

WINTER WHEAT VARIETY PERFORMANCE SUMMARY IN MONTANA

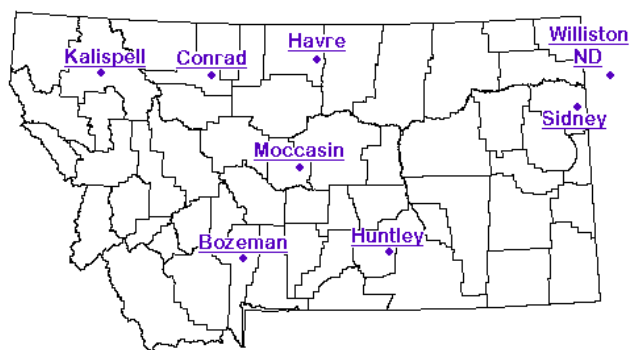
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Introduction

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 2019.



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 31 varieties (16 public and 15 private) and 18 experimental lines (15 public and 3 private). Numbered entries preceded by a state designation [e.g. MT1642 (Montana) or private company, ASC107, (All Star Seeds)] 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 2019. Fall nitrogen (N), phosphorus (P₂O₅) and potassium (K₂O) were preplant applied and incorporated.

Location	2018 Crop	2017 Crop	2018 Planting Date	Fertilizer				2019 Harvest Date
				N		P ₂ O ₅	K ₂ O	
				Fall	Spring			
----- Pounds per acre -----								
Kalispell	canola	winter wheat	Sep 27	10	82	40	90	Aug 20
Bozeman	fallow	barley	Oct 2	220	-	50	20	Aug 25
Huntley	chem. fallow	barley	Sep 26	161	-	39	0	Aug 7
Moccasin	lentil cover	lentil cover	Sep 27	10	62	15	10	Aug 8
Conrad	chem. fallow	barley	Sep 26	na	-	na	na	Aug 9
Havre	fallow	spring wheat	Oct 10	125	-	20	10	Aug 8
Carter	chem. fallow	na	Oct 10	na	-	na	na	Aug 9
Sidney	fallow	spring wheat	Sep 27	73	-	21	0	Aug 6
Williston, ND	na	na	Sep 26	na	na	na	na	na

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 1-37% (average = 15%, on June 3 and at Williston (average = 76%, range = 39-87%), in 2019.

Table 12 contains information on % winter survival and associated yield in winter-kill environments from 2015 to 2019. The data summarizes 5 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), Bobcat (2019) and StandClear CLP (2019).

Table 13 contains information on yield and % sawfly cutting at 19 testing locations where sawfly

pressure was present during the years 2015-2019. The data is from Carter (13 miles west of Ft. Benton), Choteau, Conrad, 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 2019 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.

2019 Test Conditions

Statewide winter wheat yields were projected by the Montana Agricultural Statistics Service at 50 bushels per acre (bu/a), for 2019. This is unchanged from 2018's record yield. The harvested acreage in 2019 was 1.90 million acres (total production = 95.0 million bu) compared 1.57 million acres in 2018 (total production = 78.5 million bu).

Rainfall for the 2018-2019 crop year was roughly divided between above (Moccasin, Huntley, Sidney and Bozeman) and below (Conrad, Havre, Kalispell, Williston and Carter-Fort Benton) average rainfall. Extremes, from historical averages, ranged from +4.02 inches at Moccasin to -6.72 inches at Williston (Table 14).

In 2017, 'Yellowstone' was miss-planted. No 3 and 4 year comparisons, with this variety, 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 80 bushels per acre (bu/a) {range 50 (Conrad, heat impacted) to 129 bu/a (Bozeman)}. Yields of named varieties, across the 7 harvested locations, ranged from a low of 72 bu/a (SY legend CL2) to a high of 91 bu/a for LCS Jet.

Test weight averaged 61.0 pounds per bushel (lb/bu) across all locations. Conrad (58.4 lb/bu, heat) and Carter-/Fort Benton (59.9) were below 60 lb/bu, while the other 7 locations were above.

Heading dates were later in 2019 than long term averages at 6 of the 8 harvested locations (Sidney and Conrad were earlier) where comparisons are available. Huntley at +6 days had the greatest difference, while the least change occurred at Conrad (around one half day earlier). Heading dates for all these stations averaged over 6 days later than 2018.

Stripe rust at Bozeman, typically a yield reducing factor was practically non-existent in 2019. Stripe rust at Kalispell (data not recorded) was a factor in yield and test weight reduction for susceptible varieties (Brawl CL Plus and Decade).

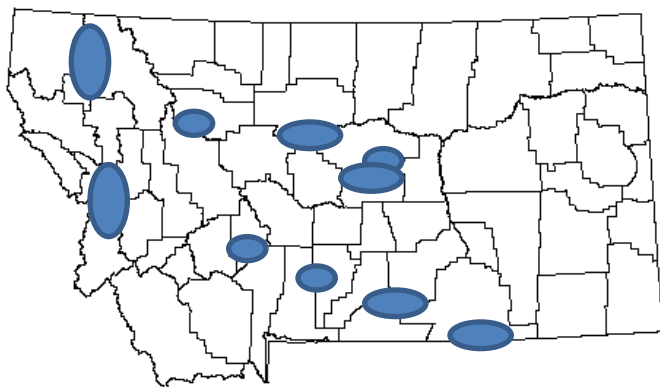


Fig. 2. Known areas of dwarf smut (TCK) infestations.

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
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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
Bobcat	MTS1588	Montana	2019	selection from a composite of 2 crosses: 07X291, ((SMN82164/SMN82140//Rocky/Tiber, MT9659)/3/S87-101/4/Pronghorn, MT0598)/5/(98X366E29-1, Heyne/Rampart/(MT9513, BigSky sib)) and 07X295, (((Lew/Tiber//Redwin ,MTS92021)/3/Judith/Arapahoe, MTS0023)/4/Pryor/ Genou, 01X258C1)/5/ MT0598
Brawl CL Plus	CO06052	Colorado: Plainsgold/ Colorado Research Foundation	2011	Teal 11A/Above//(CO99314, TX91V4931/ Halt)
Byrd CL Plus	CO13003C	Colorado: Plainsgold/ Colorado Research Foundation	2018	CO06072/4*Byrd (Als1, Als2)
Canvas	CO12D1770	Colorado: Plainsgold/ Colorado Research Foundation	2018	Denali/Antero//Byrd
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)
Flathead	MT1564	Montana	2019	selection from a composite of 2 crosses: 07X76, Yellowstone *2/5/ (PI640431, BC4F4 line derived from WA007900*5/4/WA007900// Yr5/6*Avocet/3/ WA007900/Yr15/ 6*Avocet) and 07X77, Yellowstone/PI640431/4/(Yellowstone(340,233),Yellowstone*5/3/ (Yellowstone sib, MT9982))//(MTS0222, Rampart*2/Judith))
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: Plainsgold/ Colorado Research Foundation	2017	(AF28/Byrd)//(AF10/2*Byrd)
Judee	MTS0713	Montana	2011	(Vanguard/Norstar//Judith dwf, 93X312E14)/3/ NuHorizon
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 (forage)	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)

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

Variety	Experimental Designation	Origin	Release Year	Pedigree
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

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	N94L027 / Thunderbolt // KS891808 /3/ KS920946-B-16-1-1 / Overlay // Jagger
LCS Jet	NSA10-7208	Limagrain Europe s.a.	2015	Apache/Autan
LCS Zoom	LWW14-73915	Limagrain LLC	2018	na
Long Branch	LCH12-012, HRX1652	Limagrain; Dyna-Gro Wheat	2015	T154 / T158
StandClear CLP	MTCS1601	Nutrien Ag Solutions (Loveland Products, Inc.); Loveland, CO	2019	((L'Govskaya 167/Rampart/6/(MT9409, Tiber/5/ (MT8030, TAM W-103/Froid /4/Yogo//Turkey Red /Oro/3/Centurk)) ,MTS0531) /13/ (MTS0532, same pedigree as MTS0531) /12/ (Morgan/5/ (88X24D247-?, (Wasatch/Yogo//Rescue/3/Tendoy, Sel. 251, MT88006)/4/Judith)), 96X17E69) /9/((Tiber/5/(MT8030, TAM W-103/Froid /4/Yogo//Turkey Red /Oro/3/Centurk), MT9409)*2/6/IMI Fidel, MTCL0309)/7/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/ (MTS0531, see above)
SY 517 CL2	07CL039-7	Syngenta	2017	(BC950811-2-6 / BC98343-09-7, 03B212#4) // (CL03040-6-1, iW98-362A1 (imiJagalene, Als3) / AP502CL (Als1) /3/ Art
SY Clearstone 2CL	MTCL1077	Syngenta, Montana	2012	Yellowstone*4/3/MTCL01158/CDC Teal 11A/Jagalene
SY Legend CL2	07CL046-2	Syngenta	2018	(BC950811-2-6 / BC98343-09-7 /3/ (CL03040-24-1, iW98-362A1 (imiJagalene, Als3) / AP502CL (Als1)), 06CL028) /4/ Jagalene
SY Monument	04BC574-2	Syngenta	2014	(KS89180B-2-1-1/CM75113, F1//X920750-A-11-2, BC991149-11)/3/(00x0090-4, W95091/W98-183
SY Wolverine	08BC379-40-1	Syngenta	2019	na
WB4269	H4N12-0038	WestBred-Monsanto:	2017	na
WB4311	XA4104	WestBred-Monsanto:	2017	ACS 51016 / Harvard
WB4418	XA4402	WestBred-Monsanto:	2018	na
(name pending)	MTW1491	Montana: private company pending	2018	(Yellowstone (Low PPO) plant seln, MT08184)/(Yellowstone (Low PPO) plant seln, MT08188/(MT08175, Colter sib)

Public Elite Lines

	MT1642			Yellowstone/Madsen//Yellowstone
	MT1683			selection from a composite of 2 crosses: 08X243, Yellowstone(L)*2/CDC Buteo and 08X245, same pedigree

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

Variety	Experimental Designation	Origin	Release Year	Pedigree
	MTS1731			(L'Govskaya 167/Rampart/6/(MT9409, Tiber/5/ (MT8030, TAM W-103/Froid /4/Yogo//Turkey Red /Oro/3/Centurk)), MTS0531)*2/7/ (BC4F4 line derived from WA007900*5/4/WA007900// Yr5/6*Avocet /3/ WA007900//Yr15/ 6*Avocet, PI640431)/5/(MTS04114, same pedigree as MTS0531)
	MTCL1732			(NuFrontier-2CL line, AP035-8-1)/11/ ((Yellowstone sib, MT9982)*2/9/(MT9904, (Froid/Winoka/7/((Sinvalocho/Wichita//Hope/Cheyenne/3/ Wichita/4/Seu Seun 27, TX55-391-56-D8)/5/Westmont, MT6928) /6/Trader, MT85200)/8/Tiber), MT08134) /10/Yellowstone*4 /4/ (IMI-Fidel/ Tiber, MTCL01158)//CDC Teal 11A/3/ Jagalene
	MTCL1737			Yellowstone-2CL /3/ Yellowstone*2 /Pelsart// Promontory/ 3*Yellowstone
	MT1745			Decade*2/3/(NI06732, HBK0630-4-5// (NE98632, Niobrara/NE91525)
	MT1746			selection from a composite of 2 crosses: 09X135, (selection from a composite of 2 crosses, see pedigree, MT06103)/3/ (selection from a composite of 2 crosses, see pedigree, MTW0881)//(SD06W166, Wendy*2/CDC Falcon) and 09X136, (same pedigree as MTW0881, MTW0880)// MTW0881/SD06W166
	MT1747			selection from a composite of 2 crosses: 09X135, (selection from a composite of 2 crosses, see pedigree, MT06103)/3/ (selection from a composite of 2 crosses, see pedigree, MTW0881)//(SD06W166, Wendy*2/CDC Falcon) and 09X136, (same pedigree as MTW0881, MTW0880)// MTW0881/SD06W166
	MT1750			(Yellowstone (Low PPO) plant seln, MT08185)/5/YLL(L)/4/ (NX05M4391, Cimarron/Rio Blanco//Bai Hou 4/N91L0097 /3/ Lakin)
	MT1764			Yellowstone*3/3/(NE01533, HBC059E/HBK0935W-24//2137) /4/Promontory/3*Yellowstone/3/Yellowstone*2/ Pelsart// Promontory/3*Yellowstone
	MT1773			(L'Govskaya 167/Rampart/6/(MT9409, Tiber/5/ (MT8030, TAM W-103/Froid /4/Yogo//Turkey Red /Oro/3/Centurk)), MTS04114)*2/7/(PI640431, BC4F4 line derived from WA007900*5/4/ WA007900// Yr5/6*Avocet/3/ WA007900//Yr15/ 6*Avocet)
	MT1782			selection from a composite of 2 crosses: 09X87, (((MT8709, Erhardt sib)/NuWest// Erhardt, MT0071)/10/(Wesley sib, N95L1229)/9/(MT9834, (Froid/Winoka/7/ ((Sinvalocho/Wichita// Hope/Cheyenne/3/ Wichita/4/Seu Seun 27, TX55-391-56-D8) /5/Westmont, MT6928)/6/Trader, MT85200) /8/Tiber), MT0859)/11/(same pedigree as MT0859, MT0860)/(MT0885, selection from a composite of 4 crosses, see pedigree) and 09X89, (selection from a composite of 2 crosses, see pedigree, MT0938)// MT0860/MT0885
	MT1787			selection from a composite of 2 crosses: 09X257, MT08185//YLL*2/PI640431 /3/PROM/ 3*YLL//YLL*2/Pelsart and 09X258, MT08185//YLL*2/PI640431/3/ YLL*2/ Pelsart//PROM/3*YLL
	MT1793			Decade/WesleyFHB1-106BC2F4-10
	MT1796			Decade/WesleyFHB1-106BC2F4-15

Private Elite Lines

	ASC107	Europe; All Star Seeds		na
	ASC116	Europe; All Star Seeds		na
	ASC122	Europe; All Star Seeds		na

Table 3. HARD WINTER : District 1-- Kalispell - Dryland (High Rainfall)

Cultivar/Line	Spring flooding, weeds - plots not harvested in 2017			2019 Data				
	Grain Yield (bushels/acre)			Test weight	Heading Date		Plant height	Protein %
	2019	2018-19	2016//18		Ordinal	Calendar		
	1 yr	2 yr	3 yr	lb/bu	from Jan1		in	%
AAC Wildfire ++	134.4	108.8		62.3	170.7	20-Jun	40.1	8.4
ASC107	118.9			62.5	164.8	14-Jun	29.6	9.6
ASC116	100.4			59.6	157.7	17-Jun	33.0	10.0
ASC122	110.0			62.0	165.2	14-Jun	29.9	8.9
Bobcat ++	117.6	105.9		62.1	168.1	17-Jun	32.7	8.7
Brawl CL Plus +	110.0	98.5	83.8	61.2	159.4	8-Jun	32.9	9.3
Byrd CL Plus ++	126.2	98.2		59.5	164.0	13-Jun	37.5	7.8
Canvas ++	127.7			61.6	164.8	14-Jun	32.1	8.3
Decade +	115.0	81.7	60.6	59.8	164.9	14-Jun	38.3	8.4
Flathead ++	136.9	121.6		61.3	161.9	11-Jun	36.2	8.3
FourOsix ++	129.1	110.8	118.8	60.2	165.1	14-Jun	33.6	8.0
Incline AX	122.5	87.7		59.1	167.4	16-Jun	34.7	7.4
Judee +	135.1	114.8	116.1	62.4	166.6	16-Jun	37.5	8.5
Keldin (P)+	135.4	118.4	112.6	60.8	166.1	15-Jun	35.0	8.1
LCS Chrome (P)+	113.3	95.9		61.0	162.8	12-Jun	35.9	9.5
LCS Jet (P)+	145.7	134.0		58.8	166.4	15-Jun	33.2	7.5
LCS Zoom (P)++	128.5	125.4		58.0	164.2	13-Jun	32.9	8.2
Loma +	130.3	109.0	115.3	61.6	168.0	17-Jun	35.5	8.7
Long Branch (P)+	121.1	111.3		61.6	158.2	7-Jun	32.0	8.6
MT1642	135.7	116.0		62.0	168.1	17-Jun	36.6	8.3
MT1683	138.7	119.4		60.9	165.5	15-Jun	38.1	8.5
MT1745	124.4			60.9	166.9	16-Jun	36.9	7.8
MT1746	128.3			62.3	165.1	14-Jun	35.1	8.6
MT1747	123.7			61.9	165.0	14-Jun	33.3	8.3
MT1750	134.8			62.7	166.6	16-Jun	32.8	8.5
MT1764	128.2			60.6	164.3	13-Jun	32.4	8.8
MT1773	142.2			61.1	164.9	14-Jun	36.9	8.3
MT1782	132.9			62.1	164.8	14-Jun	35.0	8.6
MT1787	120.7			61.4	168.1	17-Jun	31.8	8.6
MT1793	121.7			60.0	163.1	12-Jun	35.4	8.8
MT1796	103.3			60.5	163.5	13-Jun	36.6	8.8
MTCL1732	123.3			60.7	168.0	17-Jun	33.8	8.0
MTCL1737	132.5			60.5	169.1	18-Jun	33.1	8.3
MTS1731	119.5			61.4	163.9	13-Jun	32.1	8.5
MTW1491 (P)	145.2	118.8	125.5	60.6	167.8	17-Jun	41.0	8.1
Northern +	139.1	108.7	117.0	61.2	168.9	18-Jun	38.9	8.5
Oahe +	125.4	113.0		60.7	164.2	13-Jun	40.4	8.6
Ray ++	131.4	114.3		60.4	171.0	20-Jun	42.9	8.4
StandClear CLP (P)++	122.6	104.0		62.4	166.0	15-Jun	36.6	8.8
SY 517 CL2 (P)+	93.6	73.4		63.3	158.4	7-Jun	31.2	9.7
SY Clearstone 2CL	140.2	114.9	115.7	60.5	166.9	16-Jun	39.5	7.9
SY Legend CL2 (P)+	119.0	95.1		61.2	164.8	14-Jun	32.9	8.5
SY Monument (P)+	121.0	102.6	110.7	59.8	165.2	14-Jun	34.0	8.4
SY Wolverine (P)++	111.3			61.2	160.6	10-Jun	29.8	8.3
Warhorse	118.4	105.2	112.4	60.6	165.6	15-Jun	35.6	8.6
WB4269 (P)++	112.8			61.4	164.9	14-Jun	29.5	8.8
WB4311 (P)+	121.8			61.8	165.9	15-Jun	30.8	9.6
WB4418 (P)++	122.2			59.5	162.7	12-Jun	31.0	8.4
Yellowstone + (1)	127.9	105.8		60.7	167.6	17-Jun	37.2	8.1
Average	124.9	107.6	108.0	61.0	165.2	14-Jun	34.8	8.5
LSD (0.05)	13.0	21.2	32.1	0.4	1.5		2.2	0.5
C.V.	6.4	9.6	17.4	0.4	0.5		3.6	3.6

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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

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

Cultivar/Line	Grain Yield (bushels/acre)				Test weight lb/bu	2019 Data		Plant height in	Protein %
	2019	2018-19	2017-19	2016-19		Heading Date			
	1 yr	2 yr	3 yr	4 yr		Ordinal from Jan1	Calendar		
AAC Wildfire ++	125.3	130.3			63.0	181.7	1-Jul	37.9	12.5
ASC107	107.3				63.0	171.3	20-Jun	29.4	12.5
ASC116	120.9				61.8	166.3	15-Jun	31.0	13.8
ASC122	103.0				63.5	175.0	24-Jun	28.5	13.1
Bobcat ++	119.5	127.0	115.1		63.2	177.0	26-Jun	32.2	11.9
Brawl CL Plus +	126.3	120.8	101.4	96.4	64.5	167.7	17-Jun	33.0	12.3
Byrd CL Plus ++	138.1	136.8	112.0		62.9	171.0	20-Jun	35.6	11.0
Canvas ++	113.1				64.5	173.7	23-Jun	31.9	11.5
Decade +	127.4	128.4	99.8	87.6	62.6	174.0	23-Jun	35.8	12.3
Flathead ++	134.9	132.7	128.0		64.1	170.7	20-Jun	35.2	11.6
FourOsix ++	128.6	131.5	122.5	114.0	63.1	175.0	24-Jun	34.1	12.0
Incline AX	122.0	126.8			61.6	175.0	24-Jun	33.8	10.7
Judee +	122.5	125.4	113.6	102.3	63.5	175.0	24-Jun	36.1	12.4
Keldin (P)+	152.8	148.7	131.7	120.2	63.6	175.7	25-Jun	33.6	11.5
LCS Chrome (P)+	129.9	122.8	117.6		63.4	172.3	21-Jun	34.4	12.5
LCS Jet (P)+	146.0	145.7	138.7		61.4	176.0	25-Jun	31.8	11.4
LCS Zoom (P)++	133.0	136.5			59.4	172.0	21-Jun	32.6	12.0
Loma +	128.7	134.2	121.4	114.1	63.0	179.3	28-Jun	34.0	11.6
Long Branch (P)+	120.7	127.8	121.8		63.6	167.0	16-Jun	33.3	11.2
MT1642	144.0	142.2			62.7	179.7	29-Jun	35.8	11.8
MT1683	139.2	140.4			62.3	178.3	27-Jun	38.4	12.2
MT1745	137.2				63.4	176.7	26-Jun	34.7	11.4
MT1746	129.7				64.6	175.3	24-Jun	32.4	11.9
MT1747	134.8				64.7	174.7	24-Jun	32.6	11.8
MT1750	130.0				64.5	177.0	26-Jun	31.9	11.8
MT1764	130.1				63.0	171.0	20-Jun	31.9	11.6
MT1773	138.6				62.9	176.0	25-Jun	35.2	11.5
MT1782	130.1				64.3	174.3	23-Jun	32.9	11.8
MT1787	125.6				63.0	178.3	27-Jun	30.7	12.2
MT1793	124.6				62.5	170.7	20-Jun	32.8	12.4
MT1796	127.6				62.9	171.0	20-Jun	34.1	12.3
MTCL1732	118.5				61.1	176.0	25-Jun	31.9	11.7
MTCL1737	125.0				62.3	179.7	29-Jun	31.5	12.4
MTS1731	131.7				63.3	174.0	23-Jun	31.5	12.2
MTW1491 (P)	149.6	149.9	138.5	130.9	63.6	178.0	27-Jun	38.8	11.3
Northern +	145.1	146.5	127.8	116.9	63.0	177.3	26-Jun	37.0	11.5
Oahe +	138.0	129.4			64.0	171.0	20-Jun	38.6	11.9
Ray ++	138.8	138.7	128.3		61.7	180.7	30-Jun	40.0	12.4
StandClear CLP (P)++	127.7	131.5			63.8	176.0	25-Jun	35.1	12.4
SY 517 CL2 (P)+	117.3	115.5	103.3		64.6	168.3	17-Jun	31.2	12.5
SY Clearstone 2CL	144.5	143.5	128.6	119.0	61.6	178.0	27-Jun	38.6	12.4
SY Legend CL2 (P)+	113.7	115.4			64.0	172.3	21-Jun	31.9	11.2
SY Monument (P)+	130.8	133.8	122.2	114.9	62.4	175.0	24-Jun	33.0	11.1
SY Wolverine (P)++	112.6				63.2	170.3	19-Jun	29.1	12.6
Warhorse	118.9	119.8	111.0	102.6	62.8	176.7	26-Jun	34.0	12.6
WB4269 (P)++	113.7				63.2	169.7	19-Jun	30.2	11.6
WB4311 (P)+	126.6				64.2	170.3	19-Jun	29.6	12.0
WB4418 (P)++	112.0				61.8	169.3	18-Jun	31.2	11.6
Yellowstone + (1)	142.4	139.9			62.2	178.0	27-Jun	38.6	11.7
Average	128.5	132.9	120.2	110.8	63.0	174.3	23-Jun	33.7	12.0
LSD (0.05)	12.7	11.6	19.4	14.0	0.6	1.1		1.2	
C.V.	5.7	4.2	9.8	8.7	0.6	0.4		2.1	

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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

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

Cultivar/Line	Grain Yield (bushels/acre)				2019 Data					
					Test weight	Heading Date		Plant height	Lodging %	Protein %
	2019	2018-19	2017-19	2016-19		Ordinal	Calendar			
	1 yr	2 yr	3 yr	4 yr	lb/bu	from Jan1		in	%	%
AAC Wildfire ++	97.8	98.3			62.0	173.5	Jun 23	42.1	24	12.8
ASC107	101.0				60.7	164.6	Jun 14	35.0	0	13.6
ASC116	117.4				62.0	158.5	Jun 8	36.0	0	12.7
ASC122	89.0				61.1	166.2	Jun 15	31.3	0	14.4
Bobcat ++	99.9	100.4	103.5		62.1	169.7	Jun 19	36.9	10	12.8
Brawl CL Plus +	123.2	118.6	117.7	115.5	63.9	159.1	Jun 8	37.6	8	12.9
Byrd CL Plus ++	119.7	122.6	123.5		60.6	163.4	Jun 12	41.9	19	11.2
Canvas ++	95.6				61.7	165.2	Jun 14	37.0	0	11.7
Decade +	115.5	115.0	110.3	107.2	62.0	166.6	Jun 16	41.0	13	11.6
Flathead ++	120.7	118.8	123.1		62.3	163.3	Jun 12	40.0	0	12.2
FourOsix ++	105.2	108.1	110.9	111.2	61.6	168.5	Jun 18	38.9	0	12.4
Incline AX	104.1	106.4			59.9	166.3	Jun 15	39.1	0	11.2
Judee +	96.0	98.1	103.9	103.3	61.0	168.5	Jun 18	40.0	6	12.9
Keldin (P)+	133.0	134.8	134.9	129.6	62.5	168.4	Jun 17	38.6	3	11.2
LCS Chrome (P)+	122.0	115.2	117.6		63.0	164.0	Jun 13	41.3	8	12.0
LCS Jet (P)+	129.1	132.0	134.8		60.3	168.6	Jun 18	37.7	0	12.5
LCS Zoom (P)++	119.3	125.6			58.5	163.5	Jun 13	37.3	0	12.3
Loma +	93.2	95.6	100.8	103.3	60.5	171.3	Jun 20	39.4	15	12.1
Long Branch (P)+	116.7	117.6	120.9		62.1	161.9	Jun 11	37.9	28	11.5
MT1642	119.9	120.1			61.5	172.1	Jun 21	40.9	0	12.2
MT1683	111.0	108.1			60.2	168.8	Jun 18	41.8	13	12.4
MT1745	112.7				61.2	168.4	Jun 17	39.0	0	12.1
MT1746	120.3				64.1	167.5	Jun 17	37.8	3	11.6
MT1747	128.1				64.3	167.3	Jun 16	38.5	13	11.8
MT1750	108.4				63.2	169.9	Jun 19	35.6	4	12.3
MT1764	102.7				60.6	164.7	Jun 14	35.4	34	12.2
MT1773	105.8				60.1	168.6	Jun 18	38.7	43	12.4
MT1782	126.2				63.4	166.2	Jun 15	40.4	6	11.8
MT1787	108.5				61.9	168.5	Jun 18	34.7	6	12.5
MT1793	114.1				61.5	164.9	Jun 14	39.3	3	11.9
MT1796	117.0				63.3	165.9	Jun 15	42.2	9	11.7
MTCL1732	114.4				59.8	167.7	Jun 17	38.4	0	12.2
MTCL1737	116.9				61.4	171.5	Jun 21	37.3	0	12.0
MTS1731	106.0				61.6	165.2	Jun 14	34.7	29	12.4
MTW1491 (P)	116.3	111.5	116.3	115.9	61.9	169.2	Jun 18	42.4	3	11.4
Northern +	110.9	109.7	110.8	112.5	62.2	170.8	Jun 20	39.8	22	12.2
Oahe +	106.5	108.5			63.7	164.9	Jun 14	42.2	55	12.0
Ray ++	100.5	102.7	106.2		59.1	173.1	Jun 22	47.1	67	12.7
StandClear CLP (P)++	110.8	107.9			62.9	166.7	Jun 16	38.4	15	12.4
SY 517 CL2 (P)+	126.8	123.7	117.0		64.3	160.3	Jun 9	36.8	0	12.1
SY Clearstone 2CL	111.2	107.3	111.3	111.6	59.9	168.4	Jun 17	41.8	32	12.1
SY Legend CL2 (P)+	97.9	100.2			59.8	163.7	Jun 13	39.4	70	12.2
SY Monument (P)+	118.4	120.3	123.5	121.0	60.5	165.7	Jun 15	37.5	12	11.6
SY Wolverine (P)++	133.1				63.1	162.6	Jun 12	35.2	0	11.8
Warhorse	107.5	109.1	109.5	107.6	62.1	168.6	Jun 18	38.7	6	13.1
WB4269 (P)++	114.4				62.8	162.2	Jun 11	36.7	0	11.2
WB4311 (P)+	120.5				63.2	164.3	Jun 13	36.5	0	12.2
WB4418 (P)++	107.7				61.4	163.4	Jun 12	35.9	3	12.0
Yellowstone + (1)	105.6	105.1			60.3	169.6	19-Jun	41.3	3	12.4
Average	112.2	112.2	115.6	112.6	61.7	166.6	16-Jun	38.6	12.0	12.2
LSD (0.05)	9.2	8.7	10.5	9.8	0.9	1.5		2.9	8.0	0.6
C.V.	5.2	3.8	5.5	6.0	0.9	0.5		4.4	17.1	2.7

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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

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

Cultivar/Line	Grain Yield (bushels/acre)				Test weight lb/bu	2019 Data		Plant height in	Protein %
	2019	2018-19	2017-19	2016-19		Heading Date Ordinal Calendar	height		
	1 yr	2 yr	3 yr	4 yr					
AAC Wildfire ++	77.9	71.5			61.3	177.0 Jun 26	34.7	9.7	
ASC107	57.2				63.8	170.3 Jun 19	28.8	10.7	
ASC116	64.3				62.2	165.0 Jun 14	28.0	12.2	
ASC122	66.9				64.2	170.3 Jun 19	27.4	11.0	
Bobcat ++	71.4	67.6	65.3		63.7	171.3 Jun 20	29.9	9.8	
Brawl CL Plus +	63.1	61.6	63.0	62.0	65.0	165.0 Jun 14	28.9	10.9	
Byrd CL Plus ++	76.2	72.0	68.9		61.0	168.7 Jun 18	32.2	9.0	
Canvas ++	65.8				64.0	168.7 Jun 18	27.9	10.4	
Decade +	72.0	66.0	63.7	61.5	63.8	169.3 Jun 18	33.0	10.4	
Flathead ++	64.4	65.0	66.4		64.0	167.0 Jun 16	30.6	10.1	
FourOsix ++	76.3	72.8	68.3	69.2	63.1	171.0 Jun 20	30.5	9.5	
Incline AX	78.1	73.1			62.1	171.7 Jun 21	31.3	9.3	
Judee +	69.6	63.4	62.3	58.9	64.5	170.3 Jun 19	31.3	10.1	
Keldin (P)+	73.0	69.4	69.3	69.1	63.5	174.0 Jun 23	31.6	9.6	
LCS Chrome (P)+	67.2	60.5	62.2		63.0	165.7 Jun 15	30.6	11.3	
LCS Jet (P)+	86.0	77.9	73.8		59.9	170.3 Jun 19	29.0	8.8	
LCS Zoom (P)++	73.9	71.4			60.5	170.3 Jun 19	29.2	9.4	
Loma +	71.6	69.5	65.8	63.9	63.0	171.3 Jun 20	30.5	9.6	
Long Branch (P)+	75.0	68.5	66.6		63.8	164.0 Jun 13	27.9	9.8	
MT1642	83.6	79.8			62.8	172.3 Jun 21	31.6	10.0	
MT1683	74.7	78.3			62.7	172.0 Jun 21	33.2	9.6	
MT1745	77.9				62.9	176.0 Jun 25	32.1	9.9	
MT1746	73.3				64.6	170.3 Jun 19	30.2	10.1	
MT1747	72.1				64.9	169.7 Jun 19	29.4	9.8	
MT1750	65.6				64.4	175.3 Jun 24	28.8	10.5	
MT1764	65.8				64.4	168.7 Jun 18	29.0	9.8	
MT1773	69.6				63.7	169.3 Jun 18	31.0	10.1	
MT1782	72.9				64.1	168.7 Jun 18	31.2	10.6	
MT1787	72.7				63.6	174.0 Jun 23	28.6	9.8	
MT1793	63.4				63.7	167.3 Jun 16	30.8	11.2	
MT1796	68.6				63.9	168.0 Jun 17	32.3	11.6	
MTCL1732	71.3				62.4	172.0 Jun 21	29.6	9.6	
MTCL1737	71.6				61.2	175.3 Jun 24	29.0	9.8	
MTS1731	65.0				64.4	168.0 Jun 17	27.5	10.6	
MTW1491 (P)	76.4	73.6	71.3	69.8	63.3	172.7 Jun 22	33.5	9.2	
Northern +	79.4	72.4	68.4	65.7	63.1	173.7 Jun 23	31.9	9.8	
Oahe +	67.6	66.4			64.6	167.7 Jun 17	33.6	10.4	
Ray ++	56.7	67.3	65.3		61.4	175.0 Jun 24	36.4	9.0	
StandClear CLP (P)++	68.0	68.2			63.8	169.7 Jun 19	31.8	10.4	
SY 517 CL2 (P)+	73.1	66.8	65.2		63.0	168.7 Jun 18	31.0	10.4	
SY Clearstone 2CL	80.6	74.8	71.1	69.7	62.6	171.3 Jun 20	34.7	9.3	
SY Legend CL2 (P)+	64.3	57.5			64.6	168.7 Jun 18	30.4	10.8	
SY Monument (P)+	77.6	75.2	73.4	70.8	63.4	169.0 Jun 18	29.6	9.6	
SY Wolverine (P)++	73.5				63.3	166.3 Jun 15	27.0	10.6	
Warhorse	66.0	62.9	63.0	63.2	63.6	170.0 Jun 19	30.4	10.3	
WB4269 (P)++	68.3				64.0	167.7 Jun 17	27.9	10.9	
WB4311 (P)+	77.2				62.5	169.3 Jun 18	28.7	10.8	
WB4418 (P)++	71.0				62.9	167.0 Jun 16	27.9	10.4	
Yellowstone + (1)	71.9	70.8			62.9	170.7 20-Jun	33.9	9.6	
Average	71.2	69.4	67.0	65.8	63.2	170.1 19-Jun	30.5	10.1	
LSD (0.05)	9.4	11.2	ns	5.9	1.7	2.5	2.3	0.6	
C.V.	7.6	7.9	7.9	6.2	1.6	0.9	4.4	3.8	

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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

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

Cultivar/Line	Grain Yield (bushels/acre)				Test weight lb/bu	2019 Data		Plant height in	Sawfly cutting %	Protein %
	2019	2018-19	2017-19	2016-19		Heading Date				
	1 yr	2 yr	3 yr	4 yr		Ordinal	Calendar			
AAC Wildfire ++	50.3	56.0			57.5	171.3	Jun 20	29.0	51	14.8
ASC107	61.6				57.9	165.0	Jun 14	25.5	65	13.6
ASC116	76.7				57.4	159.7	Jun 9	27.8	64	14.4
ASC122	72.1				59.7	167.0	Jun 16	26.0	17	14.4
Bobcat ++	68.3	67.7	71.6		58.0	168.7	Jun 18	27.6	20	14.1
Brawl CL Plus +	79.5	<u>72.5</u>	75.1	79.7	58.4	159.7	Jun 9	29.2	48	13.1
Byrd CL Plus ++	65.7	71.1	75.2		55.9	164.7	Jun 14	30.8	30	13.3
Canvas ++	75.4				60.4	164.3	Jun 13	27.9	45	12.0
Decade +	56.0	54.3	58.6	67.9	56.0	165.0	Jun 14	29.3	56	14.1
Flathead ++	63.1	58.1	63.0		55.6	163.3	Jun 12	28.8	57	13.5
FourOsix ++	64.4	62.6	65.5	75.2	56.3	165.7	Jun 15	28.1	66	13.7
Incline AX	60.7	64.5			55.7	165.7	Jun 15	29.3	42	12.5
Judee +	48.7	52.9	59.7	67.2	57.1	166.3	Jun 15	28.9	52	14.9
Keldin (P)+	72.8	67.2	71.5	81.0	56.9	166.7	Jun 16	29.2	79	13.7
LCS Chrome (P)+	60.9	58.5	64.3		57.4	164.7	Jun 14	30.6	77	13.7
LCS Jet (P)+	73.0	69.9	74.9		55.1	168.0	Jun 17	26.4	37	13.5
LCS Zoom (P)++	67.4	70.1			53.5	166.3	Jun 15	28.6	78	13.6
Loma +	64.1	64.4	67.1	74.4	56.8	167.7	Jun 17	27.0	48	14.0
Long Branch (P)+	72.8	68.3	<u>76.2</u>		57.6	161.0	Jun 10	29.4	41	12.7
MT1642	65.5	63.2			57.4	169.3	Jun 18	29.7	62	13.7
MT1683	56.5	57.5			56.0	166.7	Jun 16	30.9	60	13.8
MT1745	71.6				57.0	168.3	Jun 17	30.6	43	13.0
MT1746	62.8				58.0	166.7	Jun 16	27.9	53	13.4
MT1747	68.5				58.2	166.0	Jun 15	29.0	32	13.7
MT1750	53.4				57.6	168.0	Jun 17	25.9	45	13.9
MT1764	73.3				57.3	164.0	Jun 13	28.2	71	13.3
MT1773	64.7				57.2	167.7	Jun 17	28.6	62	13.5
MT1782	66.9				60.1	164.0	Jun 13	29.4	48	12.9
MT1787	<u>79.7</u>				58.1	167.7	Jun 17	26.9	44	13.7
MT1793	66.0				56.8	164.0	Jun 13	28.5	81	13.4
MT1796	60.4				57.8	164.3	Jun 13	29.1	82	13.5
MTCL1732	52.2				55.5	167.3	Jun 16	27.1	5	13.9
MTCL1737	70.7				56.9	169.0	Jun 18	27.1	43	13.7
MTS1731	69.9				58.1	164.7	Jun 14	28.0	21	13.6
MTW1491 (P)	66.7	62.0	64.9	74.1	57.7	168.3	Jun 17	29.6	37	13.5
Northern +	69.1	62.1	66.1	75.5	57.3	168.3	Jun 17	32.2	40	14.0
Oahe +	66.6	63.9			57.8	163.7	Jun 13	32.4	49	12.9
Ray ++	56.1	58.8	62.3		56.6	171.0	Jun 20	34.0	49	14.1
StandClear CLP (P)++	64.7	68.0			58.0	168.3	Jun 17	29.1	49	14.5
SY 517 CL2 (P)+	63.9	66.5	69.8		58.9	161.3	Jun 10	26.8	60	12.7
SY Clearstone 2CL	62.7	64.1	69.7	76.7	55.4	167.3	Jun 16	29.7	66	13.9
SY Legend CL2 (P)+	59.9	65.7			56.5	165.7	Jun 15	29.1	90	13.8
SY Monument (P)+	71.6	67.7	71.4	<u>81.4</u>	56.5	165.0	Jun 14	28.7	80	12.6
SY Wolverine (P)++	71.5				59.8	163.3	Jun 12	27.3	38	13.7
Warhorse	49.6	49.8	55.2	62.6	55.2	167.7	Jun 17	28.5	27	14.3
WB4269 (P)++	75.2				59.3	163.3	Jun 12	26.3	40	12.2
WB4311 (P)+	69.3				59.3	165.7	Jun 15	27.1	55	13.3
WB4418 (P)++	62.0				55.8	162.0	Jun 11	25.7	25	13.3
Yellowstone + (1)	57.4	56.9			56.1	168.7	18-Jun	31.1	58	13.6
Average	65.3	63.0	67.5	74.1	57.3	165.9	15-Jun	28.7	50.8	13.6
LSD (0.05)	10.3	11.2	7.4	7.0	1.8	1.6		2.1	23.5	0.8
C.V.	9.0	8.7	6.6	6.5	1.8	0.6		4.3	27.2	3.2

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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

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

Cultivar/Line	Grain Yield (bushels/acre)				2019 Data					
					Test weight	Heading Date		Plant height	Sawfly cutting	Protein
	2019	2018-19	2017-19	2016-19		Ordinal	Calendar			
	1 yr	2 yr	3 yr	4 yr	lb/bu	from Jan1	in	%	%	
AAC Wildfire ++	54.0	63.3			58.8	174.3	Jun 23	25.4	32	14.6
ASC107	38.0				59.7	166.1	Jun 15	23.0	23	15.6
ASC116	41.3				60.1	161.8	Jun 11	22.7	18	15.9
ASC122	39.5				59.9	166.1	Jun 15	24.3	13	16.0
Bobcat ++	62.6	62.7	<u>60.5</u>		60.6	168.1	Jun 17	25.6	<u>1</u>	14.9
Brawl CL Plus +	52.2	54.9	51.1	60.8	62.0	160.5	Jun 10	25.3	14	15.3
Byrd CL Plus ++	51.0	54.9	54.1		60.6	163.7	Jun 13	24.3	21	13.9
Canvas ++	55.5				<u>62.4</u>	165.8	Jun 15	21.5	24	14.2
Decade +	55.5	54.6	52.5	59.5	60.1	167.2	Jun 16	29.2	22	15.5
Flathead ++	49.1	55.2	53.9		60.4	163.8	Jun 13	24.6	27	15.1
FourOsix ++	57.5	58.9	56.1	66.7	60.0	166.8	Jun 16	25.4	39	14.9
Incline AX	63.1	63.4			59.8	166.7	Jun 16	27.3	15	13.7
Judee +	52.6	54.2	52.6	60.8	61.3	168.9	Jun 18	27.0	11	15.8
Keldin (P)+	52.4	60.5	59.2	71.4	59.9	169.2	Jun 18	25.4	46	15.1
LCS Chrome (P)+	48.2	51.4	50.1		59.6	166.8	Jun 16	26.2	51	15.1
LCS Jet (P)+	58.9	59.2	55.6		57.5	167.6	Jun 17	20.7	35	14.6
LCS Zoom (P)++	48.7	51.3			57.6	167.3	Jun 16	24.5	48	14.2
Loma +	51.1	55.8	53.4	60.3	59.7	172.2	Jun 21	23.7	15	15.2
Long Branch (P)+	61.5	63.1	58.9		60.9	160.8	Jun 10	23.4	12	13.9
MT1642	51.3	55.7			58.8	173.2	Jun 12	28.0	34	15.7
MT1683	51.6	56.6			59.8	170.2	Jun 19	27.4	46	15.1
MT1745	57.5				60.9	169.7	Jun 19	26.2	18	14.4
MT1746	54.8				61.5	169.4	Jun 18	22.6	13	14.7
MT1747	52.6				61.6	168.3	Jun 17	23.9	24	14.8
MT1750	49.8				61.4	171.7	Jun 21	22.4	10	15.3
MT1764	51.6				59.9	163.9	Jun 13	24.9	21	15.5
MT1773	49.1				60.2	169.3	Jun 18	26.3	21	14.9
MT1782	53.5				60.9	165.4	Jun 14	25.9	20	15.5
MT1787	52.3				60.3	169.1	Jun 18	25.5	30	15.0
MT1793	58.5				59.7	164.4	Jun 13	26.2	22	16.1
MT1796	47.8				60.0	164.9	Jun 14	23.7	18	<u>16.5</u>
MTCL1732	53.0				59.6	168.7	Jun 18	27.4	14	14.4
MTCL1737	56.4				58.6	173.5	Jun 23	29.0	23	14.8
MTS1731	54.0				59.8	166.0	Jun 15	27.6	8	15.6
MTW1491 (P)	57.5	59.0	59.3	<u>72.1</u>	59.6	169.6	Jun 19	27.5	30	14.7
Northern +	57.7	57.1	55.4	67.5	60.3	170.0	Jun 19	24.4	38	14.8
Oahe +	46.7	48.0			60.2	165.0	Jun 14	28.6	36	15.1
Ray ++	58.9	59.8	57.3		58.7	173.8	Jun 23	31.4	39	14.5
StandClear CLP (P)++	61.6	58.6			60.7	168.0	Jun 17	25.8	12	15.1
SY 517 CL2 (P)+	46.4	48.9	44.5		61.3	162.9	Jun 12	22.4	16	16.0
SY Clearstone 2CL	56.8	59.3	55.5	66.2	59.5	168.8	Jun 18	28.1	44	15.3
SY Legend CL2 (P)+	53.6	54.3			60.6	165.9	Jun 15	26.0	27	14.8
SY Monument (P)+	57.4	58.4	56.6	68.3	59.5	165.7	Jun 15	25.3	32	14.0
SY Wolverine (P)++	48.9				60.3	163.6	Jun 13	23.0	29	15.7
Warhorse	46.5	51.8	49.2	59.3	60.2	170.4	Jun 19	26.2	3	16.2
WB4269 (P)++	53.5				60.8	162.7	Jun 12	25.3	12	13.7
WB4311 (P)+	51.1				60.4	164.4	Jun 13	22.6	30	15.0
WB4418 (P)++	53.5				59.9	163.1	Jun 12	22.6	15	14.4
Yellowstone + (1)	54.8	58.4			59.5	169.7	19-Jun	30.0	30	15.1
Average	52.9	56.7	54.5	64.8	60.1	167.3		25.4	24.2	15.0
LSD (0.05)	7.4	7.8	5.3	7.1	0.6	1.7		2.0	14.1	0.5
C.V.	8.0	6.7	5.9	7.6	0.6	0.6		4.8	34.6	1.8

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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

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

Cultivar/Line	Grain Yield (bushels/acre)				2019 Data			
					Test	Plant	Sawfly	Protein
	2019	2018-19	2017-19	2016-19	weight	height	cutting	
	1 yr	2 yr	3 yr	4 yr	lb/bu	in	%	%
AAC Wildfire ++	45.1	57.7			61.0		53	13.3
ASC107	40.9				58.9		77	13.6
ASC116	52.3				59.0		43	14.8
ASC122	52.9				59.7		10	14.1
Bobcat ++	62.0	65.3	62.7		60.6		18	13.1
Brawl CL Plus +	61.1	62.2	57.4	61.6	61.1		73	12.6
Byrd CL Plus ++	46.4	60.1	57.5		57.0		63	12.0
Canvas ++	62.2				61.4		75	12.6
Decade +	56.7	61.8	58.8	62.3	59.5		63	13.3
Flathead ++	59.0	58.9	59.2		59.8		77	12.4
FourOsix ++	56.7	55.1	54.3	58.2	58.8		73	13.0
Incline AX	50.7	52.8			58.1		37	12.1
Judee +	60.9	62.5	59.7	60.5	61.3		45	13.4
Keldin (P)+	55.6	57.8	57.6	61.4	59.7		63	13.0
LCS Chrome (P)+	54.1	59.8	53.7		60.2		78	12.9
LCS Jet (P)+	52.3	53.5	54.2		56.5		50	12.6
LCS Zoom (P)++	59.0	56.5			54.7		92	12.7
Loma +	59.7	63.4	61.3	65.4	60.1		32	13.0
Long Branch (P)+	58.2	62.7	58.0		59.9		67	12.1
MT1642	57.1	61.9			59.4		58	13.3
MT1683	54.8	61.2			59.0		80	13.1
MT1745	59.7				59.8		45	12.3
MT1746	56.7				62.3		28	12.8
MT1747	56.7				62.4		43	12.6
MT1750	57.5				62.0		25	13.1
MT1764	56.8				59.8		63	13.1
MT1773	54.9				60.0		77	12.7
MT1782	53.7				62.0		50	12.6
MT1787	58.0				60.4		57	13.2
MT1793	56.0				60.4		65	13.5
MT1796	53.2				61.1		60	13.7
MTCL1732	56.9				59.2		23	12.7
MTCL1737	53.4				59.0		52	13.6
MTS1731	74.6				61.4		43	12.6
MTW1491 (P)	53.8	57.4	55.8	59.8	57.9		73	12.8
Northern +	56.1	62.9	56.2	59.7	60.1		50	13.4
Oahe +	63.7	73.4			61.5		67	12.5
Ray ++	48.1	52.4	48.2		56.6		63	13.2
StandClear CLP (P)++	56.7	54.8			60.3		67	12.9
SY 517 CL2 (P)+	59.4	59.2	59.2		61.3		53	13.1
SY Clearstone 2CL	56.7	62.6	56.2	60.2	59.3		77	13.1
SY Legend CL2 (P)+	54.6	62.0			58.8		92	13.1
SY Monument (P)+	56.6	66.5	59.1	64.0	59.0		65	12.3
SY Wolverine (P)++	44.1				60.7		60	14.0
Warhorse	57.5	65.0	61.0	61.4	61.0		13	13.5
WB4269 (P)++	56.2				60.8		62	12.2
WB4311 (P)+	57.4				61.0		58	13.0
WB4418 (P)++	54.2				60.2		55	12.4
Yellowstone + (1)	51.9	61.0			58.9		80	12.9
Average	57.9	60.3	57.4	61.3	59.9		57.0	13.0
LSD (0.05)	11.5	ns	ns	ns	1.9		18.4	0.5
C.V.	12.2	9.8	9.9	8.5	1.9		20.0	2.2

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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

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

Cultivar/Line	Grain Yield (bushels/acre)				Test weight	Winter survival	2019 Data		Plant height	Protein %	
	2019	2018-19	2017-19	2016-19			Heading Date	Ordinal			Calendar
	1 yr	2 yr	3 yr	4 yr							
AAC Wildfire ++	88.8	79.6			64.5	20	168.3	17-Jun	30.1	13.1	
ASC107	5.5				(2)	1	162.0	11-Jun	21.0	14.9	
ASC116	20.6				59.1	11	157.0	6-Jun	23.9	17.9	
ASC122	15.5				61.5	3	163.7	13-Jun	22.0	15.4	
Bobcat ++	65.2	64.8	55.8		64.2	13	165.0	14-Jun	26.2	13.4	
Brawl CL Plus +	35.8	48.3	41.7	49.9	63.3	18	157.0	6-Jun	26.1	15.7	
Byrd CL Plus ++	51.2	64.3	56.9		63.0	13	161.0	10-Jun	28.9	12.8	
Canvas ++	46.8				64.7	10	161.0	10-Jun	26.5	14.0	
Decade +	68.8	71.1	64.3	62.6	63.6	22	162.0	11-Jun	30.4	14.5	
Flathead ++	66.6	61.9	54.4		64.0	27	159.0	8-Jun	27.0	13.7	
FourOsix ++	64.6	66.3	57.9	58.4	62.9	13	162.7	12-Jun	27.0	14.1	
Incline AX	48.3	58.6			61.4	9	163.7	13-Jun	27.2	12.9	
Judee +	81.1	73.9	53.8	53.8	65.1	23	162.3	11-Jun	28.9	14.0	
Keldin (P)+	66.8	79.5	62.9	66.9	63.8	20	164.3	13-Jun	29.3	14.1	
LCS Chrome (P)+	50.7	63.7	55.8		63.3	10	162.3	11-Jun	29.0	15.0	
LCS Jet (P)+	75.6	58.9	49.9		60.2	13	164.3	13-Jun	23.6	13.1	
LCS Zoom (P)++	50.7	48.1			58.1	10	163.0	12-Jun	24.7	13.8	
Loma +	71.8	71.9	60.1	56.8	62.5	12	167.3	16-Jun	26.2	13.7	
Long Branch (P)+	50.8	59.6	51.0		63.4	17	157.3	6-Jun	25.9	13.3	
MT1642	68.4	65.9			62.1	11	165.0	14-Jun	29.7	13.5	
MT1683	79.0	80.5			62.7	22	164.0	13-Jun	29.8	13.3	
MT1745	87.8				64.0	32	164.3	13-Jun	28.7	12.9	
MT1746	70.1				64.1	23	163.0	12-Jun	25.3	13.5	
MT1747	52.8				63.4	13	161.7	11-Jun	25.7	13.7	
MT1750	46.2				62.9	8	163.7	13-Jun	25.6	13.8	
MT1764	45.8				62.2	17	161.0	10-Jun	24.9	15.4	
MT1773	70.7				63.6	17	163.0	12-Jun	26.2	13.2	
MT1782	59.7				64.0	25	163.0	12-Jun	28.3	15.1	
MT1787	68.6				63.1	14	165.0	14-Jun	24.3	14.3	
MT1793	65.1				63.4	37	161.0	10-Jun	28.7	15.2	
MT1796	63.5				63.5	22	161.0	10-Jun	28.3	16.3	
MTCL1732	65.0				62.8	17	164.3	13-Jun	26.2	12.8	
MTCL1737	76.2				62.9	17	165.0	14-Jun	25.9	13.4	
MTS1731	68.1				63.5	18	161.7	11-Jun	26.1	14.2	
MTW1491 (P)	87.3	80.1	65.8	65.9	63.7	20	164.3	13-Jun	31.1	12.7	
Northern +	86.6	85.2	69.0	66.4	63.6	22	165.7	15-Jun	28.2	13.6	
Oahe +	38.6	56.4			63.0	25	161.0	10-Jun	30.1	14.8	
Ray ++	64.6	68.3	60.0		60.8	14	169.0	18-Jun	31.1	14.1	
StandClear CLP (P)++	79.3	74.6			64.4	23	164.7	14-Jun	28.7	14.1	
SY 517 CL2 (P)+	26.3	43.3	37.5		63.4	12	157.0	6-Jun	24.3	16.0	
SY Clearstone 2CL	73.7	69.4	60.0	60.6	63.1	17	164.0	13-Jun	28.2	13.3	
SY Legend CL2 (P)+	38.7	50.9			63.2	10	162.3	11-Jun	26.0	14.2	
SY Monument (P)+	38.7	59.5	54.6	58.5	60.8	14	161.0	10-Jun	24.0	14.0	
SY Wolverine (P)++	25.5				61.9	6	160.0	9-Jun	24.3	15.2	
Warhorse	53.4	61.3	51.7	50.4	63.0	15	165.0	14-Jun	28.7	15.8	
WB4269 (P)++	33.9				62.9	8	160.0	9-Jun	22.7	14.2	
WB4311 (P)+	45.4				63.2	15	161.0	10-Jun	24.0	15.6	
WB4418 (P)++	40.7				62.8	10	158.3	7-Jun	25.6	13.2	
Yellowstone + (1)	73.3	73.0			62.8	22	165.0	14-Jun	29.1	13.5	
Average	57.5	65.7	56.0	59.1	62.9	16.1	162.6	12-Jun	26.8	14.2	
LSD (0.05)	15.9	ns	ns	ns	1.3	10.7	1.6		2.5	0.8	
C.V.	17.1	20.1	21.4	20.6	1.2	40.8	0.6		5.7	3.1	

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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) too little grain harvested to do test weight

(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	Winter survival	2019 Data		Plant height	Protein
	2019	2018-19	2016//18			Heading Date			
	1 yr	2 yr	3 yr	lb/bu	%	Ordinal	Calendar	in	%
AAC Wildfire ++	54.1	54.6		60.5	87	167.4	16-Jun	21.3	16.7
ASC107	34.4			59.9	54	162.7	12-Jun	20.0	18.3
ASC116	22.5			56.8	72	157.1	6-Jun	17.7	21.2
ASC122	27.4			60.3	40	164.1	13-Jun	18.8	17.5
Bobcat ++	57.5	52.3		60.7	74	162.8	12-Jun	20.4	17.1
Brawl CL Plus +	43.8	41.2	44.1	60.8	82	156.3	5-Jun	21.0	18.7
Byrd CL Plus ++	48.6	46.0		61.1	70	159.5	9-Jun	19.3	16.1
Canvas ++	55.3			62.5	71	160.2	9-Jun	18.5	17.3
Decade +	47.6	46.0	47.2	60.5	80	160.3	9-Jun	17.4	19.3
Flathead ++	44.7	44.6		60.6	82	157.4	6-Jun	19.0	18.2
FourOsix ++	56.7	51.8	50.9	60.8	79	161.3	10-Jun	20.1	16.9
Incline AX	57.0	49.9		60.0	73	163.0	12-Jun	20.8	14.7
Judee +	49.3	46.6	46.6	61.9	85	161.6	11-Jun	19.3	18.4
Keldin (P)+	52.4	48.9	50.9	61.2	75	163.9	13-Jun	18.6	16.6
LCS Chrome (P)+	56.5	47.7		61.0	82	160.3	9-Jun	20.1	18.1
LCS Jet (P)+	48.8	45.9		57.3	39	163.5	13-Jun	19.8	15.6
LCS Zoom (P)++	56.4	50.2		57.9	77	162.7	12-Jun	18.3	15.1
Loma +	57.9	52.3	50.8	60.7	85	163.2	12-Jun	19.1	17.2
Long Branch (P)+	52.2	43.0		60.9	84	156.8	6-Jun	18.0	15.8
MT1642	63.2	57.0		60.1	72	164.1	13-Jun	25.4	16.5
MT1683	56.8	52.8		60.7	84	162.7	12-Jun	22.3	16.5
MT1745	52.3			60.9	81	162.4	11-Jun	18.7	16.3
MT1746	52.3			61.2	79	162.3	11-Jun	18.6	17.3
MT1747	47.1			60.8	80	161.1	10-Jun	19.1	17.7
MT1750	56.2			61.7	80	163.3	12-Jun	18.1	17.3
MT1764	52.7			59.2	82	160.1	9-Jun	18.0	18.8
MT1773	43.8			59.7	84	161.7	11-Jun	18.1	18.6
MT1782	48.9			60.7	81	161.0	10-Jun	17.9	18.5
MT1787	60.3			60.9	81	162.6	12-Jun	17.3	16.7
MT1793	43.2			60.1	87	159.4	8-Jun	17.3	19.5
MT1796	44.2			60.5	80	159.8	9-Jun	19.4	20.2
MTCL1732	51.3			59.5	77	161.1	10-Jun	17.3	17.8
MTCL1737	56.1			59.7	79	164.0	13-Jun	18.8	17.6
MTS1731	53.0			60.3	77	160.8	10-Jun	19.1	18.9
MTW1491 (P)	63.9	55.8	58.0	59.9	79	162.7	12-Jun	20.2	16.8
Northern +	53.1	49.3	49.6	61.0	71	163.7	13-Jun	18.7	17.7
Oahe +	45.5	44.0		60.8	77	159.2	8-Jun	18.9	17.6
Ray ++	52.8	47.2		59.5	76	165.0	14-Jun	24.2	16.2
StandClear CLP (P)++	50.8	46.9		60.2	80	163.7	13-Jun	20.4	18.2
SY 517 CL2 (P)+	44.1	41.8		61.7	74	156.6	6-Jun	19.2	17.6
SY Clearstone 2CL	45.5	45.5	48.0	60.1	85	161.8	11-Jun	20.2	18.0
SY Legend CL2 (P)+	45.4	41.7		61.4	78	159.3	8-Jun	18.1	17.9
SY Monument (P)+	58.5	50.4	52.1	60.4	85	160.8	10-Jun	17.6	16.3
SY Wolverine (P)++	47.6			60.6	66	157.6	7-Jun	18.4	18.3
Warhorse	50.8	48.0	45.7	61.4	80	162.7	12-Jun	19.1	18.2
WB4269 (P)++	37.4			59.4	67	157.8	7-Jun	16.8	17.0
WB4311 (P)+	49.4			60.3	74	161.8	11-Jun	18.7	17.8
WB4418 (P)++	38.7			57.8	81	157.6	7-Jun	18.7	18.0
Yellowstone + (1)	55.6	51.3		60.3	80	162.3	11-Jun	20.5	16.9
Average	49.9	48.3	49.5	60.3	76.4	161.3	10-Jun	19.2	17.5
LSD (0.05)	12.5	7.6	6.7	0.9	12.5	1.8		3.0	1.3
C.V.	14.3	7.7	8.0	0.8	9.5	0.6		9.2	4.4

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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

Table 12. 2015//2019 Intrastate Winter Wheat Test (Exp. 35): Combined Locations Winter Survival and associated Yield (Locations: Williston (2015, 2019), Sidney (2017, 2018, 2019) = 5 locations

***** No recordable Winterkill, with a harvest, in 2016 *****

location-years	Winter Survival (%)				Yield under Winterkill conditions			
	2019	2018-19	2017-19	2015//19	2019	2018-19	2017-19	2015//19
	2	3	4	5	2	3	4	5
AAC Wildfire ++	53	57			71.5	71.1		
ASC107	28				20.0			
ASC116	42				21.6			
ASC122	21				21.5			
Bobcat ++	43	46	40		61.4	62.3	56.2	
Brawl CL Plus +	49	47	42	44	39.8	46.8	42.2	38.9
Byrd CL Plus ++	41	47	44		49.9	59.0	54.8	
Canvas ++	40				51.1			
Decade +	52	58	59	63	58.2	63.3	60.1	57.6
Flathead ++	54	51	50		55.7	56.2	52.0	
FourOsix ++	45	46	46		60.7	63.1	57.6	
Incline AX	41	38			52.7	58.1		
Judee +	53	51	45	44	65.2	65.7	52.7	47.7
Keldin (P)+	47	50	45	42	59.6	70.4	60.3	53.9
LCS Chrome (P)+	46	45	44		53.6	61.3	56.0	
LCS Jet (P)+	26	22	19		62.2	55.5	49.7	
LCS Zoom (P)++	44	35			53.6	50.9		
Loma +	49	48	46	56	64.9	67.2	59.6	58.1
Long Branch (P)+	51	51	51		51.5	57.1	51.3	
MT1642	42	41			65.8	65.0		
MT1683	52	52			67.9	72.6		
MT1745	55				70.1			
MT1746	50				61.2			
MT1747	46				50.0			
MT1750	44				51.2			
MT1764	49				49.3			
MT1773	50				57.3			
MT1782	50				54.3			
MT1787	47				64.5			
MT1793	63				54.2			
MT1796	51				53.9			
MTCL1732	46				58.2			
MTCL1737	48				66.2			
MTS1731	47				60.6			
MTW1491 (P)	50	52	50		75.6	74.7	65.3	
Northern +	46	47	45	53	69.9	74.5	65.0	62.1
Oahe +	50	51			42.1	52.8		
Ray ++	45	45	42		58.7	63.1	58.2	
StandClear CLP (P)++	51	54			65.1	66.6		
SY 517 CL2 (P)+	43	42	36		35.2	43.6	39.1	
SY Clearstone 2CL	51	50	49	54	59.6	61.4	56.4	54.3
SY Legend CL2 (P)+	44	40			42.1	49.1		
SY Monument (P)+	49	53	52	56	48.6	59.1	55.6	52.6
SY Wolverine (P)++	36				36.6			
Warhorse	46	48	49	54	52.1	57.8	51.5	49.3
WB4269 (P)++	38				35.7			
WB4311 (P)+	44				47.4			
WB4418 (P)++	45				39.7			
Yellowstone + (1)	50	54	-	-	64.5	67.2	-	-
Average	45.9	47.2	44.9	51.7	53.7	61.3	54.9	52.7
LSD (0.05)	12.3	11.8	10.7	ns	23.1	ns	ns	ns
C.V.	13.3	15.3	16.8	21.6	21.4	17.8	18.9	19.7

(1) Yellowstone mis-planted in 2017: no 3 and 4 year data

Table 13. Combined Locations Yield under Sawfly Pressure and % Sawfly Cutting: 2015-2019
 (Note: Sawfly cutting in each location-year $\geq 10\%$)

Cultivar/Line	Grain Yield (bu/a)					Sawfly Cutting (%)				
	2019	2018-19	2017-19	2016-19	2015-19	2019	2018-19	2017-19	2016-19	2015-19
Location-years	7	13	16	18	19	7	13	16	18	19
AAC Wildfire ++	59.6					38				
Bobcat ++ (ss)	70.5	68.5	64.5			12	8	8		
Brawl CLP +	61.1	60.9	57.9			41	35	39		
Byrd CL Plus ++	64.0					40				
Decade +	60.5	59.1	56.0	58.4	57.8	39	41	42	41	39
Flathead ++	56.6	56.7				53	54			
FourOsix ++	61.1	59.1	56.8			60	61	60		
Judee + (ss)	58.9	58.8	55.8	59.6	58.7	41	43	39	38	36
Keldin (P)+	62.4	60.9	58.3	62.6		54	53	53	53	
LCS Jet (P)+	60.6	58.9				52	55			
Loma + (ss)	64.4	63.6	60.2	62.4	61.6	30	31	31	29	28
MT1642	66.3	63.5				45	47			
MT1683	59.7					67				
MT1747	65.0					32				
MT1750	61.5					22				
MT1782	58.7					36				
MTCL1732	61.8					19				
MTW1491 (HWW, P)	64.1	61.2	57.8			55	60	58		
Northern +	64.8	63.0	58.7	61.1	60.8	46	51	50	47	45
Ray ++	59.1	58.0	54.4			51	54	53		
StandClear CLP (P)++ (ss)	63.2	61.7				36	37			
SY Clearstone 2CL (P)+	59.2	59.5	56.0	60.1	59.6	63	65	63	61	59
SY Monument (P)+	64.5	63.0	59.2			51	53	53		
Warhorse + (ss)	55.8	55.7	53.4	55.4	54.9	16	11	10	9	9
Yellowstone +	60.2	59.9	57.0	60.3	59.5	59	62	59	58	56
Average	61.7	60.7	57.6	60.0	59.0	42.3	45.6	44.1	41.9	38.7
LSD (0.05)	6.3	4.2	3.6	4.1	3.8	11.5	9.7	9.3	8.3	7.9
C.V. (%)	9.7	9.0	9.1	10.3	10.0	25.8	27.6	30.3	30.0	31.9

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

Table 14. Precipitation (top, in inches) and Average Monthly Temperature (bottom, °F) for Crop Year 2018-2019

Agricultural Research Center	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Total
	2018	2018	2018	2018	2019	2019	2019	2019	2019	2019	2019	2019	Average
Western Triangle, Conrad	1.23	0.44	0.15	0.14	0.24	0.12	0.11	2.12	2.50	0.81	0.56	0.89	9.31
	1987-2019 Average = 11.65 (Temp = 43.7)												
Northern, Havre	51.2	40.8	31.6	27.6	26.0	-1.6	23.7	41.1	47.0	58.6	64.2	64.0	42.4
	1916-2019 Average = 12.07 (Temp = 42.8)												
Northwestern, Kalispell	2.08	0.29	0.35	0.02	0.40	0.86	0.23	0.92	1.53	3.24	0.64	0.73	11.29
	1980-2019 Average = 19.84 (Temp = 43.3)												
Central, Moccasin	54.1	42.8	31.9	27.0	24.1	-6.1	21.0	44.6	49.4	61.4	67.4	67.3	40.4
	1910-2019 Average = 15.35 (Temp = 42.9)												
Southern, Huntley	0.59	1.17	1.52	0.46	1.37	1.79	0.98	1.19	1.63	1.96	1.12	0.65	14.43
	1911-2018 Average = 13.49 (Temp = 45.6)												
Northeastern, Sidney	55.5	44.7	37.3	29.0	25.6	11.3	25.5	43.9	53.5	59.4	63.4	64.8	42.8
	1949-2019 Average = 14.11 (Temp = 43.3)												
Williston (WREC), N. Dakota	1.55	1.15	1.22	0.16	0.41	1.24	0.60	1.87	3.71	2.71	1.91	1.92	18.45
	1990-2019 Average = 14.55 (Temp = 40.6)												
Northern Seeds, Carter/Ft. Benton	55.1	43.0	33.2	29.6	28.7	3.3	25.0	41.7	46.5	57.7	64.2	64.3	41.0
	2008-2019 Average = 13.46 (Temp = 44.8)												
Post Farm, Bozeman	0.36	0.66	0.48	0.40	0.61	1.44	0.28	1.53	3.48	2.32	1.71	1.70	14.97
	1958-2019 Average = 15.99 (Temp = 43.6)												
Northern Seeds, Carter/Ft. Benton	57.3	44.0	34.7	28.9	25.4	6.3	24.8	46.2	50.4	63.0	69.6	70.6	43.4
	1990-2019 Average = 14.55 (Temp = 40.6)												
Northern Seeds, Carter/Ft. Benton	1.35	0.45	1.06	0.41	0.38	0.87	0.00	1.26	1.56	2.98	2.50	1.85	14.67
	1990-2019 Average = 14.55 (Temp = 40.6)												
Williston (WREC), N. Dakota	53.8	41.7	27.3	24.9	19.2	-4.0	25.6	44.5	50.3	63.4	68.3	67.1	40.2
	1990-2019 Average = 14.55 (Temp = 40.6)												
Northern Seeds, Carter/Ft. Benton	1.30	0.65	0.94	0.51	0.11	1.39	0.00	0.18	0.50	1.10	0.26	0.89	7.83
	1990-2019 Average = 14.55 (Temp = 40.6)												
Northern Seeds, Carter/Ft. Benton	55.5	42.3	26.5	24.8	18.5	-2.0	25.0	42.9	52.8	64.5	69.4	67.0	40.6
	1990-2019 Average = 14.55 (Temp = 40.6)												
Northern Seeds, Carter/Ft. Benton	1.69	0.46	0.81	0.13	0.61	1.61	0.27	1.30	1.74	2.76	0.59	0.78	12.75
	2008-2019 Average = 13.46 (Temp = 44.8)												
Post Farm, Bozeman	56.0	44.1	33.5	30.3	27.0	-1.7	24.1	45.8	50.8	62.4	68.5	69.3	42.5
	1958-2019 Average = 15.99 (Temp = 43.6)												
Post Farm, Bozeman	0.58	1.51	0.98	0.37	0.60	1.31	0.59	3.32	1.72	2.06	2.69	0.74	16.47
	1958-2019 Average = 15.99 (Temp = 43.6)												
Post Farm, Bozeman	55.7	43.8	31.6	24.8	25.5	11.4	22.1	43.0	49.1	59.1	64.8	65.8	41.4
	1958-2019 Average = 15.99 (Temp = 43.6)												

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	Straw Strength	Stem solid	Clear- field	Coleop- tile length(5)	Milling (6)	Baking (6)	PPO (7)	Dwarf Smut	Stripe Rust	Stem Rust	Leaf Rust
AAC Wildfire	L	Red	4	M		N	-	3	4	H	-	MR	-	-
Bobcat	M	White	2	S	23	N	S	4	4	ML	S	R	MS	S
Brawl CL Plus	E	White	2	S		Y	L	3	3	H	S	S	-	-
Byrd CL Plus	E	White	3	MS		Y	-	3	3	H	-	S	-	-
Canvas	M	White	3	S		N		-	-	-	-	-	-	-
Decade	M	White	4	S		N	M	3	4	H	S	S	R	MS
Flathead	E	White	3	S		N	S	3	3	M	MR	R	MR	
FourOsix	M	White	3	S		N	M	3	4	M	S	R	MS	-
Incline AX	M	White	2	S		AX	-	2	2	M	-	S	-	-
Judee	M	White	2	M	21	N	L	3	4	H	S	R	S	S
Keldin	M	White	2	S		N	S	3	2	H	S	MS	-	-
LCS Chrome	M-E	Red	3	S		N	M-L	3	3	M	S	R	-	-
LCS Jet	M	White	2	S		N	L	4	2	H	S	R	-	-
LCS Zoom	M-E	White	1	S		N	-	3	2	H	-	R	-	-
Loma	M-L	White	4	M	21	N	S	4	4	ML	S	R	R	-
Long Branch	E	White	3	M		N	M	3	3	H	S	R	-	-
MTW1491	M-L	White	3	MS		N	S	4	3	L	-	R	S	-
Northern	M	White	3	S		N	S	3	3	L	S	R	R	-
Oahe	E	White	3	M		N	-	3	2	H	-	R	-	-
Ray	L	White	2	MW		N	M	3	3	L	S	R	S	-
StandClear CLP	M	White	3	MS	19	Y	-	3	3	H	-	R	MS	-
SY 517 CL2	E	White	2	S		Y	M-L	3	2	M	S	MS	-	-
SY Clearstone 2CL	M	White	3	S		Y	S	3	3	M	R	R	MR	-
SY Legend CL2	M-E	Red	2	MW		Y	-	3	3	H	-	MR	-	-
SY Monument	M	White	3	S		N	M	3	2	ML	S	R	-	-
SY Wolverine	M-E	White	2	S		N		-	-	-	-	-	-	-
Warhorse	M	White	4	MS	22	N	M	3	3	H	S	R	R	MR
WB4269	M-E	White	2	S		N		-	-	-	-	-	-	-
WB4311	M	White	3	S		N		-	-	-	-	-	-	-
WB4418	M-E	White	3	S		N		-	-	-	-	-	-	-
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 and Williston)
- (3) W = Weak, MW = Medium Weak, MS = Medium Strong, S = Strong
- (4) scored 5-25, 25 = most solid
- (5) L = Long, M = Medium, S = Short
- (6) 0-5, 5 = Best
- (7) PPO = Polyphenol Oxidase (low is better for noodles); L = low, M = medium, H = high
- (8) R = Resistant, MR = Moderately Resistant, m = Moderat, MS = Moderately Susceptible, S = Susceptible, VS = Very Susceptible
- AX = Coaxium herbicide resistance
- = no information

Additional Descriptive Information for Winter Wheat Varieties

New for the 2020 Bulletin:

Canvas – hard red winter wheat developed by Colorado and released in 2018. Canvas is a medium maturing, hollow-stemmed, short wheat with white chaff. Canvas has average yield, high test weight, and below average protein, with average winter survival. Resistance or susceptibility to stripe rust, under Montana conditions, has not been determined for Canvas. Mill and bake characteristics, under Montana conditions, have not been determined.. PVP, Title V is pending (Certificate #201900418). *Canvas will not be in the Montana Intrastate Winter Wheat Test for 2020.*

SY Wolverine – hard red winter wheat developed by Syngenta and released in 2019. SY Wolverine is a medium early maturing, hollow-stemmed, short wheat with white chaff. SY Wolverine has below average yield, above average test weight, and above average protein, with below average winter survival. Resistance or susceptibility to stripe rust, under Montana conditions, has not been determined for SY Wolverine. Mill and bake characteristics, under Montana conditions, have not been determined. PVP, Title V is pending (Certificate #201900271).

WB4269 – hard red winter wheat developed by WestBred and released in 2017. WB4269 is a medium early maturing, hollow-stemmed, short wheat with white chaff. WB4269 has below average yield, above average test weight, and below average protein, with below average winter survival. Resistance or susceptibility to stripe rust, under Montana conditions, has not been determined for WB4269. Mill and bake characteristics, under Montana conditions, have not been determined. PVP, Title V is pending (Certificate #201800093).

WB4311 – hard red winter wheat developed by WestBred and released in 2017. WB4311 is a medium maturing, hollow-stemmed, short wheat with white chaff. WB4311 has average yield, above average test weight, and above average protein, with average winter survival. Resistance or susceptibility to stripe rust, under Montana conditions, has not been determined for WB4311. Mill and bake characteristics, under Montana conditions, have not been determined. PVP, Title V is issued (Certificate #201800086).

WB4418 - hard red winter wheat developed by WestBred and released in 2018. WB4418 is a medium-early maturing, hollow-stemmed, short wheat with white chaff. WB4418 has below average yield, below average test weight, and average protein, with average winter survival. Resistance or susceptibility to stripe rust, under Montana conditions, has not been determined for WB4418. Mill and bake characteristics, under Montana conditions, have not been determined. PVP, Title V is pending (Certificate #201800530).

Lines approved for variety release, name to be determined later:

MTW1491 (name pending) – hard white winter wheat developed by the Montana Agricultural Experiment Station (approved for release in 2018) for exclusive license to a private company. MTW1491 is a medium-late maturing, hollow-stemmed, medium-tall wheat with white chaff. MTW1491 has very high yield, average test weight, and below average protein, with above average winter survival. MTW1491 is resistant to stripe rust and susceptible to stem rust. MTW1491 has low PPO and above average milling, and average baking characteristics. PVP, Title V will be applied for. MTW1491 will not be in the Montana Intrastate Winter Wheat Test for 2020.

Varieties previously in 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. AAC Wildfire has high PPO, average milling and above average baking characteristics. PVP, Title V is pending (Certificate #202000008).

Bobcat – hard red winter wheat developed by developed by the Montana Agricultural Experiment Station and available to certified seed growers in fall 2019. Bobcat is a medium maturing, solid-stemmed, short wheat with white chaff. Bobcat has above average yield and test weight, average protein, with average winter survival. Bobcat has the highest yield and lowest percent sawfly cutting, of all varieties, in trials where sawfly pressure was above 10% cutting. Bobcat has excellent resistance to stripe rust and is moderately susceptible to stem

rust. Bobcat has medium-low PPO and above average milling and baking characteristics. PVP, Title V has been applied for.

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.

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. Byrd CL Plus has high PPO and average milling and baking characteristics. PVP, Title V is pending (Certificate #201900417). 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). *Decade will not be in the Montana Intrastate Winter Wheat Test for 2020.*

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

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. FourOsix is moderately susceptible to stem rust. FourOsix has excellent milling and baking qualities, comparable to Decade and parental cultivar, Yellowstone. PVP, Title V is pending (Certificate #201900053).

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. Incline AX has medium PPO and below average milling and baking characteristics. PVP, Title V will be applied for. Additionally, the CoAXium genes are patented.

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).

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. LCS Chrome has medium PPO and average milling and baking characteristics. PVP, Title V is issued (Certificate #201600404). *LCS Chrome will not be in the Montana Intrastate Winter Wheat Test for 2020.*

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).

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. LCS Zoom has high PPO, average milling and below average baking characteristics. PVP, Title V will be applied for LCS Zoom will not be in the Montana Intrastate Winter Wheat Test for 2020.

Loma – hard red winter wheat developed by the Montana Agricultural Experiment Station and released in 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 issued (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).

Oahe – a hard red winter wheat developed by the Oahe has high PPO, average milling and below average baking characteristics. PVP, Title V has been issued (Certificate #201700296). *Oahe will not be in the Montana Intrastate Winter Wheat Test for 2020.*

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 is pending (Certificate #201900058). *Ray will not be in the Montana Intrastate Winter Wheat Test for 2020.*

StandClear CLP – hard red winter wheat developed by the Montana Agricultural Experiment Station for exclusive license to Nutrien Ag Solutions (Loveland Products Inc., Loveland, CO) with a full partnership agreement with BASF Chemical Company. StandClear CLP will be available to certified seed growers in fall 2020. StandClear CLP is a medium maturing, semisolid-stemmed, medium height wheat with white chaff. StandClear CLP has average yield, above average test weight, and average protein, with good winter survival. StandClear CLP has high PPO and average milling and baking characteristics. PVP, Title V will be applied for. Additionally, the CLEARFIELD genes are patented.

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 issued (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 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. SY Legend CL2 has high PPO and average milling and baking characteristics. PVP, Title V is issued (Certificate #201800226). 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).

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).

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>