plant **CERTIFIED CLASS SEED** of varieties **RECOMMENDED** by the Montana Agricultural Experiment Station.

Seed Treatment

Treat all winter wheat seed with a recommended fungicide to reduce losses caused by cereal smut or other seed-borne diseases. Several non-mercurial compounds are registered for grain seed treatment.

Dwarf smut (bunt) can be controlled with difenoconazole. Dividend® contains this compound and is available in Montana. If you farm in a dwarf smut area contact your seed dealer or chemical representative for more information about this seed treatment. See Figure 2 for known areas of dwarf smut infestations.

Diseases are best controlled when all seeds are coated with a seed treatment. Do not over-treat-- Follow recommendation of manufacturer of product as to rate.

Truck-mounted seed treaters, which apply the fungicide as the seed is augered into the drill box, do a good job of treating if operated according to manufacturer's specifications.

Drill box treatments are not effective for general use.

When using any pesticide materials, read the information on the label as to rate of application, specific uses, methods of handling, precautions, etc.

Seeding Rate and Date

The following rates and dates for seeding are general (Figure 3). The heavier seeding rate, where indicated, is applicable to plump seed of high test weight (above 60 lbs/bu) or for seed having a kernel size larger than normal for most other varieties. The lighter rates are for the smaller seeded varieties or when test weight is below normal for larger seeded varieties. Seeding rates may be lower if adequate nitrogen and phosphorus amounts are applied at planting.

Winter wheat seed lots may vary in the number of seeds per pound depending on the ratio of large-to-small seeds in a seed lot. The average is approximately 15,000 seeds per pound. A precise count of the number of seeds per pound should be made on your seed lot to help calibrate your drill. You can also calculate how many pounds of seed you will need to plant an acre.

Figure 3. Seeding rate (lb/acre) and date for winter wheat

Districts	Dryland	Irrigated	Date of Seeding
5,6	30-60	60-75	Sept. 1-15
1,2,3,4	30-60 (10-20 seeds/sq. ft.)	60-75 (20-25 seeds/sq. ft.)	Sept. 10-25

As to seeding date -- DO NOT SEED TOO EARLY in areas where root rot diseases are prevalent. In areas where Cephalosporium stripe, wheat streak mosaic virus or other root rot diseases have caused losses, delay seeding until the soil temperature in the seed zone will stay below 55°F except for brief periods during the day. In the southern half of Montana, this is usually September 10 to 20. In Districts 5 and 6, plant between September 1 and 15. Cooler soil temperatures slow root development and reduce the probability of winter

root injury and invasion by soil-borne organisms. To reduce the incidence of root and foot rots, plant winter wheat on land previously seeded to other crops such as barley, oats or spring wheat. Extreme seeding delay, however, reduces seedling vigor and increases chances of winter-kill.

Seeding Depth

Set the drill to place the seed 1 to 2 inches below the soil surface. Deeper seeding reduces tillering and lowers crop yields. With the furrow drills, wind-driven soil particles settle in the furrows covering the seed deeper than desired.

Yield in Winter Wheat as Influenced by Percent Stand

During periods of winter injury farmers are frequently faced with a decision as to whether or not a field should be torn up and re-seeded. A 40 to 50 percent winter wheat stand, if general over field, may produce as much as re-seeded spring wheat. Thinner stands will likely demand more attention for weed control.

The guidelines for evaluating winter wheat stands are to determine the average number of healthy plants per square yard. We suggest making a square frame out of 3/8 inch rod. Walk the field in a zigzag pattern counting at ten random locations.

Fields that have 80 or more plants per square yard will probably produce more than if replanted to spring wheat (information taken from 1995 Master's Thesis, "Critical Overwintering Plant Population for Successful Winter Wheat Production in Montana" by Doug Holen).

Table 2. List of public, private, and experimental hard winter wheat varieties.

Variety	Experimental Designation	Origin	Release Year	Pedigree
Public Varieties				
AAC Wildfire	W512	Alberta; SECAN	2015	((Norstar*5/PGR16635, AMN4LV) /6/ (RWA53, PI294994/3/ I3C//Norwin/Blizzard/4/2*AC Readymade /5/ Norstar*5/PGR16635// 2*Redwin/3/ AC Readymade) /7/ (A7257W-71-2-1/ A77695W, ID337-R1)// CDC Kestrel, L99-1236)8/ AC Bellatrix
Bearpaw	MTS0721	Montana	2011	selection from a composite of 5 crosses: 99X96, DMS/Rampart// Pronghorn/3/2*Rampart; 99X97, DMS/Rampart//Pronghorn/3/ Rampart/4/(MTW9806, Redwin/Rio Blanco/NuWest) ; 99X98, DMS/Rampart//Pronghorn/3/Rampart/4/NuPlains; 99X99, DMS/Rampart//Pronghorn/3/Rampart/4/(MT9513, NuWest/5/(TAM W-103/Froid/4/Yogo/Turkey Red/3/Centurk, MT8030)); and 99X100, DMS/Rampart//Pronghorn/3/Rampart/6/(MT98113, Judith/5/ (MT8764, Crest/(VT1230, French male sterile line)/4/((PI178383/ Cheyenne//3*Tendoy, ID5011)/3/(ID5006, Norin 10/Staring// 2*Cheyenne, ID745101)))
Brawl CL Plus	CO06052	Colorado	2011	Teal 11A/Above/(CO99314, TX91V4931/ Halt)
Byrd CL Plus	CO13003C	Colorado	2018	CO06072/4*Byrd (Als1, Als2)
Decade	MT0552	Montana; North Dakota	2010	selection from composite of 3 crosses:((Sumner sib, KS831936-3, (Plainsman V/Odesskaya 51)/(NE86501, Colt/Cody), N95L159, Wesley sib)/3/ CDC Clair, N95L159/(MT9602, NuWest/Tiber) and N95L159/4/ (MT9609, Froid/SD1287// Redwin/3/NuWest)
FourOsix	MT1465	Montana	2018	selection from a composite of 5 crosses: 06X272, Yellowstone/ (MT0684, a composite - see pedigree); 06X276, Yellowstone/ (MT06102, , a composite - see pedigree); 06X278, Yellowstone/7/ (MT06110, (Arapahoe/3/Brule//Hiplains/ Newton, SD93528)/6/ (MT9409, Tiber/5/ (TAM W-103/Froid/4/Yogo//Turkey Red/ Oro/3/Centurk, MT8030)); 06X282, Yellowstone/3/(MT06123, '2174'/(MT9440, BigSky sib)/BigSky); and 06X285, Yellowstone/7/ (98X168E1, (Nuwest/4/ (MT88001, Sawmont/Tendoy /3/Yogo// Norin 10/Brevor) /5/(MT7863, Froid/Winoka/ Centurk), MTS9720)/6/(PI 191303, Alba = Belgian variety)/Elkhorn);
Incline AX	CO14A065	Colorado	2017	(AF28/Byrd)/(AF10/2*Byrd)
Judee	MTS0713	Montana	2011	(Vanguard/Norstar//Judith dwf, 93X312E14)/3/ NuHorizon
Langin	CO11D446	Colorado	2016	(Hatcher/(NW97S295, Antelope sib), CO050270)//Byrd
Loma	MTS1224	Montana	2016	Yellowstone/5/((Lew/Tiber//Redwin, MTS92045)/3/2*Erhardt, MTS0112)/4/(MTS0125 , selection from a composite of 4 crosses)
Northern	MT0978	Montana	2015	selection from a composite of 2 crosses: 00X248, (Yellowstone sib, MT9982)/4/((MT8709, Erhardt sib)/NuWest//Erhardt, MTW0072)/3/ (NW97S151, KSSB0192-3/NE89529) and 00X249, (Judith/(PI262605, Karagach, RWA resis.)/3/(S86-740, Norstar/Plainsman V //Ulianovka), MTW0047)/4/MTW0072/NW97S151
Oahe	SD10257-2	South Dakota	2016	Ransom//3/(SD96240-3-1, (Colt*2/Chisholm, NE87513)//USSR#67)
Ray	MTF1432	Montana	2018	Yellowstone*2/7/(98X168E1, (Nuwest/4/(MT88001, Sawmont/ Tendoy /3/Yogo//Norin 10/Brevor) /5/(MT7863, Froid/Winoka/ Centurk), MTS9720)/6/(PI 191303, Alba = Belgian variety)/Elkhorn)
Warhorse	MTS0808	Montana	2013	selection from a composite of 3 crosses: 00X182, ((Froid/Winoka/7/ ((Sinvalocho/Wichita// Hope/Cheyenne /3/Wichita/4/Seu Seun 27, TX55-391-56-D8)/5/Westmont, MT6928)/6/ Trader, MT85200)/8/ Redwin, MT9908)/9/ NuPlains/6/(MTS9862, (NuWest/ Lovrin 24 /4/((Rego/Cheyenne, Sel. 39-18-7)// Winalta, MT7431)/3/(MT7115, Yogo/T. polonicum-70-5), MT91366)/5/ (MTS92137, Lew/Tiber//Redwin)); 00X183, NuPlains/MTS9862/4/ (MTW0047, Judith/(PI262605, Karagach, RWA resis.)/3/(S86-740, Norstar/ Plainsman V //Ulianovka)); and 00X184, NuPlains/MTS9862/5/(MTS0028, Vanguard/4/(Lew/Tiber//Redwin, MTSF1570)/3/ Norstar)
Yellowstone	MT00159	Montana	2005	F ₂ composite of Promontory/Judith and Judith-dwarf/Promontory

Private Varieties

Table 2. List of public, private, and experimental hard winter wheat varieties.

Variety	Experimental Designation	Origin	Release Year	Pedigree
Keldin	ACS55017	Peter Franck: Seed Link Inc.; Ontario, Canada, Westbred LLC	2011	Barenburg 235/Carlisle//TRX-A16-3-2
LCS Chrome	LCH13DH-20-87	Limagrain LLC	2016	na = not available
LCS Jet	NSA10-7208	Limagrain Europe s.a.	2015	Apache/Autan
LCS Link	LCH13-1471	Limagrain LLC	2017	na
LCS Rocket	NSA10-2196	Limagrain LLC	2017	na
LCS Zoom	LWW14-73915	Limagrain LLC	2018	na
Long Branch	LCH12-012, HRX1652	Limagrain; Dyna-Gro Wheat	2015	T154 / T158
MTF1435	MTF1435	Montana: AgWest Seeds, Ephraim, UT; Sioux Nation Ag, Fort Pierre, SD	2018	(Yellowstone (Low PPO) plant seln, <u>MT08186</u>)/8/ <u>Yellowstone(L)*2</u> /7/ (<u>98X168E1</u> , (Nuwest/4/(MT88001, Sawmont/ Tendoy /3/Yogo//Norin 10/Brevor) /5/(MT7863, Froid/Winoka/ Centurk), MTS9720)/6/(PI 191303, Alba = Belgian variety)/Elkhorn)
SY 517 CL2	07CL039-7	Syngenta	2017	na, Clearfield Plus variety
SY Clearstone 2CL	MTCL1077	Syngenta, Montana	2012	Yellowstone*4/3/MTCL01158/CDC Teal 11A//Jagalene
SY Legend CL2	07CL046-2	Syngenta	2018	na
SY Monument	04BC574-2	Syngenta	2014	(KS89180B-2-1-1/CM75113, F1//X920750-A-11-2, <u>BC991149-11</u>)/3/(<u>00x0090-4</u> , W95091/W98-183
SY Sunrise	06BC796#68	Syngenta Seeds	2015	((X920709B-5-2/KS90WGRC10//Ogallala, BC98337-10-53)/3/CDC Falcon, <u>06BC308</u>)/4/ (<u>NE03458</u> , (McVey 78015/NE88521, NE95544)// W91-348/3/Millennium)
SY Wolf	BC01007-7	AgriPro, Syngenta	2010	((TAM-108/veery sib, SWM1524)//TX84V2029, TX91V3308)/3/(W93-359, W188-052/W96-180), W99-331)/4/(97x0906-8, (Mesa/W89-328, W96-180))//W95-188, Karl 92/W98-232))
WB4483	BZ9W09-2212	WestBred-Monsanto:	2016	Pryor/Genou
WB4575	BZ9W09-2075	WestBred-Monsanto:	2016	(hollow stem)
WB4614	BZ9W07-2034	WestBred-Monsanto:	2013	BZ9W96-788-B/Pryor
WB4623CLP	BZ9WM09-1663	WestBred-Monsanto:	2014	(B152/Rampart, DH990356, BZ9W02-2073)// Above/CDC Teal-11A

Public Elite Lines

	MT1265			Yellowstone*4//(<u>KS96WGRC40</u> , KS93U69*2/TA 2397) (Lr41, wcm)
	MTW1491			(Yellowstone (Low PPO) plant seln, MT08184)//(Yellowstone (Low PPO) plant seln, MT08188/(MT08175, Colter sib)
	MT1547			selection from a composite of 5 crosses: 06X272, <u>Yellowstone/ (MT0684</u> , selection from a composite of 5 crosses - see pedigree); and 06X276, <u>Yellowstone/(MT06102</u> , selection from a composite of 2 crosses - see pedigree); 06X278, <u>Yellowstone/7/ (MT06110</u> , (Arapahoe/3/Brule//Hiplains/Newton, SD93528)/6/ (MT9409, Tiber/5/(TAM W-103/Froid/4/ Yogo//Turkey Red/Oro/3/ Centurk, MT8030)); 06X282, <u>Yellowstone/3/(MT06123</u> , "2174/ (MT9440, BigSky sib)//BigSky); and 06X285, <u>Yellowstone/7/ (98X168E1</u> , (Nuwest/4/ (MT88001, Sawmont/Tendoy /3/Yogo//Norin 10/Brevor) /5/(MT7863, Froid/Winoka/Centurk), MTS9720)/6/(PI 191303, Alba = Belgian variety)/Elkhorn)
	MT1563			selection from a composite of 2 crosses: 07X76, <u>Yellowstone*2/5/ (PI640431</u> , BC4F4 line derived from WA007900*5/4/WA007900// Yr5/6*Avocet/3/ WA007900//Yr15/ 6*Avocet) and 07X77, <u>Yellowstone/PI640431//Yellowstone(340,233)</u>

Table 2. List of public, private, and experimental hard winter wheat varieties.

Variety	Experimental Designation	Origin	Release Year	Pedigree
name pending?	MT1564		2019?	selection from a composite of 2 crosses: 07X76, <u>Yellowstone</u> *2/5/ (PI640431, BC4F4 line derived from WA007900*5/4/WA007900// Yr5/6*Avocet/3/ WA007900//Yr15/ 6*Avocet) and 07X77, <u>Yellowstone/PI640431/4/(Yellowstone(340,233), Yellowstone*5/3/ (Yellowstone sib, MT9982))/(MTS0222, Rampart*2/Judith), 340,233)</u>
name pending?	MTS1588		2019?	selection from a composite of 2 crosses: 07X291, ((SMN82164/ SMN82140//Rocky/Tiber, MT9659)/3/S87-101/4/Pronghorn, <u>MT0598/5/(98X366E29-1, Heyne/Rampart)/(MT9513, BigSky sib)</u>) and 07X295, (((Lew/Tiber//Redwin ,MTS92021)/3/Judith/Arapahoe, MTS0023)/4/Pryor/ Genou, <u>01X258C1</u>)/5/ <u>MT0598</u>
name pending?	MTCS1601		2019?	((('L'Govskaya 167/Rampart/6/(MT9409, Tiber/5/ (MT8030, TAM W-103/Froid /4/Yogo//Turkey Red /Oro/3/Centurk)) , <u>MTS0531</u>) /13/ (<u>MTS0532</u> , same pedigree as MTS0531) /12/ (Morgan/5/ (88X24D247-?, (Wasatch/Yogo//Rescue/3/Tendoy, Sel. 251, MT88006)/4/Judith)), <u>96X17E69</u>) /9/((Tiber/5/(MT8030, TAM W-103/Froid /4/Yogo//Turkey Red /Oro/3/Centurk), MT9409)*2/6/IMI Fidel, <u>MTCL0309</u>)/7/ <u>CDC Teal 11A/8/(MTW01143, Promontory/5/ (MT91366, NuWest/ Lovrin 24 /4/((Rego/ Cheyenne, Sel. 39-18-7)//Winalta, MT7431)/3/NuWest)) /10/(MTCL0510, Rampart*3/Fidel/6/ (MTS9720, Nuwest/4/(MT88001, Sawmont/Tendoy /3/Yogo//Norin 10/Brevor)/5/(MT7863, Froid/Winoka/Centurk))) /11/ (<u>MTS0531</u>, see above)</u>
	MT1642			Yellowstone/Madsen//Yellowstone
	MTV1681			<u>Yellowstone*2/7/WillowCreek/6/(MT06129, (KS91HW29//Rio Blanco/KS91H184, KS96HW10-3)/4/(MTW0047, Judith/ (PI262605, Karagach, RWA resis.)/3/(S86-740, Norstar/Plainsman V //Ulianovka)/5/NuSky)</u>
	MT1683			selection from a composite of 2 crosses: 08X243, <u>Yellowstone(L)*2/CDC Buteo</u> and 08X245, same pedigree
	MT1687			selection from a composite of 2 crosses: 07X90, <u>Yellowstone(L)*2/ (OK00611W, OK Rising sib)</u> and 07X91, (TX95V9315/4/ (MT9712, Judith/Rio Blanco/3/(MT7863, Froid/Winoka// Centurk), <u>MT0692</u>)/5/ <u>Yellowstone/(OK00611W, OK Rising sib)</u>)
	MT1688			selection from a composite of 2 crosses: 07X90, <u>Yellowstone(L)*2/ (OK00611W, OK Rising sib)</u> and 07X91, (TX95V9315/4/ (MT9712, Judith/Rio Blanco/3/(MT7863, Froid/Winoka// Centurk), <u>MT0692</u>)/5/ <u>Yellowstone/(OK00611W, OK Rising sib)</u>)
	MT1695			selection from a composite of 2 crosses: 07X76, <u>Yellowstone</u> *2/5/ (PI640431, BC4F4 line derived from WA007900*5/4/ WA007900// Yr5/6*Avocet/3/ WA007900// Yr15/ 6*Avocet) and 07X77, <u>Yellowstone/ PI640431//Yellowstone(340,233)</u>
	MT16101			selection from a composite of 2 crosses: 09X257, (Yellowstone (Low PPO) plant seln, <u>MT08185</u>)/6/ <u>YLL*2/5/(PI640431, BC4F4 line derived from WA007900*5/4/ WA007900// Yr5/6*Avocet/3/ WA007900// Yr15/ 6*Avocet)/7/Promontory/ 3*YLL// YLL*2/ Pelsart</u> and 09X258, <u>MT08185// YLL*2/PI640431/3/YLL*2/Pelsart// PROM/3*YLL</u>
	MTF1631			selection from a composite of 2 crosses: 09X164, (Yellowstone (Low PPO) plant seln , <u>MT08184</u>)*3/8/ <u>YLL(L)*2/7/(98X168E1, (Nuwest/4/ (MT88001, Sawmont/ Tendoy /3/Yogo// Norin 10/Brevor) /5/(MT7863, Froid/Winoka/ Centurk), MTS9720)/6/(PI 191303, Alba = Belgian variety)/Elkhorn)</u> and 09X165, (Yellowstone (Low PPO) plant seln, <u>MT08185/MT08186//YLL(L)*2/ 98X168E1</u>

Private Elite Lines

	PSB13NEDH-7-140	Limagrain		Smoky Hill/McGill
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Table 3. HARD WINTER : District 1-- Kalispell - Dryland (High Rainfall)

Cultivar/Line	Spring flooding, weeds - plots not harvested in 2017							
	Grain Yield (bushels/acre)			Test weight	2018 Data		Plant height	Protein %
	2018	2016//18	2015//18		Heading Date	Ordinal Calendar		
1y	2 yr	3 yr	lb/bu	from Jan1	in	%		
07CL046-2,SY Legend CL2, P++	71.2			60.8	156.0	5-Jun	30.1	12.0
AAC Wildfire	83.2			55.8	161.0	10-Jun	42.7	11.9
Bearpaw +	25.7	21.1	41.1	49.6	157.4	6-Jun	37.8	13.9
Brawl CLP +	86.9	70.7	77.3	60.2	151.9	1-Jun	33.4	12.2
CO13003C,Byrd CL Plus +	70.1			55.3	154.9	4-Jun	38.5	11.8
Decade +	48.4	33.5	45.4	53.1	157.6	7-Jun	39.5	11.5
FourOsix ++	92.4	113.7		61.2	159.2	8-Jun	37.3	11.2
Incline AX ++	52.9			52.7	158.2	7-Jun	34.5	11.4
Judee +	94.5	106.7	112.9	58.4	158.9	8-Jun	39.1	13.2
Keldin (P)+	101.3	101.2	108.2	61.8	158.7	8-Jun	37.7	11.2
Langin ++	87.1			58.7	151.2	31-May	37.2	11.5
LCS Chrome (P)++	78.5			61.0	155.1	4-Jun	37.2	11.8
LCS Jet (P)+	122.3			59.0	158.0	7-Jun	34.5	10.2
LCS Link (P)++	80.1			59.7	155.3	4-Jun	34.6	11.6
Loma ++	87.6	107.8	120.1	55.4	159.6	9-Jun	37.2	12.3
Long Branch P+	101.5			62.2	153.6	3-Jun	34.0	11.4
LWW14-73915, LCS Zoom (P)++	122.3			59.6	158.7	8-Jun	33.1	11.4
MT1265	93.1	111.6	121.0	58.6	161.1	10-Jun	39.3	11.1
MT1547	94.5			62.0	158.0	7-Jun	37.3	11.1
MT1563	86.6			56.4	160.5	10-Jun	39.2	11.3
MT1564	106.2			62.0	154.4	3-Jun	37.7	11.2
MT16101	105.5			60.0	158.1	7-Jun	38.7	12.0
MT1642	96.2			54.3	161.8	11-Jun	35.3	11.6
MT1683	100.1			59.5	159.9	9-Jun	41.7	11.5
MT1687	89.6			61.6	156.9	6-Jun	33.0	12.8
MT1688	79.7			61.4	155.2	4-Jun	33.4	12.4
MT1695	93.7			61.8	154.8	4-Jun	35.6	11.1
MTCS1601	85.4			60.5	159.4	8-Jun	35.4	12.7
MTF1435 ++	79.8			56.5	160.9	10-Jun	43.1	12.1
MTF1631	85.6			55.0	159.0	8-Jun	43.0	12.1
MTS1588	94.1			59.8	159.1	8-Jun	34.5	12.0
MTV1681	82.2			55.9	157.9	7-Jun	37.3	11.8
MTW1491 (HWW)	92.4	115.6		59.5	160.0	9-Jun	39.4	11.4
Northern +	78.2	106.0	114.2	56.2	161.2	10-Jun	37.0	12.2
NSA10-2196, LCS Rocket (P)++	124.9			58.7	157.4	6-Jun	35.1	10.7
Oahe ++	100.5			62.3	156.0	5-Jun	41.1	12.0
PSB13NEDH-7-140 (P)	72.1			59.7	157.6	7-Jun	41.2	11.6
Ray ++	97.2			53.9	163.6	13-Jun	41.0	11.6
SY 517 CL2 P++	53.2			56.0	151.3	31-May	36.1	11.6
SY Clearstone 2CL P+	89.6	103.4	112.9	59.1	160.0	9-Jun	44.0	11.0
SY Monument (P)+	84.1	105.6	110.9	58.8	156.1	5-Jun	36.3	11.6
SY Sunrise (P)+	95.3	113.0	112.4	61.7	158.2	7-Jun	32.3	11.7
SY Wolf (P)+	71.5	85.1	91.9	56.4	153.7	3-Jun	33.0	12.2
Warhorse +	92.0	109.4	117.0	61.0	160.9	10-Jun	35.6	12.5
WB4483 (P)+	74.5	81.7		57.6	160.9	10-Jun	35.2	12.3
WB4575 (P)++	36.4	29.1		53.3	158.8	8-Jun	35.7	12.4
WB4614 (P)+	72.2	68.2	81.1	57.5	157.5	7-Jun	34.7	11.7
WB4623CLP (P)+	87.2	116.2	116.1	60.9	158.8	8-Jun	36.2	12.5
Yellowstone +	83.6	89.3	106.3	57.8	161.1	10-Jun	36.6	11.0
Average	85.4	89.4	99.3	58.4	157.9	7-Jun	37.0	11.8
LSD (0.05)	19.2	40.6	28.1	3.4	2.8		3.9	0.7
C.V.	12.9	21.7	17.0	3.6	1.0		6.1	3.6

bold = indicates highest value within a column**bold** = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

P = Private Variety; + = Protected Variety; ++ = PVP Pending

2/ = approved for release in 2019, name pending

(HWW) = Hard White Winter Wheat

Table 4. HARD WINTER : District 2-- Bozeman - Dryland (Moderate Rainfall)

Cultivar/Line	Grain Yield (bushels/acre)				Test weight lb/bu	2018 Data		Plant height in	Protein %
	2018	2017-17	2015-18	2015-18		Heading Date			
		2 yr	3 yr	4 yr		Ordinal	Calendar		
07CL046-2,SY Legend CL2, P++	117.1				64.8	163.4	12-Jun	33.7	12.0
AAC Wildfire	135.3				63.9	170.6	20-Jun	39.3	12.4
Bearpaw +	116.1	81.1	69.7	62.8	64.8	165.2	14-Jun	36.9	12.6
Brawl CLP +	115.3	89.0	86.4	82.7	65.3	159.1	8-Jun	33.5	13.5
CO13003C,Byrd CL Plus +	135.5	99.0			64.4	162.7	12-Jun	36.9	11.2
Decade +	129.3	86.0	74.4	67.4	64.2	164.7	14-Jun	38.0	12.5
FourOsix ++	134.4	119.5	109.1		64.4	165.6	15-Jun	33.6	11.9
Incline AX ++	131.5				63.2	164.8	14-Jun	35.8	11.2
Judee +	128.2	109.1	95.5	87.8	65.1	165.9	15-Jun	37.0	12.2
Keldin (P)+	144.6	121.2	109.3	103.2	64.6	165.4	14-Jun	35.0	12.1
Langin ++	140.3	109.7			63.7	158.9	8-Jun	33.6	11.1
LCS Chrome (P)++	115.7	111.5			64.4	162.0	11-Jun	36.6	13.2
LCS Jet (P)+	145.4	135.0			62.3	165.7	15-Jun	32.1	11.9
LCS Link (P)++	134.5				65.2	161.4	10-Jun	34.0	12.5
Loma ++	139.7	117.8	109.2	104.4	63.8	168.4	17-Jun	35.1	12.0
Long Branch P+	134.8	122.3			64.4	157.8	7-Jun	34.1	12.0
LWW14-73915, LCS Zoom (P)++	139.9				61.9	162.2	11-Jun	32.2	11.8
MT1265	146.6	127.6	120.3	110.8	63.3	168.2	17-Jun	40.1	12.2
MT1547	132.9	117.9			64.6	165.3	14-Jun	35.3	12.2
MT1563	142.6	119.6			63.9	167.3	16-Jun	40.1	12.1
MT1564	130.5	124.6			64.7	161.7	11-Jun	36.1	12.1
MT16101	131.0				64.2	163.5	13-Jun	37.4	12.5
MT1642	140.3				63.5	170.4	19-Jun	37.1	12.1
MT1683	141.6				63.7	166.5	16-Jun	39.4	12.2
MT1687	124.3				64.6	162.9	12-Jun	35.2	13.5
MT1688	128.0				64.6	162.2	11-Jun	34.5	13.6
MT1695	132.5				64.2	162.1	11-Jun	37.2	11.9
MTCS1601	135.3				64.6	165.9	15-Jun	37.4	12.7
MTF1435 ++	117.8	109.3			62.7	168.0	17-Jun	45.3	12.6
MTF1631	122.6				63.3	168.1	17-Jun	45.0	13.2
MTS1588	134.5	112.9			64.9	167.3	16-Jun	33.4	12.0
MTV1681	145.2				63.5	165.9	15-Jun	38.5	12.6
MTW1491 (HWW)	150.2	132.9	124.6		64.3	167.3	16-Jun	40.0	11.9
Northern +	147.8	119.1	107.4	101.4	63.8	167.3	16-Jun	38.2	12.1
NSA10-2196, LCS Rocket (P)++	138.4				61.4	162.9	12-Jun	34.1	11.1
Oahe ++	120.7				65.1	163.0	12-Jun	40.4	12.9
PSB13NEDH-7-140 (P)	124.7	107.5			65.0	165.0	14-Jun	39.0	13.7
Ray ++	138.5	123.0			61.7	170.8	20-Jun	43.6	12.5
SY 517 CL2 P++	113.7	96.4			65.2	159.6	9-Jun	33.1	12.6
SY Clearstone 2CL P+	142.4	120.7	110.5	103.5	63.3	167.2	16-Jun	40.2	12.3
SY Monument (P)+	136.7	118.0	109.6	103.7	63.6	162.0	11-Jun	34.6	11.8
SY Sunrise (P)+	114.6	105.9	101.3	100.1	65.2	162.1	11-Jun	30.5	12.8
SY Wolf (P)+	117.2	97.4	91.8	89.7	64.9	161.7	11-Jun	34.0	12.5
Warhorse +	120.7	107.1	97.2	90.4	63.8	167.3	16-Jun	36.4	13.0
WB4483 (P)+	133.2	93.3	79.3		64.8	168.2	17-Jun	36.1	11.6
WB4575 (P)++	116.9	70.6	61.4		65.1	166.8	16-Jun	35.9	12.5
WB4614 (P)+	135.6	98.1	87.8	81.3	65.5	166.3	15-Jun	35.0	11.8
WB4623CLP (P)+	127.5	114.3	109.0	99.9	64.0	165.6	15-Jun	35.0	13.7
Yellowstone + ^{1/}	137.3	-	-	-	63.8	167.3	16-Jun	39.0	11.9
Average	131.8	109.9	97.6	92.6	64.1	164.9	14-Jun	36.6	12.3
LSD (0.05)	11.6	31.4	20.1	14.4	0.4	1.1		1.4	
C.V.	5.0	14.0	12.4	10.9	0.4	0.4		2.2	

bold = indicates highest value within a column

1/ Yellowstone mis-planted in 2017: no 2, 3, and 4 year data

bold = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

(P) = Private Variety; + = Protected Variety; ++ = PVP Pending

2/ = approved for release in 2019, name pending

(HWW) = Hard White Winter Wheat

Table 5. HARD WINTER : District 3-- Huntley - Dryland

Cultivar/Line	*** Test not planted in 2015 ***							
	Grain Yield (bushels/acre)			Test weight	2018 Data		Plant height	Protein %
	2018	2017-17	2016-18		Ordinal	Calendar		
		2 yr	3 yr	lb/bu			from Jan1	in
07CL046-2,SY Legend CL2, P++	102.5			63.1	155.7	Jun 5	37.1	12.2
AAC Wildfire	98.8			62.7	162.7	Jun 12	40.6	13.1
Bearpaw +	112.4	97.4	96.6	61.8	158.3	Jun 7	40.0	13.2
Brawl CLP +	114.0	114.9	112.9	63.0	153.0	Jun 2	39.1	13.1
CO13003C,Byrd CL Plus +	125.5	125.4		62.0	155.7	Jun 5	44.8	11.9
Decade +	114.5	107.7	104.4	60.9	158.0	Jun 7	41.4	12.5
FourOsix ++	111.0	113.7	113.1	62.1	158.3	Jun 7	38.6	12.8
Incline AX ++	108.7			60.9	157.7	Jun 7	38.9	11.6
Judee +	100.2	107.8	105.8	62.2	159.0	Jun 8	40.8	13.0
Keldin (P)+	136.6	135.9	128.5	63.1	159.7	Jun 9	40.4	12.0
Langin ++	126.7	127.8		61.3	153.0	Jun 2	37.6	11.7
LCS Chrome (P)++	108.4	115.4		63.0	157.3	Jun 5	40.2	12.8
LCS Jet (P)+	134.9	137.6		61.5	158.3	Jun 7	36.9	12.9
LCS Link (P)++	127.0			62.9	154.0	Jun 3	37.7	12.0
Loma ++	98.0	104.7	106.6	61.1	162.0	Jun 11	34.6	12.7
Long Branch P+	118.4	123.1		62.8	153.7	Jun 3	38.0	11.6
LWW14-73915, LCS Zoom (P)++	131.9			60.2	156.3	Jun 5	37.5	12.3
MT1265	114.6	114.1	113.6	61.5	161.7	Jun 10	43.7	12.7
MT1547	113.1	113.5		62.4	159.3	Jun 8	39.6	12.4
MT1563	113.6	113.6		62.0	160.7	Jun 10	41.9	12.5
MT1564	116.8	124.3		63.0	154.3	Jun 3	40.7	12.1
MT16101	113.2			62.6	157.0	Jun 6	40.9	12.3
MT1642	120.3			61.6	162.7	Jun 12	41.9	13.1
MT1683	105.1			61.8	161.3	Jun 10	40.8	12.5
MT1687	118.7			63.2	157.7	Jun 7	39.8	12.9
MT1688	111.1			61.9	157.3	Jun 6	37.9	13.0
MT1695	98.5			62.0	157.3	Jun 6	39.2	12.0
MTCS1601	104.9			62.8	159.0	Jun 8	38.5	13.4
MTF1435 ++	89.4	92.5		61.7	161.7	Jun 11	52.8	13.5
MTF1631	102.7			62.9	161.0	Jun 10	47.3	14.0
MTS1588	100.8	105.4		62.3	160.3	Jun 9	36.3	13.0
MTV1681	108.3			61.4	159.7	Jun 9	40.7	12.8
MTW1491 (HWW)	106.7	116.3	115.8	62.8	161.0	Jun 10	42.3	12.4
Northern +	108.4	110.8	113.0	62.4	162.0	Jun 11	40.7	12.5
NSA10-2196, LCS Rocket (P)++	122.6			58.6	158.0	Jun 7	36.4	11.8
Oahe ++	110.4			63.5	157.0	Jun 6	46.9	12.6
PSB13NEDH-7-140 (P)	125.5	120.4		63.2	158.0	Jun 7	41.8	12.8
Ray ++	104.9	109.1		61.0	162.7	Jun 12	46.3	13.3
SY 517 CL2 P++	120.6	112.2		63.4	153.0	Jun 2	39.1	12.0
SY Clearstone 2CL P+	103.4	111.4	111.8	61.4	160.7	Jun 10	42.3	12.7
SY Monument (P)+	122.1	126.0	121.8	62.3	157.0	Jun 6	38.5	12.2
SY Sunrise (P)+	108.3	113.8	111.3	62.5	155.3	Jun 4	36.3	11.4
SY Wolf (P)+	121.5	122.2	120.7	62.8	154.7	Jun 4	36.9	13.0
Warhorse +	110.6	110.6	107.6	62.6	160.3	Jun 9	37.7	13.6
WB4483 (P)+	90.8	96.2	99.9	60.0	161.7	Jun 11	38.2	13.5
WB4575 (P)++	106.9	90.7	93.0	63.3	159.0	Jun 8	37.7	12.6
WB4614 (P)+	97.2	106.8	107.3	61.5	160.0	Jun 9	39.2	12.8
WB4623CLP (P)+	99.5	107.3	105.7	62.9	158.3	Jun 7	40.3	13.6
Yellowstone + ^{1/}	104.5	-	-	61.5	161.0	10-Jun	41.3	12.7
Average	111.5	113.4	109.9	62.1	158.4	7-Jun	40.2	12.6
LSD (0.05)	11.7	18.2	14.3	0.7	1.2		3.3	0.6
C.V.	6.1	7.9	7.9	0.7	0.5		5.0	2.6

bold = indicates highest value within a column

1/ Yellowstone mis-planted in 2017: no 2, 3, and 4 year data

bold = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

(P) = Private Variety; + = Protected Variety; ++ = PVP Pending

2/ = approved for release in 2019, name pending

(HWW) = Hard White Winter Wheat

Table 6. HARD WINTER : District 4-- Moccasin - Dryland

Cultivar/Line	Grain Yield (bushels/acre)				Test weight	2018 Data		Plant height	Protein %	
	2018	2017-17		2015-18		Heading Date				
		2 yr	3 yr	4 yr		Ordinal	Calendar			in
07CL046-2,SY Legend CL2, P++	50.6				64.1	162.0	11-Jun	26.3	13.2	
AAC Wildfire	65.1				61.5	172.3	21-Jun	33.0	11.8	
Bearpaw +	61.7	60.3	58.5	58.4	63.4	167.0	16-Jun	28.3	12.8	
Brawl CLP +	60.0	62.9	61.6	58.7	64.2	160.7	10-Jun	26.0	13.6	
CO13003C,Byrd CL Plus +	67.7	65.3			64.0	162.0	11-Jun	30.3	11.5	
Decade +	60.0	59.5	58.0	57.3	62.5	165.0	14-Jun	31.0	13.0	
FourOsix ++	69.2	64.3	66.8		63.7	165.0	14-Jun	29.0	12.6	
Incline AX ++	68.0				61.2	167.0	16-Jun	29.7	11.5	
Judee +	57.1	58.7	55.3	52.0	63.9	166.0	15-Jun	29.7	12.7	
Keldin (P)+	65.7	67.4	67.8	66.2	63.2	167.0	16-Jun	28.7	12.1	
Langin ++	70.5	68.5			63.0	158.7	8-Jun	24.7	11.4	
LCS Chrome (P)++	53.7	59.7			64.0	163.0	12-Jun	28.3	13.0	
LCS Jet (P)+	69.8	67.7			59.5	171.0	20-Jun	26.0	11.2	
LCS Link (P)++	65.6				63.7	162.0	11-Jun	27.3	12.4	
Loma ++	67.3	62.9	61.3	59.6	62.4	171.0	20-Jun	27.7	11.8	
Long Branch P+	61.9	62.4			63.4	158.3	7-Jun	24.7	12.0	
LWW14-73915, LCS Zoom (P)++	68.8				60.0	163.0	12-Jun	27.0	11.5	
MT1265	74.2	69.9	68.6	65.7	61.9	171.0	20-Jun	32.0	11.5	
MT1547	72.9	70.5			63.2	167.0	16-Jun	30.0	12.1	
MT1563	72.1	69.4			63.1	169.3	18-Jun	30.7	11.3	
MT1564	65.6	67.5			63.5	160.7	10-Jun	26.7	12.2	
MT16101	70.5				63.5	164.0	13-Jun	30.7	11.9	
MT1642	76.0				61.2	171.0	20-Jun	32.0	11.8	
MT1683	81.9				62.5	166.0	15-Jun	32.0	11.9	
MT1687	68.9				63.4	162.0	11-Jun	30.0	12.5	
MT1688	66.3				63.4	160.3	9-Jun	26.7	12.8	
MT1695	64.9				62.5	163.0	12-Jun	29.3	12.4	
MTCS1601	68.4				63.3	165.7	15-Jun	29.7	12.6	
MTF1435 ++	61.7	66.2			61.2	171.7	21-Jun	38.3	12.3	
MTF1631	64.1				62.0	171.0	20-Jun	37.3	12.0	
MTS1588	63.7	62.2			63.6	169.3	18-Jun	27.3	11.8	
MTV1681	70.1				61.9	169.0	18-Jun	31.0	12.4	
MTW1491 (HWW)	70.7	68.8	67.6		63.0	167.3	16-Jun	31.0	11.1	
Northern +	65.4	62.9	61.1	61.9	62.8	171.0	20-Jun	29.7	12.2	
NSA10-2196, LCS Rocket (P)++	64.1				60.5	167.0	16-Jun	26.3	11.6	
Oahe ++	65.1				64.1	162.0	11-Jun	30.3	12.3	
PSB13NEDH-7-140 (P)	60.6	63.9			63.9	163.3	12-Jun	29.0	13.5	
Ray ++	77.9	69.7			59.7	172.0	21-Jun	37.3	11.6	
SY 517 CL2 P++	60.4	61.3			64.3	162.0	11-Jun	26.3	12.6	
SY Clearstone 2CL P+	69.0	66.3	66.1	63.8	62.0	171.0	20-Jun	32.0	11.6	
SY Monument (P)+	72.7	71.4	68.5	66.4	63.0	164.0	13-Jun	28.3	11.7	
SY Sunrise (P)+	63.7	63.4	62.7	61.0	64.4	162.0	11-Jun	23.0	12.3	
SY Wolf (P)+	61.1	60.2	61.2	59.0	64.0	162.0	11-Jun	26.3	12.7	
Warhorse +	59.7	61.6	62.2	59.7	62.5	167.7	17-Jun	28.3	12.6	
WB4483 (P)+	62.1	59.7	57.9		63.2	169.3	18-Jun	28.0	11.5	
WB4575 (P)++	62.5	58.6	59.6		64.9	167.3	16-Jun	27.0	13.0	
WB4614 (P)+	72.6	66.7	62.4	61.2	63.9	165.0	14-Jun	28.3	11.6	
WB4623CLP (P)+	62.0	58.4	57.1	54.8	63.2	167.3	16-Jun	29.7	12.8	
Yellowstone + ^{1/}	69.7	-	-	-	62.3	169.0	18-Jun	31.7	11.7	
Average	66.2	64.3	62.3	60.4	62.8	165.9	15-Jun	29.3	12.2	
LSD (0.05)	11.2	ns	6.2	5.3	0.8	3.5		2.2	0.9	
C.V.	10.4	6.8	6.1	6.1	0.8	1.3		4.6	4.4	

bold = indicates highest value within a column

^{1/} Yellowstone mis-planted in 2017: no 2, 3, and 4 year data

bold = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

(P) = Private Variety; + = Protected Variety; ++ = PVP Pending

2/ = approved for release in 2019, name pending

(HWW) = Hard White Winter Wheat

Table 7. HARD WINTER : District 5-- Conrad - Dryland

Cultivar/Line	Grain Yield (bushels/acre)				2018 Data					
	2018	2017-17	2015-18	2015-18	Test weight	Heading Date		Plant height	Sawfly cutting	Protein
						Ordinal	Calendar			
	2 yr	3 yr	4 yr		lb/bu	from Jan1	in	%	%	
07CL046-2,SY Legend CL2, P++	71.5				61.5	156.4	5-Jun	24.9	11.6	13.4
AAC Wildfire	61.7				60.7	166.0	15-Jun	31.2	18.9	13.7
Bearpaw +	48.2	60.5	72.1	70.8	62.5	159.1	8-Jun	26.5	7.9	15.7
Brawl CLP +	65.5	73.0	79.7	81.2	63.6	152.5	2-Jun	26.6	9.9	13.1
CO13003C,Byrd CL Plus +	76.5	79.9			61.0	155.5	5-Jun	27.3	20.9	12.9
Decade +	52.5	59.9	71.8	72.1	62.4	158.6	8-Jun	26.2	12.1	14.9
FourOsix ++	60.8	66.1	78.8		61.2	158.8	8-Jun	25.3	29.1	14.0
Incline AX ++	68.3				61.1	157.1	6-Jun	26.4	15.0	11.9
Judee +	57.0	65.3	73.3	70.8	63.3	160.1	9-Jun	27.7	8.5	15.2
Keldin (P)+	61.5	70.8	83.7	85.2	62.4	160.9	10-Jun	25.8	27.2	13.8
Langin ++	69.0	77.9			61.8	152.4	1-Jun	24.0	10.8	12.3
LCS Chrome (P)++	56.1	66.0			62.1	156.2	5-Jun	26.7	42.4	14.3
LCS Jet (P)+	66.7	75.9			60.3	161.7	11-Jun	24.8	17.6	13.8
LCS Link (P)++	50.7				64.2	155.0	4-Jun	24.3	10.7	14.6
Loma ++	64.6	68.7	77.8	78.5	62.6	162.9	12-Jun	26.8	10.6	14.9
Long Branch P+	63.8	77.9			63.1	152.7	2-Jun	23.7	16.9	13.1
LWW14-73915, LCS Zoom (P)++	72.8				60.1	154.8	4-Jun	24.2	39.6	12.8
MT1265	58.1	67.8	78.4	78.9	61.6	164.5	14-Jun	30.2	20.7	14.4
MT1547	59.8	64.6			61.3	159.7	9-Jun	27.0	24.4	14.1
MT1563	59.6	67.6			60.7	163.5	13-Jun	30.8	19.9	14.3
MT1564	53.1	63.0			61.4	156.0	5-Jun	26.4	15.1	15.2
MT16101	56.6				62.5	156.4	5-Jun	27.7	11.7	13.9
MT1642	60.9				60.6	164.1	13-Jun	29.7	10.9	14.7
MT1683	58.5				61.2	163.4	12-Jun	29.1	26.4	14.5
MT1687	54.1				61.9	157.6	7-Jun	26.7	16.1	15.3
MT1688	57.9				61.2	157.5	7-Jun	24.6	23.4	15.1
MT1695	48.9				61.5	156.1	5-Jun	25.4	15.4	14.6
MTCS1601	71.3				61.9	160.3	9-Jun	28.0	8.5	13.7
MTF1435 ++	56.5	61.9			61.0	164.0	13-Jun	33.1	15.9	13.8
MTF1631	59.1				61.3	161.7	11-Jun	32.4	21.7	13.7
MTS1588	67.0	73.3			62.7	160.9	10-Jun	25.3	1.2	14.5
MTV1681	49.3				60.6	160.6	10-Jun	25.3	24.3	14.8
MTW1491 (HWW)	57.3	64.1	76.5		61.4	161.7	11-Jun	30.4	14.3	14.1
Northern +	55.1	64.7	77.6	80.2	62.0	162.9	12-Jun	26.0	17.0	14.5
NSA10-2196, LCS Rocket (P)++	62.4				60.2	159.4	8-Jun	24.8	32.5	13.3
Oahe ++	61.2				61.7	155.5	5-Jun	27.3	21.2	13.3
PSB13NEDH-7-140 (P)	59.6	65.8			61.9	157.6	7-Jun	27.2	17.3	14.8
Ray ++	61.4	65.4			60.0	165.3	14-Jun	31.8	21.7	13.8
SY 517 CL2 P++	69.0	72.7			63.0	152.3	1-Jun	23.8	9.1	12.8
SY Clearstone 2CL P+	65.5	73.2	81.4	81.8	59.9	163.6	13-Jun	30.7	17.7	14.0
SY Monument (P)+	63.7	71.4	84.6	84.5	61.4	157.3	6-Jun	23.8	29.4	13.1
SY Sunrise (P)+	63.9	70.3	77.1	78.4	63.3	154.6	4-Jun	22.3	30.0	12.8
SY Wolf (P)+	63.9	71.8	84.3	86.0	62.9	158.0	7-Jun	25.5	9.4	14.0
Warhorse +	50.0	58.0	66.9	64.7	60.3	160.0	9-Jun	26.0	3.6	15.0
WB4483 (P)+	61.7	64.7	77.2		61.9	162.0	11-Jun	26.4	14.3	14.7
WB4575 (P)++	64.1	69.4	78.6		64.3	160.4	9-Jun	25.9	11.1	14.2
WB4614 (P)+	67.4	70.6	82.8	81.0	62.9	161.4	10-Jun	28.2	12.7	13.9
WB4623CLP (P)+	71.0	69.5	78.5	75.7	61.9	160.2	9-Jun	25.8	32.1	14.3
Yellowstone + ^{1/}	56.4	-	-	-	60.9	163.4	12-Jun	29.9	20.4	14.6
Average	61.0	64.5	78.0	78.0	61.7	159.2	8-Jun	26.9	17.9	14.0
LSD (0.05)	11.0	8.8	8.2	7.8	1.4	2.1		3.3	13.0	0.8
C.V.	10.4	6.3	6.3	7.0	1.4	0.8		7.1	43.4	3.2

bold = indicates highest value within a column

^{1/} Yellowstone mis-planted in 2017: no 2, 3, and 4 year data

bold = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

(P) = Private Variety; + = Protected Variety; ++ = PVP Pending

^{2/} = approved for release in 2019, name pending

(HWW) = Hard White Winter Wheat

Table 8. HARD WINTER : District 5-- Havre - Dryland

Cultivar/Line	Grain Yield (bushels/acre)				2018 Data					
	2018	2017-17	2015-18	2015-18	Test weight	Heading Date		Plant height	Sawfly cutting	Protein
						Ordinal	Calendar			
		2 yr	3 yr	4 yr	lb/bu	from Jan1		in	%	%
07CL046-2,SY Legend CL2, P++	55.0				63.2	156.0	5-Jun	24.7	7	14.0
AAC Wildfire	72.5				62.2	163.0	12-Jun	25.3	6	13.8
Bearpaw +	57.9	50.4	55.0	56.3	62.8	160.0	9-Jun	21.7	2	14.9
Brawl CLP +	57.6	50.6	63.6	60.8	64.3	153.7	3-Jun	27.2	7	14.0
CO13003C,Byrd CL Plus +	58.8	55.6			63.4	154.9	4-Jun	25.0	4	12.6
Decade +	53.6	51.0	60.9	60.5	62.6	158.4	7-Jun	25.8	4	14.7
FourOsix ++	60.3	55.4	69.8		62.6	158.0	7-Jun	25.1	4	14.9
Incline AX ++	63.7				62.6	157.7	7-Jun	25.0	3	12.5
Judee +	55.7	52.6	63.5	62.7	63.6	158.9	8-Jun	24.6	5	15.5
Keldin (P)+	68.6	62.7	77.7	73.6	63.1	159.4	8-Jun	25.4	7	13.7
Langin ++	62.3	55.8			63.2	153.6	3-Jun	22.4	2	12.9
LCS Chrome (P)++	54.5	51.0			63.0	158.6	8-Jun	23.5	8	14.6
LCS Jet (P)+	59.5	53.9			60.7	160.4	9-Jun	21.8	5	13.8
LCS Link (P)++	49.5				63.4	156.7	6-Jun	24.3	7	14.9
Loma ++	60.5	54.6	63.3	61.4	62.6	162.6	12-Jun	23.4	4	14.4
Long Branch P+	64.6	57.6			63.2	154.3	3-Jun	23.6	4	12.2
LWW14-73915, LCS Zoom (P)++	53.8				60.9	156.3	5-Jun	23.2	7	13.8
MT1265	58.0	56.5	73.3	69.6	61.7	162.3	11-Jun	23.5	13	14.5
MT1547	59.4	54.7			62.7	158.6	8-Jun	25.9	4	14.1
MT1563	61.0	60.2			62.0	161.0	10-Jun	25.8	9	14.0
MT1564	61.2	56.4			63.6	156.0	5-Jun	26.9	2	13.8
MT16101	55.8				62.5	156.0	5-Jun	26.0	2	14.5
MT1642	60.1				60.6	164.4	13-Jun	27.2	13	15.3
MT1683	61.5				61.4	159.7	9-Jun	26.2	8	14.6
MT1687	58.7				63.1	156.0	5-Jun	26.4	9	14.4
MT1688	60.0				63.2	156.0	5-Jun	26.2	7	14.4
MT1695	56.5				62.6	156.1	5-Jun	26.5	6	13.9
MTCS1601	55.5				62.9	159.3	8-Jun	25.1	4	14.7
MTF1435 ++	55.0	50.0			60.6	161.4	10-Jun	32.1	7	14.2
MTF1631	57.5				62.0	160.3	9-Jun	29.1	8	14.4
MTS1588	62.7	59.4			62.7	160.0	9-Jun	22.2	2	14.3
MTV1681	61.7				62.1	158.7	8-Jun	25.6	4	14.1
MTW1491 (HWW)	60.5	60.3	76.9		62.4	159.7	9-Jun	25.9	11	14.0
Northern +	56.5	54.3	70.8	68.4	62.3	160.0	9-Jun	24.3	4	14.2
NSA10-2196, LCS Rocket (P)++	56.2				60.5	159.0	8-Jun	23.7	8	13.3
Oahe ++	49.2				63.4	155.4	4-Jun	26.8	3	14.3
PSB13NEDH-7-140 (P)	48.9	51.3			62.2	156.7	6-Jun	26.0	5	16.1
Ray ++	60.6	56.5			59.8	162.7	12-Jun	29.9	15	14.3
SY 517 CL2 P++	51.3	43.5			64.1	154.6	4-Jun	25.2	2	14.1
SY Clearstone 2CL P+	61.8	54.8	69.3	66.5	61.4	160.7	10-Jun	27.5	11	14.3
SY Monument (P)+	59.3	56.2	71.9	70.4	62.4	158.0	7-Jun	24.2	3	13.0
SY Sunrise (P)+	61.0	56.8	68.8	67.6	63.8	156.6	6-Jun	21.3	3	12.8
SY Wolf (P)+	59.7	56.8	70.4	67.8	63.4	155.7	5-Jun	23.8	4	14.2
Warhorse +	57.0	50.5	63.6	62.8	62.5	159.9	9-Jun	23.3	0	14.9
WB4483 (P)+	61.2	56.3	66.7		63.0	161.7	11-Jun	24.2	3	14.8
WB4575 (P)++	61.7	56.4	62.8		64.3	158.6	8-Jun	23.3	2	14.6
WB4614 (P)+	56.9	54.1	68.5	66.4	62.9	160.7	10-Jun	23.7	7	14.7
WB4623CLP (P)+	52.7	48.2	60.4	59.1	62.1	160.0	9-Jun	22.7	7	14.8
Yellowstone +^{1/}	61.9	-	-	-	61.7	161.0	10-Jun	26.8	8	14.2
Average	58.6	54.5	67.2	64.9	62.5	158.6	8-Jun	25.1	5.7	14.2
LSD (0.05)	7.3	6.6	10.4	8.0	0.4	1.6		2.2	5.7	0.7
C.V.	7.1	5.9	9.3	8.6	0.4	0.6		5.3	6.4	2.7

bold = indicates highest value within a column

^{1/} Yellowstone mis-planted in 2017: no 2, 3, and 4 year data

bold = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

(P) = Private Variety; + = Protected Variety; ++ = PVP Pending

2/ = approved for release in 2019, name pending

(HWW) = Hard White Winter Wheat

Table 9. HARD WINTER : District 5-- Carter/Ft. Benton (Northern Seeds) - Dryland

Cultivar/Line	*** Test not planted in 2015 ***						
	Grain Yield (bushels/acre)			2018 Data			
	2018	2017-17	2016-18	Test weight	Plant height	Sawfly cutting	Protein
	2 yr	3 yr		lb/bu	in	%	%
07CL046-2,SY Legend CL2, P++	69.3			60.1	30	33	11.8
AAC Wildfire	70.2			59.9	37	7	12.3
Bearpaw +	70.7	58.5	60.4	61.7	32	25	11.9
Brawl CLP +	63.2	55.6	61.8	62.7	26	38	12.3
CO13003C,Byrd CL Plus +	73.8	63.1		60.2	33	47	11.6
Decade +	66.8	59.8	64.1	59.8	31	38	12.5
FourOsix ++	53.5	53.1	58.7	60.1	30	73	12.2
Incline AX ++	54.9			59.0	28	43	11.5
Judee +	64.0	59.2	60.3	61.0	30	30	12.4
Keldin (P)+	60.0	58.6	63.3	60.1	32	47	11.9
Langin ++	58.2	51.5		60.0	24	75	11.0
LCS Chrome (P)++	65.5	53.6		60.5	32	63	12.0
LCS Jet (P)+	54.6	55.2		57.5	29	47	11.9
LCS Link (P)++	70.7			60.8	27	53	11.2
Loma ++	67.1	62.1	67.3	59.3	30	18	12.3
Long Branch P+	67.2	58.0		60.8	28	53	10.9
LWW14-73915, LCS Zoom (P)++	53.9			55.0	30	80	12.0
MT1265	63.2	53.4	59.1	59.7	34	72	11.7
MT1547	63.5	55.8		59.6	28	90	12.8
MT1563	65.9	53.7		59.0	35	70	12.3
MT1564	58.8	59.3		60.1	28	85	11.8
MT16101	55.0			60.4	31	80	12.1
MT1642	66.7			58.5	32	40	12.2
MT1683	67.5			59.5	32	92	11.7
MT1687	58.6			60.7	27	78	12.2
MT1688	62.3			59.7	29	72	12.4
MT1695	54.4			58.8	25	92	12.1
MTCS1601	52.8			60.6	33	40	12.4
MTF1435 ++	63.7	51.9		59.4	41	47	12.2
MTF1631	65.2			59.8	39	53	12.5
MTS1588	68.6	63.1		61.4	29	2	11.6
MTV1681	53.3			58.6	30	57	12.6
MTW1491 (HWW)	61.0	56.8	61.8	59.2	30	83	11.9
Northern +	69.7	56.2	60.9	59.8	34	43	12.1
NSA10-2196, LCS Rocket (P)++	52.2			55.5	28	87	11.6
Oahe ++	83.0			61.3	33	67	11.5
PSB13NEDH-7-140 (P)	62.7	58.5		61.8	29	60	12.3
Ray ++	56.6	48.3		58.1	36	43	12.2
SY 517 CL2 P++	59.0	59.1		61.8	27	43	12.3
SY Clearstone 2CL P+	68.5	56.0	61.3	59.1	34	88	12.3
SY Monument (P)+	76.4	60.4	66.5	58.6	29	60	11.5
SY Sunrise (P)+	72.1	60.2	61.1	60.5	24	35	11.6
SY Wolf (P)+	60.2	53.4	58.8	62.1	26	18	11.8
Warhorse +	72.4	62.7	62.7	60.7	30	0	12.6
WB4483 (P)+	56.0	57.7	61.9	60.0	33	27	12.2
WB4575 (P)++	81.1	64.7	67.9	62.2	27	32	12.2
WB4614 (P)+	72.7	64.0	61.2	61.3	30	38	11.9
WB4623CLP (P)+	58.5	53.7	54.8	61.5	27	23	12.9
Yellowstone + ^{1/}	70.0	-	-	58.8	33	92	12.1
Average	64.0	57.4	61.8	59.9	30.4	52.7	12.0
LSD (0.05)	16.5	ns	ns	1.6		22.7	
C.V.	15.9	12.1	10.8	1.6		26.6	

bold = indicates highest value within a column

1/ Yellowstone mis-planted in 2017: no 2, 3, and 4 year data

bold = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

(P) = Private Variety; + = Protected Variety; ++ = PVP Pending

(HWW) = Hard White Winter Wheat

2/ = approved for release in 2019, name pending

Table 10. HARD WINTER : District 6-- Sidney - Dryland

Cultivar/Line	2015 = severe winter-kill, no harvest									
	Grain Yield (bushels/acre)			Test weight	Winter survival	2018 Data		Plant height	Protein	
	2018	2017-17	2016-18			Ordinal	Calendar			
	2 yr		3 yr	lb/bu	%	from Jan1	in	%		
07CL046-2,SY Legend CL2, P++	63.1			62.8	34	159.5	9-Jun	26.0	11.6	
AAC Wildfire	70.3			61.8	65	162.5	12-Jun	29.1	10.5	
Bearpaw +	72.9	54.2	50.6	63.2	45	162.0	11-Jun	26.4	11.7	
Brawl CLP +	60.7	44.7	54.6	64.4	45	156.0	5-Jun	24.2	12.2	
CO13003C,Byrd CL Plus +	77.3	59.7		62.6	59	158.0	7-Jun	27.8	9.8	
Decade +	73.4	62.1	60.5	62.5	69	157.5	7-Jun	25.8	10.9	
FourOsix ++	68.0	54.6	56.4	62.5	48	160.0	9-Jun	26.6	10.7	
Incline AX ++	68.9			62.7	30	160.0	9-Jun	25.0	10.8	
Judee +	66.7	40.2	44.7	63.8	49	160.0	9-Jun	27.6	11.8	
Keldin (P)+	92.1	61.0	67.0	64.1	57	160.0	9-Jun	29.1	10.2	
Langin ++	68.7	51.8		63.4	59	155.0	4-Jun	25.8	9.6	
LCS Chrome (P)++	76.6	58.4		64.2	44	157.5	7-Jun	27.8	11.4	
LCS Jet (P)+	42.2	37.1		57.0	14	163.0	12-Jun	21.7	12.8	
LCS Link (P)++	61.8			64.2	54	156.5	6-Jun	25.8	11.1	
Loma ++	72.0	54.3	51.8	61.8	46	162.5	12-Jun	26.6	12.1	
Long Branch P+	68.4	51.1		62.3	50	156.5	6-Jun	24.0	10.3	
LWW14-73915, LCS Zoom (P)++	45.5			54.8	18	160.0	9-Jun	23.8	12.4	
MT1265	82.9	63.7	68.2	62.8	52	162.0	11-Jun	30.3	10.9	
MT1547	76.0	60.9		62.3	55	160.0	9-Jun	27.6	10.5	
MT1563	60.6	52.1		62.5	61	160.0	9-Jun	26.6	9.2	
MT1564	57.2	48.3		63.9	44	157.0	6-Jun	24.6	10.6	
MT16101	44.9			62.5	21	162.0	11-Jun	27.8	12.6	
MT1642	63.4			61.5	39	163.0	12-Jun	29.7	12.0	
MT1683	82.0			62.1	53	162.0	11-Jun	29.5	10.8	
MT1687	69.8			62.3	57	156.5	6-Jun	26.0	11.5	
MT1688	67.5			61.9	57	157.0	6-Jun	27.8	11.0	
MT1695	47.3			62.3	25	159.5	9-Jun	24.8	12.2	
MTCS1601	69.8			64.6	61	160.0	9-Jun	27.8	9.5	
MTF1435 ++	51.2	46.8		60.5	45	162.5	12-Jun	31.3	10.8	
MTF1631	73.8			62.4	53	161.0	10-Jun	33.5	11.5	
MTS1588	64.3	51.1		64.0	52	162.0	11-Jun	24.2	10.8	
MTV1681	74.8			62.3	57	160.0	9-Jun	27.8	11.1	
MTW1491 (HWW)	72.9	55.0	58.8	62.9	56	161.0	10-Jun	27.6	11.0	
Northern +	83.7	60.2	59.7	63.2	49	161.5	11-Jun	27.8	11.1	
NSA10-2196, LCS Rocket (P)++	10.9			-	0	162.0	11-Jun	22.8	12.6	
Oahe ++	74.2			64.4	54	157.0	6-Jun	28.1	11.4	
PSB13NEDH-7-140 (P)	79.9	59.1		65.0	54	158.0	7-Jun	30.1	11.6	
Ray ++	71.9	57.7		60.5	44	162.5	12-Jun	32.1	11.0	
SY 517 CL2 P++	60.3	43.1		64.2	39	155.5	5-Jun	25.0	11.0	
SY Clearstone 2CL P+	65.1	53.2	56.2	61.3	48	162.5	12-Jun	30.1	11.5	
SY Monument (P)+	80.2	62.6	65.1	61.8	60	158.5	8-Jun	25.2	9.6	
SY Sunrise (P)+	70.8	59.2	64.7	63.5	55	157.0	6-Jun	24.0	10.6	
SY Wolf (P)+	70.9	52.1	60.2	64.9	51	157.0	6-Jun	25.4	10.6	
Warhorse +	69.1	50.9	49.3	62.5	52	162.0	11-Jun	27.2	11.8	
WB4483 (P)+	72.3	53.5	54.8	61.7	51	162.0	11-Jun	28.0	12.2	
WB4575 (P)++	80.5	62.0	62.9	64.8	57	159.0	8-Jun	26.6	12.0	
WB4614 (P)+	66.0	53.9	60.8	63.6	53	161.0	10-Jun	23.4	10.1	
WB4623CLP (P)+	41.7	23.5	35.5	61.4	12	164.5	14-Jun	22.6	14.2	
Yellowstone + ^{1/}	72.7	-	-	62.1	62	162.0	11-Jun	28.3	10.4	
Average	66.9	53.0	56.9	62.6	47.3	159.9	9-Jun	26.9	11.2	
LSD (0.05)	13.4	15.9	14.2	1.7	12.4	2.6		3.2	1.5	
C.V.	10.0	14.7	15.7	1.4	15.1	0.8		5.9	6.8	

bold = indicates highest value within a column

^{1/} Yellowstone mis-planted in 2017: no 2, 3, and 4 year data

bold = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

(P) = Private Variety; + = Protected Variety; ++ = PVP Pending

^{2/} = approved for release in 2019, name pending

(HWW) = Hard White Winter Wheat

Table 11. HARD WINTER : District 6-- Williston, North Dakota - Dryland

*** No harvest in 2017 due to severe winterkill ***								
Cultivar/Line	Grain Yield (bushels/acre)			Test weight	2018 Data		Plant height	Protein %
	2018	2016//18	2015//18		Ordinal	Calendar		
	1y	2 yr	3 yr	lb/bu			from Jan1	in
07CL046-2,SY Legend CL2, P++	38.0			60.3	153.3	2-Jun	23.6	13.6
AAC Wildfire	55.1			61.0	159.7	9-Jun	22.9	13.8
Bearpaw +	42.0	50.6	43.4	58.7	154.8	4-Jun	21.0	14.6
Brawl CLP +	38.6	54.6	38.0	61.2	150.9	31-May	21.6	14.0
CO13003C,Byrd CL Plus +	43.4			59.8	152.1	1-Jun	25.6	12.5
Decade +	44.3	60.5	47.3	59.7	154.0	3-Jun	24.0	14.0
FourOsix ++	46.8	56.4		60.1	155.0	4-Jun	21.8	13.9
Incline AX ++	42.7			59.8	155.7	5-Jun	22.9	12.8
Judee +	43.9	44.7	39.5	61.2	155.4	4-Jun	23.9	14.3
Keldin (P)+	45.3	67.0	42.8	60.7	155.9	5-Jun	23.9	12.8
Langin ++	37.5			59.3	151.1	31-May	23.0	12.0
LCS Chrome (P)++	38.9			60.7	154.7	4-Jun	23.1	13.7
LCS Jet (P)+	43.0			58.1	156.7	6-Jun	20.5	13.5
LCS Link (P)++	41.6			60.6	153.8	3-Jun	23.3	13.4
Loma ++	46.6	51.8	48.8	59.7	157.7	7-Jun	21.4	13.9
Long Branch P+	33.8			59.0	152.0	1-Jun	20.8	12.5
LWW14-73915, LCS Zoom (P)++	43.9			56.2	154.2	3-Jun	21.8	13.3
MT1265	48.7	68.2	52.5	60.4	157.0	6-Jun	25.2	14.0
MT1547	46.8			60.0	154.9	4-Jun	22.8	14.0
MT1563	53.1			60.5	157.0	6-Jun	25.5	13.0
MT1564	44.5			60.1	152.3	1-Jun	23.5	13.4
MT16101	43.9			60.4	153.4	2-Jun	23.5	14.1
MT1642	50.8			59.4	159.6	9-Jun	23.9	14.0
MT1683	48.7			59.8	156.3	5-Jun	24.4	13.3
MT1687	45.1			60.0	154.3	3-Jun	24.4	13.9
MT1688	41.1			59.2	154.2	3-Jun	23.4	13.7
MT1695	40.6			59.9	152.6	2-Jun	23.5	13.1
MTCS1601	42.9			59.3	156.0	5-Jun	24.0	14.1
MTF1435 ++	41.1			60.0	157.7	7-Jun	27.7	13.4
MTF1631	47.7			60.5	157.0	6-Jun	27.9	14.0
MTS1588	47.0			59.6	156.7	6-Jun	22.4	14.4
MTV1681	46.6			59.5	155.3	4-Jun	23.5	14.0
MTW1491 (HWW)	47.7	58.8		60.4	156.7	6-Jun	22.9	13.2
Northern +	45.4	59.7	48.7	60.6	157.1	6-Jun	21.5	14.2
NSA10-2196, LCS Rocket (P)++	45.2			56.8	156.7	6-Jun	21.3	12.5
Oahe ++	42.5			60.5	152.8	2-Jun	24.4	13.0
PSB13NEDH-7-140 (P)	43.5			61.1	152.7	2-Jun	25.6	14.7
Ray ++	41.6			57.8	159.3	8-Jun	24.7	13.9
SY 517 CL2 P++	39.4			60.1	151.4	31-May	21.4	13.4
SY Clearstone 2CL P+	45.5	56.2	48.1	59.6	156.9	6-Jun	25.6	13.9
SY Monument (P)+	42.2	65.1	46.2	58.7	154.3	3-Jun	22.3	12.4
SY Sunrise (P)+	40.0	64.7	39.0	59.7	152.3	1-Jun	20.5	12.9
SY Wolf (P)+	43.8	60.2	46.1	61.4	152.4	1-Jun	21.6	13.5
Warhorse +	45.2	49.3	42.3	60.0	157.4	6-Jun	24.1	14.4
WB4483 (P)+	43.8	54.8		58.8	157.7	7-Jun	21.4	14.6
WB4575 (P)++	42.7	62.9		61.1	155.1	4-Jun	23.1	14.3
WB4614 (P)+	44.6	60.8	46.8	60.1	157.0	6-Jun	23.2	14.2
WB4623CLP (P)+	41.0	35.5	37.0	60.5	156.3	5-Jun	22.9	14.8
Yellowstone +	46.9	52.8	56.6	60.0	157.0	6-Jun	26.4	13.8
Average	44.0	48.3	45.2	59.8	155.2	4-Jun	23.3	13.6
LSD (0.05)	4.8	ns	ns	0.6	1.5		2.6	0.5
C.V.	6.5	7.7	16.5	0.7	0.6		6.8	2.2

bold = indicates highest value within a column

bold = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

(P) = Private Variety; + = Protected Variety; ++ = PVP Pending

2/ = approved for release in 2019, name pending

(HWW) = Hard White Winter Wheat

Table 12. 2013//2018 Intrastate Winter Wheat Test (Exp. 35): Combined Locations Winter Survival and associated Yield (Locations: Williston (2013, 2015), Sidney (2017, 2018) = 4 locations

location-years	*** No recordable Winterkill, with a harvest, in 2014 and 2016 ***							
	Winter Survival (%)				Yield under Winterkill conditions			
	2018	2017-18	2015//18	2013//18	2018	2017-18	2015//18	2013//18
	1	2	3	4	1	2	3	4
07CL046-2,SY Legend CL2, P++	34				63.1			
AAC Wildfire	65				70.3			
Bearpaw +	45	40	51	44	72.9	54.2	50.4	50.0
Brawl CLP +	45	36	42		60.7	44.7	38.3	
CO13003C,Byrd CL Plus +	59	47			77.3	59.7		
Decade +	69	66	70	59	73.4	62.1	57.3	57.2
FourOsix ++	48	47			68.0	54.6		
Incline AX ++	30				68.9			
Judee +	49	36	38	32	66.7	40.2	36.1	36.4
Keldin (P)+	57	43	38		92.1	61.0	50.0	
Langin ++	59	48			68.7	51.8		
LCS Chrome (P)++	44	43			76.6	58.4		
LCS Jet (P)+	14	13			42.2	37.1		
LCS Link (P)++	54				61.8			
Loma ++	46	43	60		72.0	54.3	53.5	
Long Branch P+	50	50			68.4	51.1		
LWW14-73915, LCS Zoom (P)++	18				45.5			
MT1265	52	49	62		82.9	63.7	58.6	
MT1547	55	52			76.0	60.9		
MT1563	61	58			60.6	52.1		
MT1564	44	46			57.2	48.3		
MT16101	21				44.9			
MT1642	39				63.4			
MT1683	53				82.0			
MT1687	57				69.8			
MT1688	57				67.5			
MT1695	25				47.3			
MTCS1601	61				69.8			
MTF1435 ++	45	45			51.2	46.8		
MTF1631	53				73.8			
MTS1588	52	36			64.3	51.1		
MTV1681	57				74.8			
MTW1491 (HWW)	56	50			72.9	55.0		
Northern +	49	43	57	50	83.7	60.2	57.0	58.1
NSA10-2196, LCS Rocket (P)++	0				10.9			
Oahe ++	54				74.2			
PSB13NEDH-7-140 (P)	54	51			79.9	59.1		
Ray ++	44	39			71.9	57.7		
SY 517 CL2 P++	39	30			60.3	43.1		
SY Clearstone 2CL P+	48	47	56	47	65.1	53.2	50.7	50.6
SY Monument (P)+	60	54	61		80.2	62.6	55.3	
SY Sunrise (P)+	55	59	51		70.8	59.2	47.5	
SY Wolf (P)+	51	44	48	42	70.9	52.1	46.7	48.4
Warhorse +	52	51	60	53	69.1	50.9	47.5	49.2
WB4483 (P)+	51	47			72.3	53.5		
WB4575 (P)++	57	53			80.5	62.0		
WB4614 (P)+	53	43	55		66.0	53.9	50.5	
WB4623CLP (P)+	12	6	9		41.7	23.5	20.5	
Yellowstone + ^{1/}	62	-	-	-	72.7	-	-	-
Average	47.3	44.2	50.4	46.6	66.9	53.0	48.0	50.0
LSD (0.05)	12.4	13.7	21.3	11.6	13.4	15.9	12.8	7.5
C.V.	15.1	15.3	25.3	16.8	10.0	14.7	15.9	10.1

+ = new for 2018, # = paid entry

1/ Yellowstone mis-planted in 2017: no 2, 3, and 4 year data

bold = indicates highest value within a column

bold = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

Table 13. HARD WINTER WHEAT: Yield Performance under Sawfly Pressure and % Sawfly Cutting (2013//2018)
 (Note: Sawfly cutting in each location-year $\geq 10\%$)

Cultivar/Line + = new for 2018 in Off Sta.	Grain Yield (bu/a)					Sawfly Cutting (%)				
	2018	2017-18	2016-18	2015-18	2013//18	2018	2017-18	2016-18	2015-18	2013//18
Location-years	6	8	10	11	13	6	8	10	11	13
Brawl CLP +	60.6	56.4				29	35			
Decade +	57.4	52.4	57.6	56.6	57.6	45	45	43	39	36
FourOsix ++	56.9	53.6				62	58			
Judee +	58.7	53.2	60.6	59.0	60.6	45	40	37	34	31
Keldin (P)+	59.2	54.8	63.3			51	53	53		
LCS Jet (P)+	57.0					58				
Loma ++ (ss)	62.7	56.9	61.6	60.2		33	32	28	27	
MT1265	56.4	52.9	58.6	58.1		61	58	56	53	
MT1547	56.3					67				
MT1563	58.8					57				
MT1564	56.7					55				
MT1642	60.2					49				
MTCS1601	60.0					39				
MTF1435 ++	53.9	50.1				54	49			
MTS1588 (ss)	66.0	60.0				3	6			
MTV1681	51.5					43				
MTW1491	57.9	53.0				65	61			
Northern +	61.0	55.3	60.3	59.9	62.0	58	51	46	43	38
Ray ++	56.6	52.2				58	53			
SY Clearstone 2CL (P)+	59.7	54.7	62.4	61.2	62.4	68	61	59	55	49
SY Monument (P)+	61.3	56.4				54	53			
SY Wolf (P)+	56.8	52.8	59.6	58.7		35	39	37	35	
Warhorse +	55.6	51.3	55.5	54.4	56.2	6	7	5	5	5
WB4483 (P)+	56.0					40				
Yellowstone +	59.4	55.0	61.3	59.9	61.0	65	57	56	52	46
Average	58.3	54.2	60.1	58.7	59.9	48.0	44.4	41.9	38.0	34.1
LSD (0.05)	5.5	4.4	ns	ns	4.4	15.5	15.2	12.4	11.8	11.3
C.V. (%)	8.3	8.1	10.1	9.5	9.3	28	34	33	36	42

bold = indicates highest value within a column

bold = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD ($p=0.05$)

(P) = Private Variety; + = Protected Variety; ++ = PVP Pending

(ss) = solid-stemmed sawfly resistant variety

(HWW) = Hard White Winter Wheat

2/ = approved for release in 2018, name pending

Table 14. Precipitation (top, in inches) and Average Monthly Temperature (bottom, °F) for Crop Year 2017-2018

Agricultural Research Center	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Total
	2017	2017	2017	2017	2018	2018	2018	2018	2018	2018	2018	2018	Average
Western Triangle, Conrad	1.59	1.21	0.40	0.48	0.28	0.65	0.94	1.05	1.80	2.73	0.34	1.04	11.79
	1987-2018 Average = 11.72 (Temp = 43.7)												
Northern, Havre	55.1	42.0	28.3	19.5	21.9	8.7	23.1	35.4	56.9	58.9	66.5	63.0	39.9
	1916-2018 Average = 12.05 (Temp = 42.8)												
Northwestern, Kalispell	1.08	0.95	0.66	1.90	0.20	2.59	1.25	0.24	1.10	2.50	0.18	0.50	13.15
	1980-2018 Average = 20.01 (Temp = 43.3)												
Central, Moccasin	0.99	1.28	1.69	2.98	1.17	2.14	0.42	1.54	1.78	2.63	0.30	0.22	17.14
	1910-2018 Average = 15.34 (Temp = 42.9)												
Southern, Huntley	54.0	41.4	35.4	28.9	33.8	26.6	37.0	43.6	58.4	59.7	66.3	65.5	45.9
	1911-2016 Average = 13.32 (Temp = 45.5)												
Northeastern, Sidney	2.62	0.60	1.16	0.93	0.27	1.21	1.46	1.21	3.84	4.46	1.12	0.79	19.67
	1949-2018 Average = 13.74 (Temp = 43.3)												
Williston (WREC), N. Dakota	55.9	43.1	32.5	23.1	25.2	13.0	31.8	37.2	55.0	58.5	65.5	65.6	42.2
	1990-2018 Average = 14.78 (Temp = 44.4)												
Northern Seeds, Carter/Ft. Benton	2.57	0.37	1.17	1.14	0.58	1.82	0.90	2.70	3.81	3.77	0.87	2.00	21.70
	2008-2018 Average = 13.46 (Temp = 45.0)												
Post Farm, Bozeman	58.6	47.0	33.6	23.4	19.6	9.9	29.3	40.7	59.1	63.4	70.2	67.8	43.6
	1958-2018 Average = 15.91 (Temp = 43.7)												
Northern Seeds, Carter/Ft. Benton	1.35	1.05	0.19	0.37	0.24	0.32	1.40	0.94	3.42	2.26	2.19	0.61	14.34
	2008-2018 Average = 13.46 (Temp = 45.0)												
Northern Seeds, Carter/Ft. Benton	53.8	45.2	28.9	17.9	13.2	4.0	26.0	37.5	60.5	66.4	69.4	66.7	40.8
	2008-2018 Average = 13.46 (Temp = 45.0)												
Northern Seeds, Carter/Ft. Benton	3.12	0.48	0.22	0.45	0.22	0.24	0.84	1.08	1.15	3.62	5.59	0.82	17.83
	1990-2018 Average = 14.78 (Temp = 44.4)												
Northern Seeds, Carter/Ft. Benton	59.5	48.0	30.0	18.3	15.2	6.5	26.2	36.9	61.9	66.6	70.2	69.6	42.4
	2008-2018 Average = 13.46 (Temp = 45.0)												
Northern Seeds, Carter/Ft. Benton	1.14	0.43	0.48	1.30	0.31	1.39	0.34	0.89	1.94	3.04	0.11	0.87	12.24
	2008-2018 Average = 13.46 (Temp = 45.0)												
Northern Seeds, Carter/Ft. Benton	57.8	45.4	33.8	23.0	20.9	8.2	27.5	39.6	59.6	62.8	70.1	67.8	43.0
	2008-2018 Average = 13.46 (Temp = 45.0)												
Northern Seeds, Carter/Ft. Benton	2.65	1.01	1.69	1.69	1.25	0.57	1.16	3.26	2.92	3.61	0.20	1.26	21.27
	1958-2018 Average = 15.91 (Temp = 43.7)												
Northern Seeds, Carter/Ft. Benton	55.6	44.2	31.7	20.5	26.7	19.8	34.0	41.7	55.9	59.4	66.5	64.5	43.4
	1958-2018 Average = 15.91 (Temp = 43.7)												

Table 15. Selected agronomic characters, cereal quality evaluations and disease reactions of hard winter wheat varieties.

Variety	Agronomic Characters							Cereal Quality			Disease Reactions ^{8/}			
	Maturity ^{1/}	Chaff Color	Winter Survival ^{2/}	Straw Strength ^{3/}	Stem solid ^{4/}	Clear-field	Coleoptile length ^{5/}	Milling ^{6/}	Baking ^{6/}	PPO ^{7/}	Dwarf Smut	Stripe Rust	Stem Rust	Leaf Rust
AAC Wildfire	L	Red	4	-		N	-	-	-	-	-	MR	-	-
Bearpaw	M	White	2	M	21	N	M	4	2	H	S	S	R	S
Brawl CL Plus	E	White	2	S		Y	L	3	3	H	S	S	-	-
Byrd CL Plus	E	White	3	-		Y	-	3	3	H	-	S	-	-
Decade	M	White	4	S		N	M	3	4	H	S	S	R	MS
FourOsix	M	White	3	S		N	M	3	4	M	S	R	MS	-
Incline AX	M	White	2	-		N ^{10/}	-	-	-	-	-	S	-	-
Judee	M	White	2	M	20	N	L	3	4	H	S	R	S	S
Keldin	M	White	2	S		N	S	3	2	H	S	MS	-	-
Langin	E	White	3	-		N	M	2	3	H	S	MS	-	-
LCS Chrome	M-E	Red	3	-		N	M-L	3	3	M	S	R	-	-
LCS Jet	M	White	2	-		N	L	4	2	H	S	R	-	-
LCS Link	E	White	3	-		N	-	-	-	-	-	MR	-	-
LCS Rocket	M	White	0	-		N	-	-	-	-	-	R	-	-
LCS Zoom	M-E	White	1	-		N	-	-	-	-	-	R	-	-
Loma	M-L	White	4	M	20	N	S	4	4	ML	S	R	R	-
Long Branch	E	White	3	-		N	M	3	3	H	S	R	-	-
Northern	M	White	3	S		N	S	3	3	L	S	R	R	-
MT1564 ^{9/}	E	White	3	S		N	S	3	3	M	MR	R	MR	-
MTC51601 ^{9/}	M	White	3	S	19	Y	-	3	3	H	-	R	MS	-
MTS1588 ^{9/}	M	White	2	S	23	N	S	4	4	ML	S	R	MS	S
MTF1435	L	White	3	MS		N	L	4	3	L	S	R	S	-
Oahe	E	White	3	-		N	-	-	-	-	-	R	-	-
Ray	L	White	2	MS		N	M	3	3	L	S	R	S	-
SY 517 CL2	E	White	2	-		Y	M-L	-	-	-	S	MS	-	-
SY Clearstone 2CL	M	White	3	S		Y	S	3	3	M	R	R	MR	-
SY Legend CL2	M-E	Red	2	-		Y	-	-	-	-	-	MR	-	-
SY Monument	M	White	3	S		N	M	3	2	ML	S	R	-	-
SY Sunrise	E	White	2	S		N	M	3	2	H	S	R	-	-
SY Wolf	M	White	3	S		N	M	3	2	M	S	R	R	-
Warhorse	M	White	4	MS	22	N	M	3	3	H	S	R	R	MR
WB4483	L	White	3	S	20	N	S	3	3	H	S	MS	-	-
WB4575	M	White	3	S		N	M	3	4	M	S	S	-	-
WB4614	M	White	4	S		N	M	3	3	H	S	R	-	-
WB4623CLP	M-L	White	1	M		Y	M	3	4	ML	S	R	-	-
Yellowstone	M	White	4	S		N	S	3	4	M	MS	R	S	MS

1/ VE = Very Early, E = Early, M = Medium, L = Late, VL = Very Late

2/ 5 = Best Winter survival (over several years at Sidney, Williston and Moccasin)

3/ W = Weak

5/ L = long

MW = Medium Weak

M = medium

M = Medium

S = short

MS = Medium Strong

- = no info.

S = Strong

4/ scored 5-25, 25 = most solid

Combined 2013-2017 Bozeman, Carter, Conrad, Havre, Gildford, Loma, and Moccasin data; varieties with no number were not evaluated

9/ = approved for release in 2019, name pending

6/ 5 = Superior

4

3

2

1 = Inferior

7/ PPO = Polyphenol Oxidase

(low is better for noodles)

L = low

M = medium

H = high

8/ R = Resistant

MR = Moderately Resistant

M = Moderate

MS = Moderately Susceptible

S = Susceptible

VS = Very Susceptible

- = no information

10/ Coaxium herbicide

resistance

Additional Descriptive Information for Winter Wheat Varieties

New for the 2019 Bulletin:

AAC Wildfire – hard red winter wheat developed by Agriculture and AgriFoods Canada in Alberta, released in 2015, and marketed by SECAN. AAC Wildfire is a late maturing, hollow-stemmed, tall wheat with red chaff. AAC Wildfire has average yield, test weight, and protein, with above average winter survival. AAC Wildfire is moderately resistant to stripe rust. Mill and bake characteristics, under Montana conditions, have not been determined.

Byrd CL Plus – hard red winter wheat developed by Colorado and released in 2018. Byrd CL Plus is an early maturing, hollow-stemmed, medium-tall wheat with white chaff. Byrd CL Plus has above average yield, average test weight, and below average protein, with average winter survival. Resistance or susceptibility to stripe rust, under Montana conditions, has not been determined for Byrd CL Plus. Mill and bake characteristics, under Montana conditions, have not been determined PVP, Title V will be applied for. Additionally, the CLEARFIELD genes are patented.

Incline AX – hard red winter wheat developed by Colorado and released in 2017. Incline AX is the first wheat to be released as part of the CoAXium Wheat Production System for use in control of grassy weeds. Incline AX is a medium maturing, hollow-stemmed, medium height wheat with white chaff. Incline AX has below average yield, test weight, and protein, with below average winter survival. Resistance or susceptibility to stripe rust, under Montana conditions, has not been determined for Incline AX. Mill and bake characteristics, under Montana conditions, have not been determined. PVP, Title V will be applied for. Additionally, the CoAXium genes are patented.

LCS Link – hard red winter wheat developed by Limagrain LLC and released in 2017. LCS Link is an early maturing, hollow-stemmed, short wheat with white chaff. LCS Link has average yield, above average test weight, and average protein with average winter survival. Resistance or susceptibility to stripe rust, under Montana conditions, has not been determined for LCS Link. Mill and bake characteristics, under Montana conditions, have not been determined PVP, Title V is pending (Certificate #201700394). *LCS Link will not be in the Montana Intrastate Winter Wheat Test for 2019.*

LCS Rocket – hard red winter wheat developed by Limagrain LLC and released in 2017. LCS Rocket is a medium maturing, hollow-stemmed, short wheat with white chaff. LCS Rocket has average yield, below average test weight and protein, with extremely low winter survival (in limited testing). Resistance to stripe rust, under Montana conditions, appears to be high - since it was the leading variety at Kalispell, in 2018, where stripe rust impacted yield. Mill and bake characteristics, under Montana conditions, have not been determined PVP, Title V is pending (Certificate #201800534). *LCS Rocket will not be in the Montana Intrastate Winter Wheat Test for 2019.*

LCS Zoom – hard red winter wheat developed by Limagrain LLC and released in 2018. LCS Zoom is a medium-early maturing, hollow-stemmed, short, awnless wheat with white chaff. LCS Zoom has above average yield, below average test weight, and average protein, with below average winter survival. Resistance or susceptibility to stripe rust, under Montana conditions, has not been determined for LCS Zoom. Mill and bake characteristics, under Montana conditions, have not been determined PVP, Title V will be applied for

MT1435 – hard red winter wheat developed by the Montana Agricultural Experiment Station and licensed to both AgWest Seeds, Ephraim, UT and Sioux Nation Ag, Fort Pierre, SD. MTF1435 was approved in 2018 and intended for release outside of Montana. Like Ray, MTF1435 is a late maturing, tall, awnless line developed for **forage** production as a possible replacement (or supplement to) Willow Creek (MT, 2005). Compared to Willow Creek, MTF1435 has similar forage yield and forage quality, but superior seed yield. Compared to conventional bread wheats; MTF1435 has below average yield, below average test weight, and average protein. MTF1435 is resistant to stripe rust and susceptible to stem rust. MTF1435 has low PPO and above average milling and average baking characteristics. PVP, Title V will be applied for. *MTF1435 will not be in the Montana Intrastate Winter Wheat Test for 2019.*

SY Legend CL2 – hard red winter wheat developed by Syngenta Participations AG and released in 2018. SY Legend CL2 is a medium-early maturing, hollow-stemmed, short wheat with white chaff. SY Legend CL2 has below average yield, above average test weight, and average protein with below average winter survival.

Resistance or susceptibility to stripe rust, under Montana conditions, has not been determined for SY Legend CL2. Mill and bake characteristics, under Montana conditions, have not been determined. PVP, Title V will be applied for. Additionally, the CLEARFIELD genes are patented.

Lines approved for variety release in 2019, names to be determined later:

MT1564 (name pending) – hard red winter wheat developed by the Montana Agricultural Experiment Station and available to certified seed growers in fall 2019. MT1564 is an early maturing (especially for a Montana line), hollow-stemmed, medium height wheat with white chaff. MT1564 has average yield, above average test weight, and average protein, with average winter survival. MT1564 has excellent resistance to stripe rust and is moderately resistant to both stem rust and dwarf bunt. MT1564 has medium PPO and above average milling and baking characteristics. PVP, Title V will be applied for.

MTS1588 (name pending) – hard red winter wheat developed by the Montana Agricultural Experiment Station and available to certified seed growers in fall 2019. MTS1588 is a medium maturing, solid-stemmed, short wheat with white chaff. MTS1588 has above average yield and test weight, average protein, with average winter survival. MTS1588 has the highest yield and lowest percent sawfly cutting, of all varieties, in trials where sawfly pressure was above 10% cutting. MTS1588 has excellent resistance to stripe rust and is moderately susceptible to stem rust. MTS1588 has medium-low PPO and above average milling and baking characteristics. PVP, Title V will be applied for.

MTCL1601 (name pending) – hard red winter wheat developed by the Montana Agricultural Experiment Station for exclusive license to a private company (to be determined) with a full partnership agreement with BASF Chemical Company. MTCL1601 will be available to certified seed growers in fall 2019. MTCL1601 is a medium maturing, semisolid-stemmed, medium height wheat with white chaff. MTCL1601 has average yield, above average test weight, and average protein, with good winter survival. MTCL1601 has high PPO and average milling and baking characteristics. PVP, Title V will be applied for. Additionally, the CLEARFIELD genes are patented.

Varieties previously in bulletin:

Bearpaw – hard red winter wheat developed by the Montana Agricultural Experiment Station in 2011. Bearpaw is a white-glumed, solid-stem, semi-dwarf (*Rht1*) wheat with medium maturity. Bearpaw has average yield, test weight, and protein, and below average winter hardiness. Bearpaw is resistant to prevalent races of stem rust but susceptible to stripe and leaf rust. Stem-solidness of Bearpaw is most similar to Rampart. Bearpaw is a high PPO variety with above average milling and below average baking properties. PVP, Title V option has been issued (Certificate #201200407). *Bearpaw will not be in the Montana Intrastate Winter Wheat Test for 2019.*

Brawl CL Plus – hard red winter wheat developed by Colorado and released in 2011. Brawl CL Plus is an early maturing, medium short statured wheat, with white chaff. Brawl CL Plus has average yield and above average test weight and protein. Brawl CL Plus is susceptible to stripe rust. Brawl CL Plus is a high PPO variety with average mill and bake characteristics. PVP, Title V has been issued (Certificate #201200434). Additionally, the CLEARFIELD genes are patented.

Decade – hard red winter wheat developed by the Montana Agricultural Experiment Station and released jointly with North Dakota (pending at publication) in 2010. Decade is an early to medium maturing reduced height wheat with white chaff. Decade is a high yielding wheat with good winter hardiness and medium to high test weight and protein. Decade is resistant to prevalent races of stem rust but very susceptible to stripe rust. Decade has excellent milling and baking quality. PVP, Title V has been issued (Certificate #201100096).

FourOsix - hard red winter wheat developed by the Montana Agricultural Experiment Station and available to seed growers in fall 2018. FourOsix is a medium maturing, short to medium statured wheat, with average winter-hardiness. FourOsix is a high yielding variety with above average test weight and average protein. FourOsix (50% Yellowstone, in pedigree) is similar in grain yield of Yellowstone - but with significantly earlier heading, shorter plant height, and significantly higher test weight and protein. FourOsix is resistant to stripe rust and this resistance is either similar or significantly higher than that of Yellowstone. MFourOsix is moderately susceptible to stem rust. FourOsix has excellent milling and baking qualities, comparable to Decade and parental cultivar, Yellowstone. PVP, Title V will be applied for.

Judee – hard red winter wheat developed by the Montana Agricultural Experiment Station in 2011. Judee is a white-glumed, solid-stem, semi-dwarf (*Rht1*) wheat with medium maturity. Judee has average yield, test weight, and protein, and below average winter hardiness. Judee is susceptible to prevalent races of stem and leaf rust but resistant to stripe rust. Stem-solidness of Judee is most similar to Genou. Judee is a high PPO variety with average mill and above average bake properties. PVP, Title V has been issued (Certificate #201200161).

Keldin – hard red winter wheat developed by Peter Franck (Germany) and released by WestBred in 2011. Keldin is a medium maturing, medium short statured wheat, with white chaff. Keldin has above average yield and test weight and average protein. Keldin is moderately susceptible to stripe rust. Keldin is a high PPO variety with average mill and below average bake characteristics. PVP, Title V has been issued (Certificate #201300462).

Langin – hard red winter wheat developed by Colorado and released in 2016. Langin is an early maturing, short statured wheat, with white chaff. Winter-hardiness is average. Langin has average yield and test weight and below average protein. Langin is moderately susceptible to stripe rust. Langin is a high PPO variety with below average mill and average bake characteristics. PVP, Title V is pending (Certificate #201700298). *Langin will not be in the Montana Intrastate Winter Wheat Test for 2019.*

LCS Chrome – hard red winter wheat developed by Limagrain LLC and released in 2016. LCS Chrome is an early to medium maturing, medium statured wheat, with red chaff. Winter-hardiness is average. LCS Chrome has above average yield and test weight and average protein. LCS Chrome is resistant to stripe rust. Mill and bake characteristics, under Montana conditions, have not been determined. PVP, Title V is pending (Certificate #201600404).

LCS Jet – hard red winter wheat developed by Limagrain LLC and released in 2015. LCS Jet is a medium maturing, short statured wheat, with white chaff. Winter-hardiness is below average. LCS Jet has above average yield (#1 in 2017 across 7 locations tested) and below average test weight and average protein. LCS Jet is resistant to stripe rust. LCS Jet is a high PPO variety with above average mill and below average bake characteristics. PVP, Title V has been issued (Certificate #201600094).

Loma – hard red winter wheat developed by the Montana Agricultural Experiment Station and available to growers in fall 2016. Loma is a semi-solid stemmed (similar to Genou), medium-late maturing, medium short statured wheat, with white chaff. Loma has above average yield and average test weight and protein. Loma is resistant to both stripe and stem rust. Loma is a medium low PPO line with above average mill and bake. PVP, Title V is pending (Certificate #201700021).

Long Branch – hard red winter wheat developed by Limagrain LLC, licensed by Dyna Gro Wheat, and released in 2015. Long Branch is an early maturing, short statured wheat, with white chaff. Winter-hardiness is average. Long Branch has above average yield and test weight and below average protein. Long Branch is resistant to stripe rust. Mill and bake characteristics, under Montana conditions, have not been determined. PVP, Title V is pending (Certificate #201700105).

Northern – hard red winter wheat developed the Montana Agricultural Experiment Station and available to growers in fall 2015. Northern is a medium-late maturing, medium-short statured wheat, with white chaff. Northern has average yield (similar to Yellowstone and Colter), average test weight, and average protein. Northern is resistant to both stem and stripe rust. Northern is a low PPO variety with average milling and average baking properties. PVP, Title V has been issued (Certificate #201600092).

Ray – a hard red winter wheat developed by the Montana Agricultural Experiment Station and available to seed growers in fall 2018. Ray is a late maturing, tall, awnless line developed for **forage** production as a possible replacement (or supplement to) Willow Creek (MT, 2005). Compared to Willow Creek, Ray has similar forage yield and forage quality, but superior seed yield. Compared to conventional bread wheats; Ray has average to above average yield, below average test weight, and average protein. Ray is resistant to stripe rust and susceptible to stem rust. Ray has low PPO and average milling and baking characteristics. PVP, Title V will be applied for.

SY 517 CL2 – a 2-gene CLEARFIELD hard red winter wheat developed by Syngenta and released in 2017. SY 517 CL2 is an early maturing, short statured wheat, with white chaff. Winter-hardiness is below average. SY 517 CL2 has below average yield, above average test weight, and average protein. SY 517 CL2 is moderately susceptible to stripe rust. SY 517 CL2 is a medium PPO variety

with average mill and below average bake characteristics. PVP, Title V is pending (Certificate #201700216). Additionally, the CLEARFIELD genes are patented.

SY Clearstone 2CL – a 2-gene CLEARFIELD hard red winter wheat developed by Montana Agricultural Experiment Station in 2012 and licensed exclusively to Syngenta Seeds. SY Clearstone wheat 2CL is very similar to Yellowstone. It is a medium maturing, medium tall, white chaffed wheat with average winter hardiness. It is a high yielding wheat with average test weight and protein. SY Clearstone 2CL is resistant to stripe rust and has moderate resistance to stem rust, the latter an improvement over Yellowstone. SY Clearstone 2CL is resistant to common bunt. SY Clearstone 2CL is a medium PPO variety with average mill and above average bake properties. PVP, Title V has been issued (Certificate #201300357). Additionally, the CLEARFIELD genes are patented.

SY Monument – hard red winter wheat developed by Syngenta and released in 2015. SY Monument is a medium maturing, medium short statured wheat, with white chaff. SY Monument has average yield, below average test weight and average protein. SY Monument is resistant to stripe rust. SY Monument is a medium low PPO variety with average mill and below average bake characteristics. PVP, Title V has been issued (Certificate #201400332).

SY Sunrise – hard red winter wheat developed by Syngenta and released in 2015. SY Sunrise is an early maturing, short statured wheat, with white chaff. SY Sunrise has average yield, above average test weight, and average protein. SY Sunrise is resistant to stripe rust. SY Monument is a high PPO variety with average mill and below average bake characteristics under Montana conditions. PVP, Title V has been issued (Certificate #201500370). *SY Sunrise will not be in the Montana Intrastate Winter Wheat Test for 2019.*

SY-Wolf – hard red winter wheat developed by Syngenta (AgriPro) Seeds in 2010. SY-Wolf is a medium maturing, short statured wheat with white glumes. SY-Wolf has above average yield and test weight and average protein. Winter-hardiness is average. SY-Wolf is moderately susceptible to moderately resistant (MS/MR) to stripe rust, but resistant to stem rust. SY Wolf has average milling and below average baking properties. PVP, Title V has been issued (Certificate #201100390). *SY Wolf*

will not be in the Montana Intrastate Winter Wheat Test for 2019.

Warhorse - is an awned, white glumed, solid-stemmed hard red winter wheat released in 2013 by the Montana Agricultural Experiment Station. Warhorse has medium maturity and has medium short, semi-dwarf height. Warhorse's winter hardiness, rated at 4 on 0-5 scale, is an improvement over other solid stem varieties. Stem solidness is similar to that of Bearpaw and Rampart, while sawfly cutting of stems is very low (similar to Rampart). Warhorse yield is similar to Judee, while test weight and protein are above average. Warhorse is resistant to both stem and stripe rust. Warhorse has acceptable mill and bake qualities. PVP, Title V has been issued (Certificate #201400131).

WB4483 – hard red winter wheat developed by WestBred/Monsanto in 2016. WB4483 is solid stemmed, late maturing, short to medium statured wheat, with white chaff. WB4483 has slightly below average yield and average test weight and protein. WB4483 is moderately susceptible to stripe rust. WB4483 is a high PPO variety with average mill and below average bake characteristics under Montana conditions. PVP, Title V is pending (Certificate #201600380). *WB4483 will not be in the Montana Intrastate Winter Wheat Test for 2019.*

WB4575 – hard red winter wheat developed by WestBred/Monsanto in 2016. WB4575 is a medium maturing, short to medium statured wheat, with white chaff. WB4575 has below average yield and above average test weight and protein. WB4575 is susceptible to stripe rust. WB4575 is a medium PPO variety with average mill and above average bake characteristics under Montana conditions. PVP, Title V is pending. *WB4575 will not be in the Montana Intrastate Winter Wheat Test for 2019.*

WB4614 – hard red winter wheat developed by WestBred and released in 2013. WB4614 is a medium maturing, medium short statured wheat, with white chaff. WB4614 has average yield and protein and above average test weight. WB4614 is resistant to stripe rust. WB4614 is a high PPO variety with average mill and bake characteristics. PVP, Title V has been issued (Certificate #201500188). *WB4614 will not be in the Montana Intrastate Winter Wheat Test for 2019.*

WB4623CLP – hard red winter wheat developed by WestBred and released in 2015. WB4623CLP is a medium late maturing, short statured wheat, with white chaff. WB4623CLP has average yield, test weight, and protein. WB4623CLP is resistant to stripe rust. WB4623CLP is a medium low PPO variety with average mill and above average bake characteristics. PVP, Title V has been issued (Certificate #201500189). Additionally, the CLEARFIELD genes are patented. WB4623CLP will not be in the Montana Intrastate Winter Wheat Test for 2019.

Yellowstone – hard red winter wheat developed by the Montana Agricultural Experiment Station and released to seed growers in 2005. Yellowstone is a very high yielding winter hardy variety with medium test weight, maturity, height, and grain protein. Yellowstone has excellent baking and good Asian noodle quality. It is moderately resistant to TCK smut and resistant to stripe rust, but susceptible to stem rust. Yellowstone has been the leading winter wheat variety planted in Montana since 2012. PVP, Title V has been issued (Certificate #200600284).

Plant Variety Protection

The Plant Variety Act, signed into law in 1970, offers legal protection to developers of new varieties of plants which reproduce sexually – that is, through seeds. The law provides for a Plant Variety Protection Office in the U.S. Department of Agriculture. The office receives and processes applications and when “novelty” is established, issues a certificate granting protection rights specified by the applicant.

The owner (or developer) holding a “certificate of protection” has complete control over the variety for 20 years. The law provides two types of protection:

1. Without Seed Certification

The owner of the protected variety may exclude others from reproducing the variety, selling it, offering it for sale, importing or exporting it, or use it in the commercial production of a hybrid or a different variety without permission. In this sense, the owner of a protected variety may bring civil damage action against anyone who infringes upon his rights.

2. Certified Seed Option

The owner may specify that the seed of his variety “...be sold or advertised only as a class of Certified Seed”. Production and sale of such seed by variety

name, when not certified, constitute a violation of the Federal Seed Act. This means of protection may be used extensively for publicly as well as privately developed varieties.

Amendments to the Plant Variety Protection Act (PVPA) have passed both houses of Congress and been signed into law by the President. These amendments went into effect in 1995. The farmers exemption has been changed for new varieties. Seed for varieties issued a certificate after April 4, 1995, may only be purchased from the owner or his agent. A farmer can only save seed of these varieties for use on his own farm and cannot sell seed of the protected variety to his neighbor.

A variety protected under the certification option does not permit a farmer producing seed to sell or offer for sale or advertise by variety name unless it is certified. Sale of such seed by variety name as uncertified seed will constitute a violation of the Federal Seed Act. Interstate movement of seed is subject to inspection by Federal Seed Control officials. Seed within the state is subject to inspection by State Department of Agriculture inspectors.

Owners of protected varieties will give public notice that their variety is protected by affixing to the label or container the words: “Unauthorized Propagation Prohibited” or the words, “Unauthorized Seed Multiplication Prohibited”. Producers must check the label (tag) or the container for the above wording.

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Note: Information in this article is available on the web at:

<http://plantsciences.montana.edu/crops>