

WINTER WHEAT VARIETY PERFORMANCE SUMMARY IN MONTANA

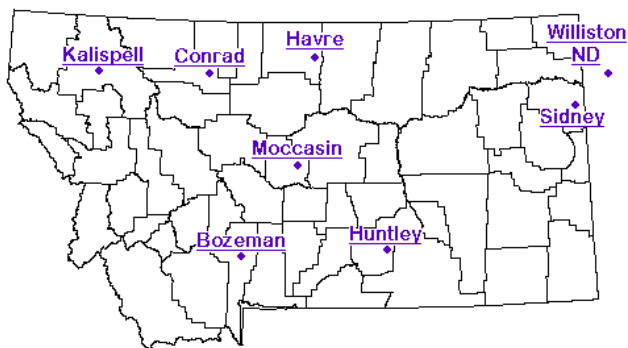
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Introduction

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 2020.



Entries

Names of commercially available varieties and experimental lines evaluated in 2020 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 30 varieties (13 public and 17 private) and 19 experimental lines (18 public and 1 private). Numbered entries preceded by a state designation [e.g. MT1642 (Montana) or private company, LCS18-7071, (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 2020, data is provided for two (2019-2020), three (2018-2020) and four (2017-2020) 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 2020. Fall nitrogen (N), phosphorus (P₂O₅) and potassium (K₂O) were preplant applied and incorporated.

Location	2019 Crop	2018 Crop	2019 Planting Date	Fertilizer				2020 Harvest Date
				N		P ₂ O ₅	K ₂ O	
				Fall	Spring			
----- Pounds per acre -----								
Kalispell	canola	spring wheat	Sep 24	14	100	45	80	Aug 11
Bozeman	fallow	barley	Oct 16	210	-	22	0	Aug 18
Huntley	chem. fallow	chem. fallow	Sep 27	0	250	0	0	July 28
Moccasin	lentil cover	millet	Sep 27	10	52	15	10	Aug 7
Conrad	chem. fallow	barley	Oct 19	na	-	na	na	July 28
Havre	fallow	spring wheat	Sep 25	125	46	20	10	July 31
Carter	chem. fallow	wheat	Oct 10	14	92	0	5	Aug 5
Sidney	fallow	peas	Sep 25	72	-	0	0	July 28
Williston, ND	soybeans	wheat	Sep 24	49	-	20	0	July 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 Conrad, resulting in winter survival ranging from 33-90% (average = 65%) and at Williston (average = 87%, range = 71-97%), in 2020.

Table 12 contains information on % winter survival and associated yield in winter-kill environments from 2016 to 2020. The data summarizes 6 tests in which significant winter-kill occurred (test average for winter survival was less than 90%). Most 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 (2020).

Table 13 contains information on yield and % sawfly cutting at 21 testing locations where sawfly

pressure was present during the years 2016-2020. The data is from Belt, 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 2020 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.

2020 Test Conditions

Statewide winter wheat yields were projected by the Montana Agricultural Statistics Service at 51 bushels per acre (bu/a), for 2020. This represents a new record yield for Montana, 1 bushel above the previous record set in both 2018 and 2019. The harvested acreage in 2020 was 1.49 million acres (total production = 76.0 million bu) compared 1.90 million acres in 2019 (total production = 95.0 million bu).

Rainfall for the 2019-2020 crop year was generally below average at all locations except Huntley and Conrad. Extremes, from historical averages, ranged from +4.22 inches at Conrad to -5.89 inches at Sidney (Table 14).

In 2017, 'Yellowstone' was not planted. No 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 77 bushels per acre (bu/a) (range 49 bu/a at Williston to a whopping 152 bu/a at Kalispell). Yields of named varieties, across the 9 harvested locations, ranged from a low of 62 bu/a (SY 517 CL2) to a high of 86 bu/a for Northern.

Test weight averaged 62.2 pounds per bushel (lb/bu) across all locations. Sidney, at 59.8, was the only location below 60 lb/bu.

Heading dates were earlier in 2020 than long term averages at 5 of the 6 locations where notes were taken (Kalispell was later). Sidney at -5 days had the greatest difference, while the least change occurred at Huntley (equal to long term average). Heading dates for all these stations averaged 3.6 days earlier than 2019.

Stripe rust at Bozeman, typically a yield reducing factor, was practically non-existent in 2020. Trace amounts of stripe rust at Kalispell were not a factor in yield and test weight reduction for susceptible varieties (Brawl CL Plus and Byrd CL Plus).

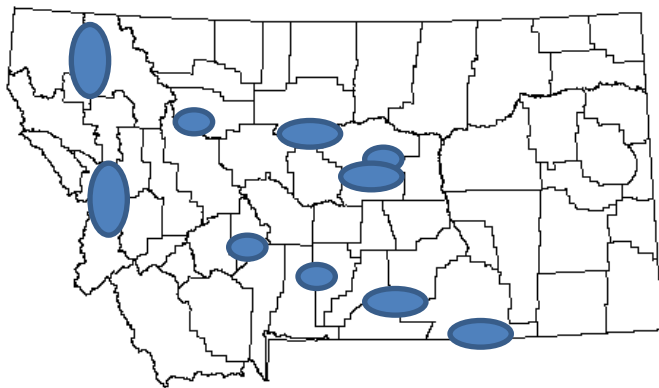


Fig. 2. Known areas of dwarf smut (TCK) infestations.

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

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
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)
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
Langin	CO11D446	Colorado: Plainsgold/ Colorado Research Foundation	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

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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 Seu 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 //Ulianova)); 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

CP7909		Winfield Solutions, LLC, Arden Hills, MN	2018	na
Keldin	ACS55017	Peter Franck: Seed-Link Inc.; Ontario, Canada, Westbred LLC	2011	Barenburg 235/Carlisle//TRX-A16-3-2
LCS Helix AX	LCS15ACC-8-21	Limagrain LLC	2020	na
LCS Jet	NSA10-7208	Limagrain Europe s.a.	2015	Apache/Autan
LCS Photon AX	LCH15ACC-13-4	Limagrain LLC	2018	(AF28/Byrd)//(AF10/2*Byrd)
Long Branch	LCH12-012, HRX1652	Limagrain; Dyna-Gro Wheat	2015	T154 / T158
Mpress (SWW)	09PN066#36, 122006W	Syngenta Participations AG: McGregor Seed Co.	2017	SY Ovation / AP Badger
StandClear CLP	MTCS1601	Montana/ Loveland Products Inc; Loveland, CO	2020	((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</u> /8/(<u>MTW01143</u> , Promontory/5/ (MT91366, NuWest/ Lovrin 24 /4/((Rego/ Cheyenne, Sel. 39-18-7)//Winalta, MT7431)/3/NuWest)) /10/(<u>MTCL0510</u> , 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)
SY 517 CL2	07CL039-7	Syngenta	2017	(BC950811-2-6 / BC98343-09-7, <u>03B212#4</u>) // (<u>CL03040-6-1</u> , iW98-362A1 (imiJagalene, Als3) / AP502CL (Als1) /3/ <u>Art</u>
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, <u>BC991149-11</u>)/3/(<u>00x0090-4</u> , W95091/W98-183
SY Wolverine	08BC379-40-1	Syngenta	2019	Everest / Platte // SY Wolf
WB4269	H4N12-0038	WestBred-Monsanto:	2017	KS98W0512-2-4 // HV9W02-846R / HV9W96-1271R-1
WB4311	XA4104	WestBred-Monsanto:	2017	ACS 51016 / Harvard
WB4418	XA4402	WestBred-Monsanto:	2018	TUKURU-S-3 /3/ KS920750-A-13-1 // KS89180B-2-1-1 / CMBW91M02959T /4/ TX92U3060 / TX91D6564

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

Variety	Experimental Designation	Origin	Release Year	Pedigree
WB4792	XB4711	Bayer: WestBred-Monsanto:	2019	na

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
	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
	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
	MTS1810			((Yellowstone loppo plant seln, MT08189) /8/ (Yellowstone loppo plant seln, MT08188)/7/ (MT0419-1, Erhardt/5/ (KS92H21-4, (Plainsman IV/ Cheney// Odessa/ 2*Eagle/3/ Pawnee / DURM, KS82H238-1)/4/ HF5761/ TAM 105//Bounty 203)/6/ Pronghorn), 08X350-A6) /9/ Warhorse
	MTS1831			selection from a composite of 2 crosses: 09X203, (selection from a composite of 2 crosses, see pedigree , MTS0907/ (MTS082Z, selection from a composite of 2 crosses, see pedigree) and 09X211, (selection from a composite of 2 crosses, see pedigree , MTS0916)/MTS082Z
	MT1845			Yellowstone // (493-22, Reeder/6*Paul)
	MT1848			Northern// (Yellowstone (Low PPO) plant seln, MT08184) / (MT0887, selection from a composite of 4 crosses, see pedigree)
	MT1855			selection from a composite of 2 crosses: 10X199, (05X438-aC71, (Erhardt //Judith / CDC Kestrel, MT0097)*2 /3/ Jagalene / Choteau) /4/ Roughrider and 10X200, (05X438-aB30-2, (Erhardt //Judith / CDC Kestrel, MT0097)*2 /3/ Jagalene / Choteau) /4/ (MT0890, selection from a composite of 2 crosses, see pedigree)
	MT1866			selection from a composite of 2 crosses: 09X63, (((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/ (selection from a composite of 2 crosses, see pedigree, 00X83cE45)/3/ (MT0698, PI592496// (MT9523, NuWest/Tiber)) and 09X65, MT0859// (Yellowstone (Low PPO) plant seln, MT08188)/ MT0698
	MT1867			selection from a composite of 2 crosses: 09X63, (((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/ (selection from a composite of 2 crosses, see pedigree, 00X83cE45)/3/ (MT0698, PI592496// (MT9523, NuWest/Tiber)) and 09X65, MT0859// (Yellowstone (Low PPO) plant seln, MT08188)/ MT0698

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

Variety	Experimental Designation	Origin	Release Year	Pedigree
	MT1872			selection from a composite of x crosses: 09X83, (((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/ ((Judith/(PI262605, Karagach, RWA resis.)/3/(S86-740, Norstar/Plainsman V //Ulianovka), MTW0047)/4/(G97019, G33/Tomahawk//Karl 92), MT0840) /5/ (MT0873, selection from a composite of 2 crosses, see pedigree) and 09X84, MT0859*2 / (MT0872, selection from a composite of 2 crosses, see pedigree)
	MTS18116			Loma*2/Warhorse
	MTS18149			Loma*2/AAC Gateway

Private Elite Lines

	LCS-18-7071	Limagrain LLC		na
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Table 3. HARD WINTER : District 1-- Kalispell - Dryland (High Rainfall)

Spring flooding, weeds - plots not harvested in 2017								
Cultivar/Line	Grain Yield (bushels/acre)			Test weight	2020 Data		Plant height	Protein %
	2020	2019-20	2018-20		Heading Date	Ordinal		
	1y	2y	3y	lb/bu	from Jan1	Calendar	in	%
AAC Wildfire ++	156.9	145.7	124.8	59.1	169.7	18-Jun	42.4	10.2
Bobcat ++	139.5	128.6	117.1	63.8	167.0	15-Jun	36.4	10.2
Brawl CL Plus +	135.6	122.8	110.8	63.5	161.0	9-Jun	34.5	11.4
Byrd CL Plus ++	158.7	142.5	118.3	62.2	163.3	11-Jun	40.3	9.0
CP7909 (P)	122.5			63.5	156.0	4-Jun	33.8	9.7
Flathead ++	159.6	148.3	134.2	63.4	161.0	9-Jun	36.8	10.1
FourOsix +	143.7	136.4	121.7	62.8	167.0	15-Jun	34.7	9.8
Incline AX +	150.5	136.5	108.6	61.1	167.0	15-Jun	38.5	8.9
Judee +	146.3	140.7	125.3	64.0	167.0	15-Jun	38.0	10.4
Keldin (P)+	167.6	151.5	134.8	62.9	167.0	15-Jun	37.4	9.8
Langin +	161.9			61.4	161.0	9-Jun	35.9	9.2
LCS 18-7071 (P)	150.4			61.5	167.0	15-Jun	40.2	9.6
LCS Helix AX (P)++	159.3			63.2	163.3	11-Jun	37.7	9.7
LCS Jet (P)+	171.1	158.4	146.4	61.5	167.0	15-Jun	33.9	9.6
LCS Photon AX (P)+	123.7			64.5	163.0	11-Jun	38.5	10.7
Loma +	162.8	146.6	126.9	61.2	171.3	19-Jun	38.8	10.5
Long Branch (P)+	155.0	138.1	125.9	63.1	161.0	9-Jun	36.5	9.7
Mpress (SWW) (P)+	170.7			60.8	168.3	16-Jun	37.0	9.5
MT1642	166.2	151.0	132.7	62.3	167.0	15-Jun	40.3	10.1
MT1683	158.5	148.6	132.4	62.2	167.0	15-Jun	39.3	10.1
MT1745	166.8	145.6		62.5	167.0	15-Jun	41.0	10.2
MT1746	146.6	137.5		63.6	167.0	15-Jun	37.7	10.4
MT1787	140.8	130.8		62.7	167.0	15-Jun	36.0	10.7
MT1793	138.0	129.9		62.0	163.0	11-Jun	36.1	10.4
MT1845	145.2			62.3	165.0	13-Jun	37.2	11.2
MT1848	159.8			62.1	167.0	15-Jun	35.9	11.1
MT1855	153.6			62.5	167.7	16-Jun	39.0	10.3
MT1866	155.1			62.6	167.0	15-Jun	36.3	9.8
MT1867	168.1			62.5	167.0	15-Jun	39.0	9.7
MT1872	154.8			63.5	167.0	15-Jun	36.9	10.1
MTCL1732	158.7	141.0		61.5	167.0	15-Jun	36.6	10.5
MTCL1737	156.7	144.6		61.2	168.3	16-Jun	35.2	10.4
MTS1810	148.6			62.0	167.7	16-Jun	38.7	11.2
MTS18116	156.0			60.6	169.0	17-Jun	35.0	9.9
MTS18149	146.6			58.6	170.3	18-Jun	37.5	10.5
MTS1831	166.1			59.5	171.3	19-Jun	35.6	10.2
Northern +	164.0	151.6	127.1	61.1	167.7	16-Jun	40.8	10.2
StandClear CLP (P)+	149.3	136.0	119.1	63.7	167.0	15-Jun	36.6	10.5
SY 517 CL2 (P)+	122.0	107.8	89.6	64.8	161.0	9-Jun	32.4	10.7
SY Clearstone 2CL (P)+	162.1	151.2	130.6	61.9	167.0	15-Jun	40.5	9.7
SY Legend CL2 (P)+	141.9	130.5	110.7	63.6	161.0	9-Jun	35.8	10.2
SY Monument (P)+	145.2	133.1	116.8	61.9	167.0	15-Jun	35.7	10.3
SY Wolverine (P)+	156.9	134.1		63.6	161.0	9-Jun	35.9	10.2
Warhorse +	138.5	128.5	116.3	62.1	167.0	15-Jun	39.2	10.9
WB4269 (P)++	144.7	128.8		63.6	161.0	9-Jun	35.8	10.3
WB4311 (P)+	148.9	135.4		62.6	167.0	15-Jun	32.9	10.3
WB4418 (P)+	145.8	134.0		60.1	165.0	13-Jun	36.2	10.2
WB4792 (P)++	173.5			62.2	167.0	15-Jun	37.4	9.2
Yellowstone +	161.6	144.8	124.4	61.4	167.0	15-Jun	40.5	10.2
Average	152.6	138.8	122.5	62.2	165.8	14-Jun	37.2	10.2
LSD (0.05)	15.2	10.8	13.7	1.1	2.2		3.1	0.6
C.V.	6.1	3.8	6.8	1.1	0.8		5.1	3.2

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

(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	2020 Data		Plant height in	Protein %
						Heading Date			
	2020	2019-20	2018-20	2017-20		Ordinal	Calendar		
	1y	2y	3y	4 yr		from Jan1			
AAC Wildfire ++	93.8	109.6	118.1		61.9	175.9	24-Jun	34.5	13.5
Bobcat ++	90.5	105.0	114.8	108.9	62.7	172.6	21-Jun	29.7	12.9
Brawl CL Plus +	73.8	100.1	105.1	94.5	63.7	163.7	12-Jun	29.4	15.3
Byrd CL Plus ++	93.3	115.7	122.3	107.3	63.3	165.1	13-Jun	32.7	12.7
CP7909 (P)	74.4				62.7	163.1	11-Jun	26.5	13.5
Flathead ++	80.6	107.8	115.3	116.2	62.9	165.2	13-Jun	30.2	14.0
FourOsix +	104.0	116.3	122.3	117.9	63.0	169.6	18-Jun	30.8	13.2
Incline AX +	94.0	108.0	115.8		61.6	168.5	17-Jun	31.6	12.2
Judee +	92.2	107.4	114.3	108.2	63.3	171.4	19-Jun	33.1	14.1
Keldin (P)+	100.1	126.5	132.5	123.8	62.9	172.8	21-Jun	31.2	13.8
Langin +	89.2				62.6	163.7	12-Jun	28.9	12.7
LCS 18-7071 (P)	93.3				62.9	172.1	20-Jun	32.2	11.6
LCS Helix AX (P)++	80.4				63.8	164.4	12-Jun	29.9	13.9
LCS Jet (P)+	95.6	120.8	129.0	127.9	59.6	171.3	19-Jun	27.0	13.0
LCS Photon AX (P)+	75.7				64.2	165.3	13-Jun	32.0	14.2
Loma +	96.5	112.6	121.6	115.2	61.5	173.9	22-Jun	30.6	13.5
Long Branch (P)+	86.4	103.6	114.0	112.9	63.2	164.5	13-Jun	29.8	13.4
Mpress (SWW) (P)+	97.9				59.4	174.8	23-Jun	29.7	12.0
MT1642	93.7	118.9	126.0		61.9	173.7	22-Jun	33.3	13.4
MT1683	92.1	115.7	124.3		61.8	172.6	21-Jun	33.9	13.5
MT1745	92.9	115.1			63.6	173.2	21-Jun	31.5	12.6
MT1746	89.4	109.6			64.3	169.1	17-Jun	28.7	13.6
MT1787	89.9	107.8			62.6	171.5	20-Jun	27.7	13.2
MT1793	87.5	106.1			62.9	166.1	14-Jun	31.4	14.9
MT1845	93.1				62.9	169.2	17-Jun	29.9	14.1
MT1848	94.5				62.1	173.9	22-Jun	32.0	14.0
MT1855	99.6				62.9	174.0	22-Jun	30.6	13.0
MT1866	91.1				62.0	172.2	20-Jun	29.0	13.7
MT1867	94.0				63.2	172.0	20-Jun	30.2	12.9
MT1872	94.8				63.4	171.1	19-Jun	31.1	13.6
MTCL1732	85.3	101.9			61.4	172.7	21-Jun	30.4	13.1
MTCL1737	92.7	108.9			61.0	174.8	23-Jun	29.4	13.0
MTS1810	87.3				63.8	175.0	23-Jun	31.6	13.7
MTS18116	96.5				63.5	174.2	22-Jun	29.8	12.3
MTS18149	93.1				61.6	174.9	23-Jun	28.5	13.4
MTS1831	93.5				62.7	174.5	23-Jun	28.6	12.4
Northern +	100.0	122.6	131.0	120.8	62.5	172.1	20-Jun	33.3	12.8
StandClear CLP (P)+	89.5	108.6	117.5		63.7	171.6	20-Jun	32.2	13.8
SY 517 CL2 (P)+	61.5	89.4	97.5	92.9	63.6	164.7	13-Jun	27.3	15.7
SY Clearstone 2CL (P)+	92.1	118.3	126.3	119.5	61.7	173.5	22-Jun	34.9	13.4
SY Legend CL2 (P)+	74.8	94.3	101.9		63.1	168.1	16-Jun	29.9	13.6
SY Monument (P)+	84.2	107.5	117.2	112.7	61.9	168.3	16-Jun	28.9	12.8
SY Wolverine (P)+	79.8	96.2			62.9	164.4	12-Jun	27.6	13.9
Warhorse +	73.8	96.4	104.5	101.7	61.3	171.6	20-Jun	31.5	14.5
WB4269 (P)++	73.5	93.6			63.0	164.6	13-Jun	27.2	13.8
WB4311 (P)+	80.6	103.6			62.7	164.8	13-Jun	26.5	14.9
WB4418 (P)+	73.7	92.9			62.5	165.1	13-Jun	27.4	13.0
WB4792 (P)++	89.6				64.1	170.3	18-Jun	30.6	12.3
Yellowstone + (1)	92.9	117.7	124.2		61.5	173.3	21-Jun	33.6	13.3
Average	88.5	108.1	118.0	112.0	62.6	170.1	18-Jun	30.4	13.4
LSD (0.05)	8.2	12.6	9.0	13.6	0.8	1.6		1.5	
C.V.	5.7	5.7	4.6	8.5	0.7	0.6		3.0	

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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)				Test weight	2020 Data		Plant height	Protein %
						Heading Date			
	2020	2019-20	2018-20	2017-20		Ordinal	Calendar		
	1y	2y	3y	4 yr	lb/bu	from Jan1	in	%	
AAC Wildfire ++	77.0	87.4	91.2		63.2	164.2 Jun 12	32.3	14.0	
Bobcat ++	77.5	88.7	92.7	97.0	63.0	162.4 Jun 10	28.8	14.2	
Brawl CL Plus +	80.4	101.8	105.9	108.4	65.1	154.5 Jun 3	33.8	14.0	
Byrd CL Plus ++	98.4	109.1	114.5	117.2	63.9	156.9 Jun 5	34.8	12.6	
CP7909 (P)	77.6				64.5	153.8 Jun 2	30.0	12.6	
Flathead ++	81.3	101.0	106.3	112.7	64.9	155.7 Jun 4	33.0	13.7	
FourOsix +	84.0	94.6	100.1	104.2	64.0	159.1 Jun 7	31.5	13.8	
Incline AX +	84.2	94.2	99.0		63.0	160.5 Jun 9	31.3	12.6	
Judee +	78.9	87.5	91.7	97.6	63.7	161.2 Jun 9	32.9	14.2	
Keldin (P)+	92.3	112.7	120.6	124.3	64.2	161.3 Jun 9	31.6	13.5	
Langin +	86.0				64.0	155.8 Jun 4	31.0	12.1	
LCS 18-7071 (P)	81.3				63.3	161.8 Jun 10	32.0	13.1	
LCS Helix AX (P)++	78.5				64.8	156.1 Jun 4	30.8	12.8	
LCS Jet (P)+	84.2	106.7	116.1	122.1	61.8	160.7 Jun 9	28.7	13.4	
LCS Photon AX (P)+	68.7				65.6	156.5 Jun 5	31.7	14.8	
Loma +	83.8	88.5	91.7	96.6	62.3	164.0 Jun 12	31.1	14.1	
Long Branch (P)+	83.8	100.3	106.3	111.7	64.2	155.9 Jun 4	32.9	12.7	
Mpress (SWW) (P)+	90.3				61.5	164.2 Jun 12	32.1	12.4	
MT1642	83.5	101.7	107.9		62.9	162.1 Jun 10	34.8	13.9	
MT1683	87.8	99.4	101.3		62.9	161.7 Jun 10	34.2	13.6	
MT1745	82.7	97.7			63.6	163.1 Jun 11	32.6	13.1	
MT1746	82.7	101.5			65.4	161.2 Jun 9	29.4	13.9	
MT1787	85.4	97.0			63.5	162.2 Jun 10	29.8	13.8	
MT1793	73.0	93.6			63.5	157.7 Jun 6	31.1	14.9	
MT1845	82.4				63.0	159.3 Jun 7	33.5	14.0	
MT1848	80.2				62.2	163.0 Jun 11	31.0	14.4	
MT1855	84.0				63.0	163.1 Jun 11	30.7	14.8	
MT1866	89.1				63.1	160.5 Jun 9	30.7	14.5	
MT1867	86.8				64.2	159.5 Jun 8	32.6	13.1	
MT1872	91.9				64.8	161.4 Jun 9	31.8	13.1	
MTCL1732	78.4	96.4			62.6	159.6 Jun 8	30.5	13.0	
MTCL1737	85.9	101.4			63.0	163.4 Jun 11	29.1	13.3	
MTS1810	83.0				64.7	163.0 Jun 11	32.3	14.3	
MTS18116	71.0				63.9	163.8 Jun 12	28.6	12.9	
MTS18149	77.1				62.5	163.8 Jun 12	30.4	14.0	
MTS1831	76.9				64.6	165.0 Jun 13	29.1	12.4	
Northern +	84.1	97.5	101.1	104.1	63.7	162.2 Jun 10	33.0	14.7	
StandClear CLP (P)+	84.7	97.8	100.1		64.0	160.2 Jun 8	33.1	14.3	
SY 517 CL2 (P)+	75.2	101.0	107.5	106.6	65.3	156.9 Jun 5	29.8	14.2	
SY Clearstone 2CL (P)+	88.5	99.9	101.0	105.6	62.9	161.4 Jun 9	35.5	13.9	
SY Legend CL2 (P)+	74.7	86.3	91.7		64.1	157.0 Jun 5	31.3	13.4	
SY Monument (P)+	79.0	98.7	106.5	112.4	63.3	158.3 Jun 6	31.5	12.4	
SY Wolverine (P)+	82.9	108.0			65.2	156.8 Jun 5	30.7	13.0	
Warhorse +	76.7	92.1	98.3	101.3	62.7	162.2 Jun 10	32.4	13.9	
WB4269 (P)++	73.8	94.1			64.6	155.5 Jun 4	29.7	12.3	
WB4311 (P)+	83.1	101.8			64.7	156.8 Jun 5	29.7	14.1	
WB4418 (P)+	75.5	91.6			64.4	157.3 Jun 5	30.4	12.9	
WB4792 (P)++	72.6				65.2	161.2 Jun 9	31.8	12.2	
Yellowstone + (1)	84.2	94.9	98.1		63.4	161.8 10-Jun	34.5	13.2	
Average	81.7	97.6	102.3	108.1	63.8	160.1 8-Jun	31.5	13.5	
LSD (0.05)	7.3	ns	10.5	9.8	0.9	1.3	1.6	0.6	
C.V.	5.1	7.4	6.3	6.4	0.9	0.5	2.9	2.7	

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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)				2020 Data	
	2020	2019-20	2018-20	2017-20	Test weight	Protein %
	1y	2y	3y	4 yr	lb/bu	%
AAC Wildfire ++	59.4	68.7	67.5		63.1	10.5
Bobcat ++	55.0	63.2	63.4	62.7	63.5	10.2
Brawl CL Plus +	45.8	54.5	56.3	58.7	65.1	12.6
Byrd CL Plus ++	66.2	71.2	70.0	68.3	64.8	9.1
CP7909 (P)	42.8				62.9	11.9
Flathead ++	46.9	55.7	59.0	61.6	63.3	11.4
FourOsix +	62.0	69.2	69.2	66.7	63.6	10.3
Incline AX +	61.5	69.8	69.2		62.9	9.3
Judee +	56.1	62.9	60.9	60.8	64.9	11.0
Keldin (P)+	60.7	66.9	66.5	67.1	63.9	10.9
Langin +	56.0				63.2	9.5
LCS 18-7071 (P)	64.7				63.2	9.0
LCS Helix AX (P)++	52.5				63.6	11.1
LCS Jet (P)+	58.5	72.3	71.4	70.0	60.6	9.4
LCS Photon AX (P)+	46.6				65.4	12.2
Loma +	59.4	65.5	66.1	64.2	63.3	10.5
Long Branch (P)+	48.8	61.9	61.9	62.2	63.1	11.7
Mpress (SWW) (P)+	63.9				62.4	9.0
MT1642	59.2	71.4	72.9		63.1	10.9
MT1683	58.0	66.4	71.5		62.1	10.7
MT1745	56.5	67.2			64.7	10.7
MT1746	59.2	66.3			65.0	10.7
MT1787	50.1	61.4			63.4	10.3
MT1793	49.7	56.6			65.0	12.5
MT1845	56.7				63.5	10.9
MT1848	58.1				62.5	10.5
MT1855	57.3				64.4	10.4
MT1866	51.8				64.2	11.1
MT1867	54.6				65.2	10.2
MT1872	56.8				64.8	11.5
MTCL1732	60.3	65.8			63.6	10.1
MTCL1737	62.0	66.8			62.9	10.1
MTS1810	51.7				65.0	11.0
MTS18116	59.0				64.3	9.2
MTS18149	60.6				62.3	10.2
MTS1831	54.8				64.4	9.5
Northern +	59.8	69.6	68.2	66.3	63.6	11.1
StandClear CLP (P)+	54.8	61.4	63.7		65.1	11.3
SY 517 CL2 (P)+	35.0	54.1	56.2	57.7	64.8	14.0
SY Clearstone 2CL (P)+	57.6	69.1	69.1	67.7	63.2	10.5
SY Legend CL2 (P)+	47.9	56.1	54.3		65.2	11.7
SY Monument (P)+	55.1	66.4	68.5	68.9	63.9	10.4
SY Wolverine (P)+	47.7	60.6			64.0	10.9
Warhorse +	51.2	58.6	59.0	60.1	63.8	11.1
WB4269 (P)++	45.0	56.7			63.5	12.8
WB4311 (P)+	52.4	64.8			64.0	12.0
WB4418 (P)+	50.6	60.8			63.3	11.1
WB4792 (P)++	59.0				65.3	9.7
Yellowstone + (1)	57.2	64.6	66.3		62.6	10.6
Average	55.0	63.9	65.0	64.1	63.8	10.8
LSD (0.05)	7.2	8.9	7.4	7.0	1.6	0.7
C.V.	8.1	6.8	6.9	7.6	1.5	3.8

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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)				2020 Data			
					Test	Winter	Sawfly	Protein
	2020	2019-20	2018-20	2017-20	weight	survival	cutting	
	1y	2y	3y	4 yr	lb/bu	%	%	%
AAC Wildfire ++	107.7	79.0	73.2		62.3	75	13	11.6
Bobcat ++	106.2	87.3	80.5	80.3	63.6	54	1	11.6
Brawl CL Plus +	80.9	80.2	75.3	76.6	64.5	59	9	13.2
Byrd CL Plus ++	110.5	88.1	84.2	84.0	62.8	74	9	10.9
CP7909 (P)	82.3				63.3	56	18	12.3
Flathead ++	100.9	82.0	72.4	72.5	62.9	78	14	11.9
FourOsix +	109.2	86.8	78.1	76.4	62.3	75	29	11.8
Incline AX +	85.9	73.3	71.6		61.5	50	9	11.0
Judee +	91.9	70.3	65.9	67.8	63.9	72	5	11.8
Keldin (P)+	88.0	80.4	74.1	75.6	62.9	50	22	12.2
Langin +	87.7				62.7	50	25	11.4
LCS 18-7071 (P)	87.6				61.6	35	20	11.4
LCS Helix AX (P)++	98.0				64.0	69	4	11.2
LCS Jet (P)+	91.4	82.2	77.0	79.0	58.9	67	27	11.5
LCS Photon AX (P)+	74.1				63.9	44	27	13.3
Loma +	103.8	84.0	77.5	76.3	62.3	72	9	11.6
Long Branch (P)+	93.6	83.2	76.7	80.5	63.6	78	8	12.1
Mpress (SWW) (P)+	97.0				59.7	67	23	10.7
MT1642	108.7	87.1	78.4		61.5	90	19	11.2
MT1683	107.7	82.1	74.2		61.5	72	26	11.7
MT1745	100.4	86.0			62.6	62	17	11.3
MT1746	88.3	75.6			64.2	53	11	11.3
MT1787	99.6	89.7			62.8	75	20	11.6
MT1793	92.6	79.3			63.2	86	5	12.7
MT1845	86.7				61.6	69	10	12.3
MT1848	106.1				62.2	79	13	12.1
MT1855	95.5				62.4	71	11	11.4
MT1866	97.9				62.6	75	7	11.1
MT1867	95.4				62.2	50	15	11.6
MT1872	98.1				64.0	58	10	11.7
MTCL1732	111.2	81.7			62.1	71	2	11.3
MTCL1737	98.5	84.6			61.3	63	19	11.7
MTS1810	99.7				64.7	65	5	12.1
MTS18116	108.9				63.0	63	1	10.6
MTS18149	107.1				62.1	60	7	12.3
MTS1831	101.4				63.4	68	1	10.9
Northern +	117.8	93.5	80.7	79.1	61.9	77	12	12.2
StandClear CLP (P)+	107.1	85.9	81.0		64.0	76	10	12.2
SY 517 CL2 (P)+	77.1	70.5	70.0	71.6	64.1	33	17	13.2
SY Clearstone 2CL (P)+	92.7	77.7	73.6	75.5	60.8	73	21	10.9
SY Legend CL2 (P)+	91.0	75.5	74.1		62.4	57	17	12.6
SY Monument (P)+	85.6	78.6	73.6	75.0	62.1	61	27	11.7
SY Wolverine (P)+	77.5	74.5			63.3	52	16	12.1
Warhorse +	99.0	74.3	66.2	66.2	62.1	66	3	12.2
WB4269 (P)++	86.4	80.8			63.4	66	6	11.9
WB4311 (P)+	79.8	74.6			63.0	48	10	12.4
WB4418 (P)+	95.4	78.7			62.4	64	8	11.5
WB4792 (P)++	106.2				63.9	72	10	10.9
Yellowstone + (1)	90.1	73.8	68.0		61.8	68	30	11.7
Average	96.0	80.7	74.8	75.7	62.6	64.7	13.4	11.8
LSD (0.05)	12.8	ns	ns	ns	0.7	16.8	11.1	0.8
C.V.	7.8	13.4	11.9	10.7	0.6	14.9	47.8	4.0

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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)				2020 Data					
					Test weight	Heading Date		Plant height	Sawfly cutting	Protein
	2020	2019-20	2018-20	2017-20		Ordinal	Calendar			
1y	2y	3y	4 yr	lb/bu	from Jan1					
AAC Wildfire ++	52.0	53.0	59.5		61.5	163.5	Jun 12	24.7	52	13.8
Bobcat ++	59.5	61.1	61.6	60.2	62.6	161.6	Jun 10	24.0	19	14.4
Brawl CL Plus +	47.1	49.7	52.3	50.1	63.4	155.7	Jun 4	24.8	31	14.0
Byrd CL Plus ++	57.7	54.4	55.8	55.0	63.0	158.0	Jun 6	25.3	44	13.1
CP7909 (P)	29.8				62.4	155.1	Jun 3	24.0	56	13.5
Flathead ++	50.4	49.8	53.6	53.1	63.1	157.3	Jun 5	26.3	34	13.9
FourOsix +	53.1	55.3	57.0	55.3	62.2	159.2	Jun 7	26.2	62	14.2
Incline AX +	52.0	57.6	59.6		61.9	161.4	Jun 9	24.7	34	12.9
Judee +	50.8	51.7	53.0	52.2	63.6	162.0	Jun 10	24.9	31	15.2
Keldin (P)+	58.1	55.3	59.7	59.0	62.0	161.3	Jun 9	25.1	61	14.3
Langin +	49.9				62.3	156.2	Jun 4	24.5	50	13.0
LCS 18-7071 (P)	54.3				62.1	162.0	Jun 10	26.1	54	12.5
LCS Helix AX (P)++	51.8				63.2	156.6	Jun 5	23.4	40	13.1
LCS Jet (P)+	52.5	55.7	57.0	54.8	60.0	161.1	Jun 9	21.2	51	14.0
LCS Photon AX (P)+	49.9				63.6	156.6	Jun 5	24.0	52	14.0
Loma +	53.0	52.1	54.9	53.3	62.1	164.3	Jun 12	24.0	38	14.7
Long Branch (P)+	51.6	56.6	59.2	57.1	62.5	155.2	Jun 3	24.1	40	13.1
Mpress (SWW) (P)+	57.1				60.5	162.9	Jun 11	25.6	43	12.9
MT1642	53.6	52.5	55.0		61.8	161.3	Jun 9	27.1	41	14.6
MT1683	53.6	52.6	55.6		61.4	161.5	Jun 10	27.7	38	14.5
MT1745	50.1	53.8			62.9	161.7	Jun 10	24.8	31	13.6
MT1746	49.3	52.1			62.9	160.9	Jun 9	23.8	35	13.7
MT1787	52.0	52.2			62.1	161.4	Jun 9	23.6	33	14.3
MT1793	46.2	52.4			62.3	158.2	Jun 6	22.2	34	15.5
MT1845	53.3				61.5	159.7	Jun 8	23.7	31	14.7
MT1848	53.1				61.3	162.5	Jun 11	24.9	29	15.1
MT1855	53.1				62.4	162.4	Jun 10	23.7	57	14.3
MT1866	49.9				61.6	160.4	Jun 8	22.9	46	14.1
MT1867	53.2				61.3	160.3	Jun 8	24.7	56	13.5
MT1872	52.9				62.5	160.9	Jun 9	23.4	25	13.9
MTCL1732	54.9	54.0			62.1	161.1	Jun 9	24.8	18	13.5
MTCL1737	51.8	54.1			61.1	163.2	Jun 11	22.8	28	14.5
MTS1810	57.4				63.9	163.6	Jun 12	24.8	1	14.5
MTS18116	56.3				64.0	163.8	Jun 12	23.0	13	13.3
MTS18149	56.6				62.4	164.1	Jun 12	23.8	29	14.8
MTS1831	52.2				63.9	163.4	Jun 11	23.3	12	13.3
Northern +	49.4	53.6	54.5	53.9	62.0	161.8	Jun 10	23.9	25	14.8
StandClear CLP (P)+	53.5	57.6	56.9		62.4	160.8	Jun 9	25.7	61	14.1
SY 517 CL2 (P)+	44.7	45.6	47.5	44.5	63.7	156.2	Jun 4	23.9	34	14.3
SY Clearstone 2CL (P)+	52.4	54.6	57.0	54.7	61.6	161.5	Jun 10	26.6	55	14.7
SY Legend CL2 (P)+	48.5	51.1	52.4		62.7	157.8	Jun 6	24.8	46	14.5
SY Monument (P)+	49.8	53.6	55.5	54.9	61.6	158.7	Jun 7	24.2	36	13.1
SY Wolverine (P)+	49.0	49.0			63.1	156.7	Jun 5	22.5	48	14.5
Warhorse +	51.4	49.0	51.6	49.7	62.1	161.7	Jun 10	22.9	35	14.8
WB4269 (P)++	49.0	51.3			62.4	156.2	Jun 4	23.3	20	12.8
WB4311 (P)+	50.0	50.6			62.8	158.7	Jun 7	23.2	55	14.2
WB4418 (P)+	46.3	49.9			61.4	156.4	Jun 4	21.9	32	13.5
WB4792 (P)++	54.0				64.5	160.8	Jun 9	24.0	31	13.1
Yellowstone + (1)	53.5	54.2	56.7		61.5	162.4	10-Jun	27.5	38	14.4
Average	51.7	53.0	55.7	53.8	62.4	160.2	8-Jun	24.3	38.1	14.0
LSD (0.05)	5.8	ns	5.9	4.3	0.6	1.3		1.8	15.6	0.4
C.V.	6.4	6.4	6.4	5.6	0.5	0.5		4.4	23.5	1.6

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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)				2020 Data		
					Test	Plant	Protein
	2020	2019-20	2018-20	2017-20	weight	height	
	1y	2y	3y	4 yr	lb/bu	in	%
AAC Wildfire ++	69.4	57.3	61.6		62.0	32.7	11.8
Bobcat ++	59.8	60.9	63.5	62.0	62.2	28.3	12.7
Brawl CL Plus +	52.6	56.9	59.0	56.2	62.8	28.7	14.6
Byrd CL Plus ++	71.2	58.8	63.8	60.9	62.6	30.7	11.5
CP7909 (P)	46.5				61.9	25.7	13.7
Flathead ++	57.5	58.3	58.4	58.8	61.6	29.3	13.7
FourOsix +	60.0	58.4	56.7	55.7	61.5	29.3	12.7
Incline AX +	62.6	56.7	56.1		61.6	29.3	11.7
Judee +	61.8	61.4	62.2	60.3	63.4	31.3	13.6
Keldin (P)+	62.2	58.9	59.3	58.8	61.8	29.7	12.8
Langin +	56.4				61.4	27.0	12.4
LCS 18-7071 (P)	63.8				62.5	30.0	12.6
LCS Helix AX (P)++	55.4				62.7	28.3	12.7
LCS Jet (P)+	70.9	61.6	59.3	58.4	60.4	26.7	12.4
LCS Photon AX (P)+	51.5				63.2	30.0	14.3
Loma +	61.9	60.8	62.9	61.4	61.8	29.3	13.6
Long Branch (P)+	62.6	60.4	62.7	59.2	61.5	28.0	12.8
Mpress (SWW) (P)+	78.0				60.1	29.0	11.0
MT1642	64.4	60.8	62.7		61.6	32.0	12.9
MT1683	59.9	57.4	60.7		60.8	31.3	14.0
MT1745	63.7	61.7			63.0	29.7	12.2
MT1746	56.6	56.7			62.7	28.0	13.6
MT1787	55.1	56.6			61.0	28.0	13.1
MT1793	60.2	58.1			62.0	30.0	14.2
MT1845	57.8				60.7	29.7	13.7
MT1848	65.9				61.3	30.7	13.3
MT1855	72.3				62.3	30.3	12.2
MT1866	63.2				61.1	27.7	12.8
MT1867	64.5				63.2	28.3	12.1
MT1872	64.6				63.1	29.3	12.8
MTCL1732	74.0	65.5			61.0	29.3	12.2
MTCL1737	68.8	61.1			60.5	27.7	12.8
MTS1810	64.7				62.4	31.0	13.2
MTS18116	71.9				63.7	28.7	11.9
MTS18149	71.4				61.7	29.3	13.5
MTS1831	63.3				63.4	28.3	12.0
Northern +	73.2	64.7	66.3	60.4	62.6	32.3	12.8
StandClear CLP (P)+	62.5	59.6	57.3		61.8	31.7	13.8
SY 517 CL2 (P)+	48.0	53.7	55.5	56.4	62.6	28.3	14.8
SY Clearstone 2CL (P)+	62.7	59.7	62.6	57.9	61.0	34.0	12.8
SY Legend CL2 (P)+	59.9	57.3	61.3		62.5	28.7	13.6
SY Monument (P)+	57.7	57.2	63.6	58.8	60.9	27.3	12.5
SY Wolverine (P)+	54.2	49.2			61.1	25.0	13.5
Warhorse +	63.7	60.6	64.5	61.7	62.1	30.0	13.5
WB4269 (P)++	55.8	56.0			61.6	26.0	12.9
WB4311 (P)+	57.7	57.6			61.8	26.7	13.6
WB4418 (P)+	68.9	61.6			61.4	27.7	12.5
WB4792 (P)++	60.3				62.8	30.0	12.3
Yellowstone + (1)	60.3	56.1	60.7		61.0	31.7	13.0
Average	62.3	58.7	60.9	59.1	61.9	29.2	13.0
LSD (0.05)	9.5	ns	ns	ns	1.0	1.9	1.1
C.V.	9.4	10.2	10.0	10.9	1.0	4.1	5.3

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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	2020 Data		Plant height	Protein
							Heading Date			
	2020	2019-20	2018-20	2017-20			Ordinal	Calendar		
	1y	2y	3y	4 yr	lb/bu	%	from Jan1	in	%	
AAC Wildfire ++	59.5	74.2	72.9		58.8	98	165.3	13-Jun	25.1	14.1
Bobcat ++	58.6	61.9	62.7	56.5	59.4	90	161.0	9-Jun	24.0	13.7
Brawl CL Plus +	55.8	45.8	50.8	45.2	61.3	92	154.7	3-Jun	21.9	13.3
Byrd CL Plus ++	59.6	55.4	62.7	57.6	58.5	82	159.0	7-Jun	25.9	12.5
CP7909 (P)	50.5				60.0	81	154.3	2-Jun	22.7	12.5
Flathead ++	60.2	63.4	61.3	55.8	60.3	94	156.3	4-Jun	25.7	13.2
FourOsix +	61.1	62.9	64.6	58.7	60.2	93	159.7	8-Jun	22.7	13.8
Incline AX +	56.0	52.2	57.7		59.1	86	160.0	8-Jun	23.0	12.6
Judee +	50.4	65.8	66.1	53.0	61.2	85	160.7	9-Jun	23.4	14.7
Keldin (P)+	63.3	65.1	74.1	63.0	60.6	91	161.0	9-Jun	25.4	12.7
Langin +	51.6				58.6	85	154.7	3-Jun	21.9	12.1
LCS 18-7071 (P)	54.7				60.9	74	162.0	10-Jun	23.9	11.8
LCS Helix AX (P)++	57.1				61.7	84	156.0	4-Jun	22.8	12.2
LCS Jet (P)+	58.0	66.8	58.6	52.0	58.7	76	162.3	10-Jun	20.8	13.4
LCS Photon AX (P)+	51.3				62.4	87	157.0	5-Jun	24.7	13.1
Loma +	60.5	66.2	68.1	60.2	60.0	95	162.7	11-Jun	23.0	13.9
Long Branch (P)+	53.8	52.3	57.7	51.7	59.4	98	155.3	3-Jun	22.3	12.2
Mpress (SWW) (P)+	63.5				58.2	95	163.3	11-Jun	23.7	12.2
MT1642	68.8	68.6	66.9		59.6	97	158.3	6-Jun	25.6	13.8
MT1683	65.9	72.5	75.6		60.1	93	160.7	9-Jun	27.6	13.6
MT1745	58.0	72.9			58.7	98	161.0	9-Jun	23.7	13.0
MT1746	52.9	61.5			59.8	94	159.3	7-Jun	23.2	13.1
MT1787	61.3	65.0			60.3	94	160.7	9-Jun	23.8	13.9
MT1793	60.7	62.9			59.4	98	158.7	7-Jun	24.8	14.0
MT1845	67.0				60.4	94	159.0	7-Jun	25.8	13.3
MT1848	56.8				59.3	92	162.0	10-Jun	22.8	14.9
MT1855	59.7				60.4	89	162.7	11-Jun	21.6	14.1
MT1866	47.6				59.3	79	160.7	9-Jun	22.8	13.8
MT1867	52.9				56.3	93	158.7	7-Jun	24.5	13.4
MT1872	57.8				59.9	97	160.7	9-Jun	24.8	12.8
MTCL1732	55.2	60.1			57.7	95	159.3	7-Jun	24.2	13.9
MTCL1737	63.5	69.9			59.8	91	163.0	11-Jun	22.0	14.2
MTS1810	54.2				60.9	96	164.0	12-Jun	24.0	14.7
MTS18116	61.6				60.7	94	162.7	11-Jun	22.6	13.3
MTS18149	60.1				60.2	88	163.0	11-Jun	20.9	13.7
MTS1831	60.2				61.0	86	164.7	13-Jun	22.7	12.9
Northern +	65.2	75.9	78.5	68.1	59.9	98	162.0	10-Jun	24.7	14.1
StandClear CLP (P)+	54.6	67.0	67.9		58.7	98	161.7	10-Jun	24.4	13.6
SY 517 CL2 (P)+	45.1	35.7	43.9	39.4	61.3	87	155.7	4-Jun	22.3	13.6
SY Clearstone 2CL (P)+	66.8	70.3	68.5	61.7	59.2	100	161.0	9-Jun	24.8	13.9
SY Legend CL2 (P)+	55.1	46.9	52.3		58.0	92	158.0	6-Jun	24.8	14.0
SY Monument (P)+	52.3	45.5	57.1	54.1	58.1	83	158.7	7-Jun	23.7	12.5
SY Wolverine (P)+	50.9	38.2			59.5	81	155.0	3-Jun	21.7	13.0
Warhorse +	53.0	53.2	58.5	52.0	59.1	96	161.3	9-Jun	23.0	14.3
WB4269 (P)++	53.4	43.7			60.6	81	157.7	6-Jun	20.9	12.2
WB4311 (P)+	51.6	48.5			61.7	79	158.7	7-Jun	23.7	13.2
WB4418 (P)+	56.5	48.6			59.7	83	155.3	3-Jun	21.6	12.4
WB4792 (P)++	61.8				62.8	83	160.0	8-Jun	24.9	12.3
Yellowstone + (1)	71.1	72.2	72.4		60.5	99	161.0	9-Jun	26.9	13.3
Average	57.7	59.7	63.6	55.3	59.8	90.1	159.8	8-Jun	23.6	13.3
LSD (0.05)	6.5	22.4	17.7	ns	1.0	12.6	1.8		2.4	0.4
C.V.	6.4	18.4	16.9	19.3	1.0	8.2	0.7		5.8	1.7

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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 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	Stand %	2020 Data		Plant height	Protein %
	2020	2019-20	2018-20	2016//18			Heading Date	Plant height		
	1y	2y	3y	3 yr						
AAC Wildfire ++	55.2	54.7	54.8		59.8	86	164.0	12-Jun	22.3	14.8
Bobcat ++	50.7	54.1	51.7		60.7	82	162.7	11-Jun	21.7	14.6
Brawl CL Plus +	46.1	45.0	42.8		61.2	97	154.7	3-Jun	21.3	13.4
Byrd CL Plus ++	51.9	50.3	48.0		59.5	94	157.3	5-Jun	22.2	12.0
CP7909 (P)	44.3				60.1	74	153.7	2-Jun	19.9	12.1
Flathead ++	46.7	45.7	45.3		60.1	91	155.7	3-Jun	21.5	12.3
FourOsix +	53.5	55.1	52.3		60.9	89	159.7	8-Jun	23.4	13.1
Incline AX +	49.0	53.0	49.6		59.2	89	160.3	8-Jun	22.7	12.5
Judee +	47.8	48.6	47.0		61.7	86	161.3	9-Jun	23.2	15.8
Keldin (P)+	52.3	52.4	50.0		61.0	90	159.7	8-Jun	22.7	12.5
Langin +	46.3				60.9	73	156.0	4-Jun	19.2	12.1
LCS 18-7071 (P)	56.2				60.5	71	160.3	8-Jun	23.8	13.0
LCS Helix AX (P)++	49.3				60.8	90	154.7	3-Jun	20.2	11.9
LCS Jet (P)+	52.6	50.7	48.1		57.7	83	161.0	9-Jun	18.4	14.4
LCS Photon AX (P)+	46.5				62.3	83	157.0	5-Jun	21.7	13.2
Loma +	50.2	54.1	51.6		60.3	87	163.0	11-Jun	19.3	13.8
Long Branch (P)+	43.9	48.1	43.3		59.7	75	155.0	3-Jun	20.9	11.5
Mpress (SWW) (P)+	50.8				59.6	87	164.0	12-Jun	22.0	12.1
MT1642	56.1	59.7	56.7		60.1	93	160.3	8-Jun	24.5	14.0
MT1683	53.1	55.0	52.9		60.3	89	160.7	9-Jun	24.4	14.3
MT1745	50.7	51.5			59.9	92	160.7	9-Jun	22.0	12.4
MT1746	41.2	46.8			61.1	84	160.0	8-Jun	19.9	12.5
MT1787	48.1	54.2			60.8	94	160.0	8-Jun	19.7	13.4
MT1793	46.5	44.9			59.7	96	156.7	5-Jun	20.6	14.3
MT1845	52.0				60.1	94	159.0	7-Jun	21.9	13.1
MT1848	49.9				60.4	84	162.7	11-Jun	21.9	14.8
MT1855	51.7				61.0	81	164.3	12-Jun	19.6	15.7
MT1866	46.3				59.3	90	161.3	9-Jun	20.5	13.6
MT1867	43.3				59.7	87	158.3	6-Jun	20.9	12.6
MT1872	42.7				60.2	86	160.0	8-Jun	21.5	12.8
MTCL1732	50.7	51.0			59.4	92	161.7	10-Jun	20.9	12.8
MTCL1737	52.3	54.2			60.4	90	163.3	11-Jun	20.9	14.6
MTS1810	52.9				61.0	85	164.0	12-Jun	21.3	15.7
MTS18116	50.1				62.0	84	164.0	12-Jun	19.6	13.7
MTS18149	50.8				60.4	84	162.7	11-Jun	19.4	15.1
MTS1831	49.0				62.2	86	164.7	13-Jun	19.7	13.7
Northern +	57.8	55.5	52.1		61.0	89	162.0	10-Jun	21.9	14.9
StandClear CLP (P)+	49.9	50.4	47.9		60.7	89	162.0	10-Jun	22.3	13.2
SY 517 CL2 (P)+	46.3	45.2	43.3		60.4	86	154.7	3-Jun	20.2	13.4
SY Clearstone 2CL (P)+	53.5	49.5	48.2		60.4	93	162.3	10-Jun	24.5	13.7
SY Legend CL2 (P)+	46.5	46.0	43.3		59.9	91	158.3	6-Jun	21.5	13.0
SY Monument (P)+	46.5	52.5	49.1		58.8	87	158.0	6-Jun	20.1	11.4
SY Wolverine (P)+	45.4	46.5			60.4	88	156.0	4-Jun	20.5	12.6
Warhorse +	43.7	47.3	46.6		59.4	92	160.3	8-Jun	21.3	13.7
WB4269 (P)++	49.6	43.5			60.2	91	157.0	5-Jun	17.7	11.8
WB4311 (P)+	44.0	46.7			59.4	89	158.3	6-Jun	20.3	13.5
WB4418 (P)+	47.7	43.2			60.9	87	155.3	3-Jun	21.1	12.5
WB4792 (P)++	54.1				61.8	86	159.3	7-Jun	22.4	12.6
Yellowstone + (1)	48.7	52.2	50.4		60.5	83	160.7	9-Jun	22.6	13.9
Average	49.3	50.2	48.9		60.4	87.1	159.8	8-Jun	21.3	13.4
LSD (0.05)	4.7	8.8	5.4		1.3	10.1	1.7		1.6	0.9
C.V.	5.9	8.6	6.7		1.4	6.8	0.7		4.5	3.7

bold = indicates highest value within a column

(1) Yellowstone mis-planted in 2017: no 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. 2017-2020 Intrastate Winter Wheat Test (Exp. 35): Combined Locations Winter Survival and associated Yield (Locations: Williston (2019, 2020), Sidney (2017, 2018, 2019), and Conrad (2020))

location-years	Winter Survival (%)				Yield under Winterkill conditions			
	2020	2019-20	2018-20	2017-20	2020	2019-20	2018-20	2017-20
	2	4	5	6	2	4	5	6
AAC Wildfire ++	80	67	66		81.5	76.5	75.2	
Bobcat ++	68	56	55	49	78.5	69.9	68.8	63.6
Brawl CL Plus +	78	63	60	54	63.5	51.7	53.5	49.3
Byrd CL Plus ++	84	63	62	57	81.2	65.6	67.9	63.6
CP7909 (P)	65				63.3			
Flathead ++	85	69	64	62	73.8	64.7	63.2	59.2
FourOsix +	82	64	60	58	81.4	71.0	70.4	65.5
Incline AX +	70	56	50		67.5	60.1	61.8	
Judee +	79	66	63	56	69.9	67.5	67.4	58.4
Keldin (P)+	70	58	58	53	70.2	64.9	70.3	63.6
Langin +	62				67.0			
LCS 18-7071 (P)	53				71.9			
LCS Helix AX (P)++	79				73.7			
LCS Jet (P)+	75	50	43	38	72.0	67.1	62.1	57.1
LCS Photon AX (P)+	64				60.3			
Loma +	80	64	61	57	77.0	70.9	71.1	65.4
Long Branch (P)+	77	64	61	59	68.8	60.1	61.8	57.1
Mpress (SWW) (P)+	77				73.9			
MT1642	92	67	61		82.4	74.1	72.0	
MT1683	81	66	64		80.4	74.2	75.7	
MT1745	77	66			75.6	72.8		
MT1746	69	59			64.8	63.0		
MT1787	85	66			73.9	69.2		
MT1793	91	77			69.6	61.9		
MT1845	81				69.4			
MT1848	82				78.0			
MT1855	76				73.6			
MT1866	82				72.1			
MT1867	69				69.4			
MT1872	72				70.4			
MTCL1732	81	64			81.0	69.6		
MTCL1737	76	62			75.4	70.8		
MTS1810	75				76.3			
MTS18116	74				79.5			
MTS18149	72				79.0			
MTS1831	77				75.2			
Northern +	83	65	62	58	87.8	78.8	79.8	72.6
StandClear CLP (P)+	83	67	66		78.5	71.8	71.4	
SY 517 CL2 (P)+	60	51	49	44	61.7	48.5	50.8	46.7
SY Clearstone 2CL (P)+	83	67	63	61	73.1	66.4	66.1	62.0
SY Legend CL2 (P)+	74	59	54		68.8	55.4	56.9	
SY Monument (P)+	74	62	61	59	66.1	57.3	61.9	59.1
SY Wolverine (P)+	70	53			61.5	49.0		
Warhorse +	79	63	61	59	71.4	61.7	63.2	58.1
WB4269 (P)++	79	59			68.0	51.8		
WB4311 (P)+	68	56			61.9	54.7		
WB4418 (P)+	76	60			71.6	55.6		
WB4792 (P)++	79				80.2			
Yellowstone + (1)	76	63	63		69.4	66.9	68.1	
Average	75.9	62.2	59.3	54.9	72.7	64.5	66.3	60.1
LSD (0.05)	15.7	10.6	10.5	9.9	12.6	12.4	11.4	10.8
C.V.	10.3	12.2	14.0	15.7	8.6	13.7	13.6	15.5

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

Table 13. Combined Locations Yield under Sawfly Pressure and % Sawfly Cutting: 2016-2020
(Note: Sawfly cutting in each location-year $\geq 10\%$)

Cultivar/Line	Grain Yield (bu/a)					Sawfly Cutting (%)				
	2020	2019-20	2018-20	2017-20	2016-20	2020	2019-20	2018-20	2017-20	2016-20
Location-years	3	10	16	19	21	3	10	16	19	21
AAC Wildfire ++	73.1	63.6				26	35			
Bobcat ++ (ss)	73.8	<u>71.5</u>	<u>69.5</u>	<u>65.9</u>		8	<u>11</u>	8	8	
Brawl CL Plus +	54.0	59.0	59.6	57.3		17	34	32	36	
Byrd CL Plus ++	74.7	67.2				25	36			
Flathead ++	64.9	59.1	58.2			18	43	47		
FourOsix +	71.1	64.1	61.4	59.1		35	53	56	56	
Judee + (ss)	66.6	61.2	60.3	57.5	60.6	13	33	37	35	34
Keldin (P)+	67.5	63.9	62.1	59.7	63.3	31	47	49	49	50
LCS Jet (P)+	63.0	61.3	59.7			28	45	50		
Loma + (ss)	71.6	66.5	65.1	62.0	<u>63.7</u>	17	26	29	29	27
MT1683	71.5	63.2				27	55			
MT1745	68.6					23				
MT1746	63.9					18				
MT1793	63.3					16				
MTCL1732	72.4	65.0				9	16			
MTCL1737	68.3					20				
MTS18149 (ss)	<u>76.9</u>					12				
Northern +	74.7	67.8	65.2	61.2	63.0	17	37	45	45	42
StandClear CLP (P)+ (ss)	72.8	66.1	63.8			27	34	35		
SY Clearstone 2CL (p)+	66.5	61.4	60.8	57.7	61.0	33	54	59	58	57
SY Monument (P)+	62.4	63.9	62.9	59.7		24	43	47	49	
Warhorse + (ss)	66.7	59.0	57.7	55.5	57.0	14	15	12	11	10
Yellowstone + 1/	64.9	61.6	60.8	58.7	61.5	29	50	56	53	53
Average	68.4	63.6	61.9	59.6	61.5	21.2	36.9	40.1	37.5	36.8
LSD (0.05)	9.3	5.6	4.0	3.8	4.1	21.8	9.8	9.1	8.8	7.9
C.V. (%)	8.2	10.0	9.3	10.0	10.9	36.7	30.2	32.7	36.6	34.8

bold = indicates highest value within a column

1/ = Yellowstone not in statistics for 4 and 5 year averages

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

Table 14. Precipitation (top, in inches) and Average Monthly Temperature (bottom, °F) for Crop Year 2019-2020

Agricultural Research Center	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Total
	2019	2019	2019	2019	2020	2020	2020	2020	2020	2020	2020	2020	Average
Western Triangle, Conrad	2.72	0.80	2.66	0.19	0.06	0.37	0.85	0.80	2.66	3.84	0.56	0.49	16.00
	1987-2020 Average = 11.78 (Temp = 43.6)												
Northern, Havre	55.5	34.8	28.3	26.8	22.4	28.4	31.0	41.4	51.9	60.7	66.5	67.9	43.0
	2.37	0.16	1.43	0.20	0.25	0.18	0.34	0.56	1.58	2.69	0.72	0.04	10.52
1916-2020 Average = 12.05 (Temp = 42.8)													
Northwestern, Kalispell	57.4	35.6	28.4	24.3	19.3	28.5	29.9	38.3	53.5	63.2	68.0	71.0	43.1
	2.50	1.12	0.90	0.48	1.59	0.61	0.10	1.53	3.44	5.39	1.22	0.41	19.29
1980-2019 Average = 19.85 (Temp = 43.3)													
Central, Moccasin	56.1	37.4	30.8	31.2	28.8	30.4	34.3	40.6	50.5	57.8	63.3	65.5	43.9
	2.87	0.85	0.78	0.30	0.26	0.56	0.43	0.77	2.68	3.79	0.96	0.35	14.60
1910-2020 Average = 15.32 (Temp = 43.0)													
Southern, Huntley	54.9	44.8	32.9	25.0	21.9	24.5	30.6	40.8	50.1	57.9	65.9	65.0	42.9
	3.66	1.00	0.81	0.50	0.17	0.46	0.69	0.79	1.58	4.75	0.00	0.72	15.13
1911-2019 Average = 13.50 (Temp = 45.6)													
Northeastern, Sidney	59.8	37.2	32.2	28.3	24.6	26.8	35.8	40.3	54.9	65.3	70.4	71.4	45.6
	0.33	0.63	0.22	0.33	0.46	0.43	0.40	0.02	1.60	1.05	1.78	0.91	8.16
1949-2020 Average = 14.05 (Temp = 43.3)													
Williston (WREC), N. Dakota	57.9	38.8	28.2	21.3	17.6	23.2	32.4	39.3	54.9	64.9	69.3	70.4	43.2
	5.94	0.64	0.84	0.20	0.53	0.15	0.14	0.13	0.86	1.37	2.10	0.45	13.35
1990-2020 Average = 14.51 (Temp = 44.2)													
Northern Seeds, Carter/Ft. Benton	60.0	40.1	30.0	21.0	16.3	23.7	34.2	39.8	55.0	66.0	71.6	72.4	44.2
	2.22	0.83	1.37	0.48	0.12	0.06	0.18	0.43	1.19	1.19	0.11	0.54	8.72
2008-2020 Average = 13.01 (Temp = 44.8)													
Post Farm, Bozeman	59.0	39.6	31.2	28.6	23.4	31.5	32.8	39.8	54.8	63.5	38.3	70.7	45.3
	3.61	1.40	0.79	0.08	0.31	0.84	1.24	0.87	0.78	3.65	0.66	0.56	14.79
1958-2020 Average = 15.90 (Temp = 43.6)													
	58.0	37.0	31.2	27.7	30.9	26.8	33.7	42.1	52.7	59.6	64.9	68.6	44.4

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	-	-
CP7909	E	White	2	-		N	-	-	-	-	-	R	-	-
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	-	-
Langin	E	White	2	-		N	-	2	2	H	-	R	-	-
LCS Helix AX	E	White	3	-		AX	-	-	-	-	-	MR	-	-
LCS Jet	M	White	2	S		N	L	4	2	H	S	R	-	-
LCS Photon AX	M-E	White	2	-		AX	-	-	-	-	-	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	-	-
Mpress (SWW)	L	White	3	-		N	-	-	-	-	-	R	-	-
Northern	M	White	3	S		N	S	3	3	L	S	R	R	-
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	-	3	2	H	-	MS	-	-
Warhorse	M	White	4	MS	22	N	M	3	3	H	S	R	R	MR
WB4269	M-E	White	2	S		N	-	2	2	ML	-	R	-	-
WB4311	M	White	3	S		N	-	3	3	H	-	R	-	-
WB4418	M-E	White	3	S		N	-	2	2	M	-	MR	-	-
WB4792	M	White	3	-		N	-	-	-	-	-	MR	-	-
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 = Moderate, MS = Moderately Susceptible, S = Susceptible, VS = Very Susceptible

AX = Coaxium herbicide resistance

- = no information

Additional Descriptive Information for Winter Wheat Varieties

New for the 2021 Bulletin:

CP7909 – hard red winter wheat developed by Winfield United (Croplan) and released in 2018. CP7909 is an early maturing, medium short statured wheat, with white chaff. CP7909 appears to have below average winter hardiness under limited testing in 2020. CP7909 has below average yield and average test weight and protein. CP7909 appears to be resistant to stripe rust conditions. Mill and bake characteristics of CP7909 have not been determined under Montana growing conditions.

Langin – (previously tested in 2017 and 208). Langin is a 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 issued (Certificate #201700298). Langin will not be in the Montana Intrastate Winter Wheat Test for 2021.

LCS Helix AX – hard red CoAxiom herbicide resistant winter wheat developed by Limagrain and released in 2020. LCS Helix AX is an early maturing, medium statured wheat, with white chaff. LCS Helix AX appears to have average winter hardiness under limited testing in 2020. LCS Helix AX has average yield, above average test weight and below average protein. LCS Helix AX appears to be moderately resistant to stripe rust under Pacific Northwest conditions. Mill and bake characteristics of LCS Helix AX have not been determined under Montana growing conditions. PVP, Title V is pending (Certificate #202000235). Additionally, the CoAxiom genes are patented.

LCS Photon AX – hard red CoAxiom herbicide resistant winter wheat developed by Limagrain and released in 2019. LCS Photon AX is a medium early maturing, medium statured wheat, with white chaff. LCS Photon AX appears to have below average winter hardiness under limited testing in 2020. LCS Photon AX has below average yield, high test weight and above average protein. LCS Photon AX appears to be resistant to stripe rust under Pacific Northwest conditions. Mill and bake characteristics of LCS Photon AX have not been determined under Montana growing conditions. PVP, Title V is issued (Certificate #201900413).

Additionally, the CoAxiom genes are patented. LCS Photon AX will not be in the Montana Intrastate Winter Wheat Test for 2021.

Mpress – soft white winter wheat developed by Syngenta (licensed to McGregor Co.) and released in 2017. Mpress is an early maturing, medium short statured wheat, with white chaff. Mpress appears to have below average winter hardiness under limited testing in 2020. Mpress has high yield and below average test weight and protein. Mpress appears to be resistant to stripe rust under Pacific Northwest conditions. Mill and bake characteristics of Mpress have not been determined under Montana growing conditions. PVP, Title V is issued (Certificate #201700113). Mpress will not be in the Montana Intrastate Winter Wheat Test for 2021.

WB4792 - hard red winter wheat developed by WestBred and released in 2019. WB4792 is a medium maturing, medium statured wheat, with white chaff. WB4792 appears to have average winter hardiness under limited testing in 2020. WB4792 has above average yield, high test weight and below average protein. WB4792 appears to be moderately resistant to stripe rust under Pacific Northwest conditions. Mill and bake characteristics of WB4792 have not been determined under Montana growing conditions. PVP, Title V is pending (Certificate #201900398).

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 is pending (Certificate #202000117).

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.

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 is pending (Certificate #202000202).

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 has been issued (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 has been issued (Certificate #201800522). Additionally, the CoAXium genes are patented. *Incline AX will not be in the Montana Intrastate Winter Wheat Test for 2021.*

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 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 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). . *Long Branch will not be in the Montana Intrastate Winter Wheat Test for 2021.*

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).

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 has been issued (Certificate #202000183). 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).

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. SY Wolverine appears to be moderately susceptible to stripe rust under Pacific Northwest

conditions. SY Wolverine has high PPO with average mill and below average baking characteristics. PVP, Title V is issued (Certificate #201900271).

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).

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. WB4269 appears to be resistant to stripe rust under Pacific Northwest conditions. WB4269 has medium-low PPO with below average mill and baking characteristics. PVP, Title V is pending (Certificate #201800093). *WB4269 will not be in the Montana Intrastate Winter Wheat Test for 2021.*

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. WB4311 appears to be moderately resistant to stripe rust under Pacific Northwest conditions. WB4311 has high PPO with average mill and baking characteristics. PVP, Title V is issued (Certificate #201800086). *WB4311 will not be in the Montana Intrastate Winter Wheat Test for 2021.*

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. WB4418 appears to be moderately resistant to stripe rust under Pacific Northwest conditions. WB4418 has medium PPO with below average mill and baking characteristics. PVP, Title V is issued (Certificate #201800530).

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>