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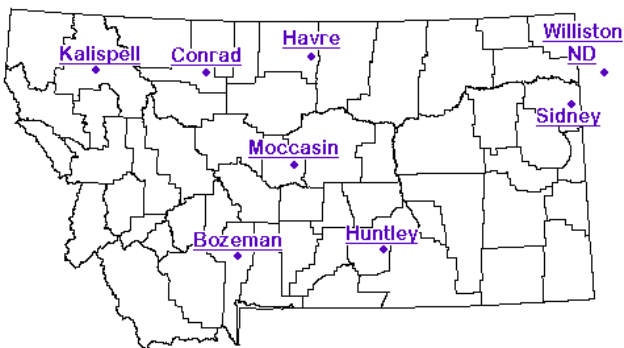
## WINTER WHEAT VARIETY PERFORMANCE SUMMARY IN MONTANA

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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. Varieties recommended for production in the respective districts of Montana are designated by an **R**. 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 and the Soft White Winter Wheat Nursery Reports. These reports are 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, frost, or other unavoidable causes.

### Variety Testing Procedures



**Fig. 1. Test Locations for Montana winter wheat performance tests in 2002.**

### Locations

Hard winter wheats were planted at 7 Montana and 1 North Dakota location (Fig. 1) including 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. Separate tests comparing soft white winter wheat

varieties were planted at Bozeman, Kalispell, Huntley and Moccasin.

### Entries

Names of commercially available entries evaluated in 2002 are listed with their origins, release year and pedigrees in Table 2 for the hard winter wheats and in Table 16 for the soft white wheats. Forty-nine hard wheats are included in this summary comprising 32 varieties (23 public and 9 private) and 17 experimental lines (15 public and 2 private). Numbered entries preceded by a state designation [e.g. SD97457 (South Dakota), MT9904] are experimental lines provided by the breeder of the originating state. Private experimental lines (e.g. BZW96-895) are provided by Western Plant Breeders and are submitted for testing on a fee basis. The soft white evaluation contains 16 varieties [12 public, 3 private (including one experimental line) and one hard wheat check (Neeley)].

### Experimental Design and Seeding Methods

The Intrastate Winter Wheat Test consisted of a 49 entry test with 3 replicates. It was planted in the form of 7x7 lattice at all locations except Kalispell, where it was in a randomized complete block design. Plot size varied by location, from 35 ft<sup>2</sup> at Conrad to 60 ft<sup>2</sup> at Havre. All plots were 4-row, except Havre (3-row), Williston (8-row) and Kalispell (7-row). Row spacing at all locations was on 1 ft. centers, except at Williston and Kalispell (6" centers). All plots were seeded at 0.6 grams seeds/ft<sup>2</sup>, which is roughly equivalent to 1 bushel per acre, except at Williston where the seeding rate was about 77 pounds per acre. Information on previous crop, planting date, fertilizer use and harvest date is available in Table 1.

Soft white winter wheat nurseries were planted similar to the hard wheat test, except all tests were planted in a randomized complete block design.

All seed for each nursery was treated with Dividend-XL seed treatment at recommended rates before planting.

**Table 1. Summary of agronomic practices used on hard winter wheat performance trials in Montana in 2002. Fall nitrogen (N), phosphorus (P<sub>2</sub>O<sub>5</sub>) and potassium (K<sub>2</sub>O) were preplant applied and incorporated.**

Location	2001 Crop	2000 Crop	2001 Planting Date	Fertilizer				2002 Harvest Date
				N		P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	
				Fall	Spring			
----- Pounds per acre -----								
Kalispell	green manure	green manure	Oct. 1	54	75	28	103	Aug. 14
Bozeman	fallow	oats	Sept. 30	130	-	52	52	Aug. 15
Huntley	chem. fallow	winter wheat	Sept. 25	18	-	46	0	Not harv.
Moccasin	fallow	barley	Sept. 24	10	60	10	10	July 31
Conrad	fallow	barley	Sept. 20	11	-	52	0	Not harv.
Havre	chem. fallow	barley	Sept. 26	70	-	45	25	Aug. 20
Sidney	fallow	safflower	Sept. 24	none	30	none	none	Aug. 1
Williston, ND	fallow	safflower	Sept. 11	18	37	46	0	Aug. 1.

### 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 2002, data is provided for two (2001-2002), three (2000-2002) and four (1999-2002) year averages for both hard and soft wheat entries tested during previous cropping seasons.

There is no data this year for Rampart, except at Havre, due to a seed mix-up prior to planting that wasn't discovered until after heading. Therefore the multiyear analyses do not contain information for Rampart if the location was harvested in 2002. For those locations, yields for 1999, 2000 and 2001 Rampart will be footnoted on each table.

#### Test Weight

Test weight (pounds per bushel) were obtained for each plot by using a Seedburo test weight apparatus. 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. Grams per quart are converted into pounds per bushels. Test weight, heading date, plant height and protein percentage are reported for 2002 data only (except Huntley and Conrad, 2001 data).

#### 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 Julian days (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. In 2002, Sidney and Williston had significant stand loss due to winter kill.

Table 11 contains information on yield in winter-kill environments from 1999 to 2002. The data summarizes 6 tests in which significant winter-kill occurred (test average for winter survival was less than 90%). Most of the testing sites with winter-kill were in District 6 (Sidney and Williston) which is 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. Solid-stemmed winter wheats, 'Vanguard' and 'Rampart' were released in 1995 and 1996, respectively. These 2 varieties were planted on 27.5% of the winter wheat acreage in the 2002 crop year. Both these varieties have marginal winter hardiness.

Table 12 contains information on yield at 10 testing locations where sawfly pressure was present during the years 1997-2002. The data is mainly from Off Station winter wheat nurseries. Big Sandy and Loma are 'satellite' locations of Havre; The Knees of Conrad, Highwood and Ft. Benton of Moccasin and Broadview of Huntley.

### **Coleoptile Length**

Coleoptile length evaluation was 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) was measured. This test was replicated 3 times for each variety. Results are reported in inches in Table 14. 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, straw strength and shattering reactions for the hard wheat varieties listed in this publication. Information on shattering is not available for all varieties.

Table 20 has information on maturity, winter survival and lodging for soft white winter wheats.

### **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 general leaf spot complex. Table 20, for soft white winter wheat, contains information on dwarf smut, snow mold, stem rust and stripe 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 mean of a variety exceeds that of another variety by more than the LSD, then the difference observed will be a true difference in 19 out of 20 times under conditions similar to those of the test.

Tables 3 through 10 show data collected in 2002 for each district at all experiment station sites for the hard winter wheats. (Data for Huntley and Conrad is 2001 because of loss of the 2002 tests to poor stands due to drought conditions.) Tables 17 - 19 contain 2002 data for the soft white wheats. Where a variety has been in the test for two, three or four years, combined analyses of the yield data over years are presented. Not all years are present at each location due to hail or stand problems.

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.

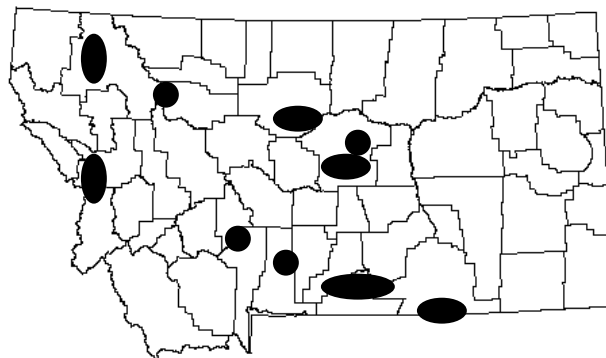
## **2002 Test Conditions**

Drought conditions again dominated testing locations in 2002. Dry planting conditions resulted in poor emergence at several sites. Nurseries at Huntley and Conrad were lost due to inadequate emergence and stands. Winter conditions were moderate at all testing sites except Sidney and Williston, which had significant stand loss due to winter kill. Statewide winter wheat yields were impacted by continuing drought and projected by the Montana Agricultural Statistics Service at 28 bu/a yield for 2002 compared to 33 bu/a average

for the 1998-2001 harvest years. Bozeman, Kalispell and Conrad experienced below average precipitation (see Table 13 for precipitation data). Yield levels were below average at all harvested sites except Bozeman and Moccasin. Mean yield for harvested locations ranged from 30 bu/a at Williston to 119 bu/a at Kalispell. Harvested acreage for Montana in 2002 was 750,000 acres for total production of 21 million bushels. In 2001: 875,000 acres were harvested and total production was 19.1 million bushels.

Leading winter wheat varieties planted for 2002 were Neeley (18.8%), Rampart (18.8%), Tiber (11.7%), Rocky (10.7%), Vanguard (8.7%), and Morgan (7.2%).

Test weight averaged above 60 lb/bu only at Kalispell. Diseases were minimal at all locations. There was no sawfly cutting at any of the Experiment Station locations. Protein content was above average at all stations except Kalispell.



**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 planting a resistant variety (Tables 15 and 20) or use 'Dividend' seed treatment, only.

### Dwarf Smut (TCK)

Dwarf smut (TCK) can be controlled with 'Dividend' seed treatment (see page 5). Dwarf smut or dwarf bunt (*Tilletia controversa* Kuhn is a fungal disease that occurs in areas where winter wheat is subjected to prolonged snow cover or unfrozen ground. The planting of dwarf smut resistant varieties (Blizzard, Manning, Promontory and Lewjain are currently recommended) as one practical means of control. Newer varieties such as Golden Spike (HWW – Utah, 1999) and DW (HRW – Idaho, 2001) have been developed with dwarf bunt resistance.

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

### What Recommendation by MAES Means

Classification of winter wheat varieties is determined on a yearly basis by the Montana Agricultural Experiment Station (MAES) Wheat Variety Release Committee. This 15 member committee is composed of four Plant Science and Plant Pathology members (two wheat breeders, one cereal quality scientist, and one plant pathologist), one entomologist, one extension specialist, one representative of Foundation Seed Stocks, six Research Center representatives, one Montana Wheat and Barley Committee member and one representative of the Montana Seed Growers Association.

A variety is eligible for recommendation when a minimum of 16 location-years of performance data is obtained from the Montana State University statewide winter wheat performance trials. Test results indicate that the variety is equal to or superior in overall merit to specified check cultivars and has end-use quality equal to or exceeding currently recommended varieties. For varieties originating from private companies, recommendation is considered only at the request of the company when adequate data is available.

Recommendations of varieties are considered on a case by case basis. Yield performance of a variety is an important criteria, but also considered are test weight, grain protein content, winter survival, pest

resistance and end-use quality data. In general, yield needs to be at least equal to currently recommended varieties in a particular district, unless the variety is being recommended for a specific purpose, e.g. winter hardiness, sawfly resistance. For example, Rampart and Vanguard, which are not competitive in the absence of wheat stem sawfly, are recommended in Districts 3, 4 and 5 for sawfly areas only. Only four varieties are recommended for the Northeast district due to severe winter conditions and a higher probability of stem rust in this region. Thus varieties recommended for District 6 must have higher winter survival and stem rust resistance.

If a serious defect in the variety is identified during performance testing, the variety will not be recommended. Examples of defects resulting in non-recommendation include: high probability of winter-kill, low grain protein, low baking quality, etc.

Lack of variety recommendation by MAES may occur due to a decision by the originating company not to test the variety in statewide performance trials. In this case the lack of recommendation is due to inadequate or no data rather than a specific varietal defect.

Montana produces primarily hard red winter and hard red spring wheats. Continuous improvement of the milling and/or baking quality of Montana grown winter wheat is one of many objectives of the Montana Agricultural Experiment Station breeding and cultivar development program. All varieties recommended by the Montana Agricultural Experiment Station have been evaluated and found to be acceptable for milling and baking performance by the Cereal Quality Laboratory at Montana State University.

The quality of Montana recommended varieties, if grown and marketed within their respective classes, is acceptable by domestic users. Montana's future as a hard red and hard white winter wheat producing state for both the domestic and export markets rests on the quality of the product.

## **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 a new chemical compound called Difenconazole. '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 page 4 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 and date for winter wheat**

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

<b>Yield in Winter Wheat as Influenced by Percent Stand</b>
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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).

## Additional Descriptive Information for Winter Wheat Varieties

### Hard Winter Wheat

#### New for 2003 Bulletin:

**Above** – a CLEARFIELD wheat with imazidole (IMI) tolerance. Above is a awned, white-chaffed, early maturing, semidwarf hard red winter wheat. It has good straw strength. In Montana tests, in 2002, Above had below average yield at all locations except Bozeman. It had low winter survival. Above had average test weight and below average protein. Above is resistant to stem rust, susceptible to leaf rust and moderately susceptible to both wheat streak mosaic virus and barley yellow dwarf virus. This variety is protected under the Plant Variety Protection Act and can only be sold or advertised by variety name as a class of certified seed. Additionally, the CLEARFIELD gene is patented.

**Expedition** (SD97457) – hard red winter wheat released by the South Dakota Agricultural Experiment Station in 2002. Expedition is an early maturing variety with white chaff color and good winter hardiness. It had average yield, above average test weight, and short stature in Montana testing locations during 2002. According to South Dakota St. Univ. it has fair lodging and excellent baking quality. PVP, Title V is pending

**Jerry** – hard red winter wheat released by North Dakota State University in 2001. It is white-chaffed and awned and similar in maturity to Roughrider. Jerry has good winter hardiness and is a top yielder in areas where winterkill can occur. Jerry has average test weight and protein under Montana conditions. It has good resistance to prevalent races of stem and leaf rust. Mixing properties and baking performance are equal to Roughrider.

**Pryor** (BZ9W96-919) – hard red winter wheat released by Western Plant Breeders in 2002. Pryor is a white chaffed, awned variety with short stature and medium winter hardiness. Good yielding variety with average test weight and below average protein. It is susceptible to stem and moderately resistant to leaf spot complex. Pryor has average milling and baking characteristics.

**Wahoo** – hard red winter wheat released jointly by Nebraska and Wyoming in 2000. Wahoo is a semidwarf, early maturing white chaffed variety. It has above average yield, below average test weight, and average protein under Montana conditions. Wahoo is moderately resistant to stem rust and leaf rust and susceptible to wheat streak and barley yellow dwarf viruses. Milling and baking characteristics are acceptable. This variety is protected under the Plant Variety Protection Act and can only be sold or advertised by variety name as a class of certified seed.

#### Varieties previously in bulletin:

**BigSky** - is a broadly adapted, high-yielding hard red winter wheat cultivar with medium maturity, good foliar disease resistance, and dual purpose (bread and Asian noodle) end-use quality. Yield performance is similar to Judith, Kestrel, Neeley and Rocky and higher than Tiber and Erhardt. Test weight is superior to all these varieties. BigSky is of medium maturity heading 1-2 days later than Judith, similar in height to Tiber, but with strong, stiff straw. BigSky is resistant to stem rust but susceptible to leaf and stripe rust. Resistance to Septoria and tan spot is good. Milling and baking qualities of BigSky are within acceptable ranges. BigSky was released by the Montana AES in the fall of 2001 and PVP, Title V is pending.

**Bighorn** - Developed by Rohm-Haas and released in 1984. Bighorn was owned and merchandised by HybriTech Seed International, Inc until 2000 and now owned by Western Plant Breeders. It is a medium height variety with good winter-hardiness and medium-late maturity. It has white chaff and good straw strength. It is moderately susceptible to leaf rust but resistant to stem rust. It is rated as good in milling quality. This variety is protected under the Plant Variety Protection Act and can only be sold or advertised by variety name as a class of certified seed.

**CDC Falcon** – hard red winter wheat developed by the Crop Development Center, Saskatoon, Saskatchewan and registered in 1998. Licensed to Western Plant Breeders. Superior stem and leaf rust resistance over all current winter wheat



varieties in western Canada. High yield, good winter-hardiness, semidwarf, short strong straw, especially good for direct seeding and straight cut harvest. It is rated as having acceptable milling and baking quality. This variety is protected under the Plant Variety Protection Act and can only be sold or advertised by variety name as a class of certified seed.

**DW** - hard red winter wheat developed for release by the Idaho Agricultural Experiment Station in 2001. Under Montana conditions, DW has shown average yield (above average at Kalispell and Moccasin), above average test weight and average protein. DW has medium maturity, average plant height and average straw strength. DW has bronze chaff color. DW is highly resistant to dwarf bunt, has adult plant resistance to stripe rust, moderate tolerance to snow mold and susceptible to stem rust. DW has average milling and above average baking characteristics. PVP, Title V is pending

**Elkorn** - released by the North Dakota Agricultural Experiment Station in 1995. It is a hard red winter wheat. Elkorn is an awned, white chaffed, tall variety, with a lax, tapering spike. Elkorn is moderately resistant to stem rust with approximately 25 percent of the plants being susceptible to the prevalent races of stem rust. It is moderately susceptible to leaf rust. The milling and baking qualities of Elkorn are acceptable by industry. This variety is protected under the Plant Variety Protection Act and can only be sold or advertised by variety name as a class of certified seed.

**Gary** – hard white winter wheat was released in 2001 by the Idaho Agricultural Experiment Station. Gary is a semidwarf with white chaff, medium to late maturity, and medium to weak straw strength. Yields are above average across Montana testing sites, but with lower than average test weight and protein. Gary is highly resistant to dwarf bunt, has adult plant resistance to stripe rust, moderate tolerance to snow mold and susceptible to stem rust. DW has average milling and only fair baking characteristics, with lower than average loaf volume. PVP, Title V is pending

**Golden Spike** – hard **white** winter wheat released by the Utah Agricultural Experiment Station in 2000. Awned, brown-chaffed. It has an erect, twisted flag leaf, an elliptical seed with mid-wide seed crease. Has excellent resistance to current prevalent races of common bunt. Moderately

resistant to snow molds. Susceptible to stripe rust and moderately susceptible to damage by Russian wheat aphid and cereal leaf beetle. Has very good milling and baking properties and is suitable for Asian noodles. This variety is protected under the Plant Variety Protection Act and can only be sold or advertised by variety name as a class of certified seed.

**Judith** - A hard red winter wheat variety released by the Montana Agricultural Experiment Station in 1988. Judith is a bearded variety with white chaff. It is high yielding with good shatter resistance. Judith is medium in maturity and has a reasonable level of winter-hardiness. The heading date is similar to Rocky, and the winter-hardiness similar to Redwin. It is resistant to stem rust, but moderately susceptible to bacterial leaf blight and leaf spotting complex. The protein of Judith is somewhat lower than Redwin, but equal to or better than other varieties on the recommended list. The test weight is 1 - 2 lb/bu lower than many varieties. The milling and baking qualities of Judith are very good exhibiting high flour yield, absorption, flour protein, loaf volume and grain/texture scores.

**McGuire** – A hard red winter wheat developed by the Montana Agricultural Experiment Station and released in 1996. McGuire is an awned, bronze chaffed, medium-tall early maturing variety. The kernels are hard, red, with a mid-sized germ and a heavy brush. Kernel cheeks are round to angular and the crease is open. The kernel backing is long and sloping, and seed coat has a rough texture. McGuire is resistant to stem rust, but susceptible to dwarf smut, stripe rust and the wheat stem sawfly. It is susceptible to the wheat streak mosaic virus and has a moderate reaction to the leaf spot complex (Septoria and tan spot). McGuire has high milling and baking qualities producing a very good quality bread flour.

**Morgan** – Developed by the Crop Development Centre, University of Saskatchewan. Western Plant Breeders was granted the production rights. It is an awned, white chaffed, semidwarf hard red winter wheat. The spike is tapered, mid-dense and lacks a waxy bloom. The glumes are medium long, medium wide, no pubescence and have oblique shoulders. Morgan is moderately tolerant to stem rust and moderately susceptible to leaf rust. Morgan is protected under the Plant Variety Protection Act, but not the Title V option.

**Neeley** – Developed and released in 1980 by USDA-ARS and the Idaho Agricultural Research Station. It is a hard red wheat. It is a semidwarf variety with intermediate maturity. The spikes are fusiform and mid-dense, have white awns and white glumes and are erect to inclined. Neeley generally has 1 to 3 percent lower protein than most recommended hard red winter wheats. Neeley has average winter-hardiness.

**Norstar** – a hard red winter wheat developed at the Agriculture Canada Research Station, Lethbridge, Alberta. It was a hard red winter wheat released in 1977. Norstar is lodging susceptible, susceptible to stem rust, but is very winter-hardy. The spikes are long, inclined, tapering, mid-dense with white awns. The florets tend to spread. The glumes are white and glabrous with narrow beaks. The glume shoulders are narrow and oblique to wanting. The kernels are light red, mid-sized to small, mid-long, narrow to mid-wide and elliptical to oval in shape.

**NuFrontier** – hard white winter wheat marketed by General Mills, released in 2001. Average yielding variety with excellent test weight, but low protein under Montana conditions. NuFrontier is early maturing, short, with good straw strength. Limited quality data shows average milling and fair baking characteristics, with lower than average loaf volume. PVP, Title V is pending

**NuHorizon** - hard white winter wheat marketed by General Mills, released in 2001. Average yielding variety with excellent test weight, but low protein under Montana conditions. NuHorizon is early maturing, short, with good straw strength. Limited quality data shows good milling, with above average flour extraction and average baking characteristics. PVP, Title V is pending

**Nuplains** – hard **white** wheat released by the Nebraska Agricultural Experiment Station in 1998. Moderately early maturing, medium-short with good straw strength. Excellent test weight and average protein under Montana conditions. Good baking quality characteristics. This variety is protected under the Plant Variety Protection Act and can only be sold or advertised by variety name as a class of certified seed.

**NuSky** – hard **white** winter wheat to be released by the Montana Agricultural Experiment Station as a public release in the fall of 2001. High yielding, medium maturity, good winterhardiness,

intermediate height, good straw strength, average grain protein, and good milling, bread-baking, and Asian noodle characteristics. Field performance and end-use quality characteristics are very similar to NuWest. PVP, Title V will be applied for.

**NuWest** – Developed by the Montana Agricultural Experiment Station. It was released in 1994 and is currently licensed to General Mills. NuWest is a hard **white** winter wheat of intermediate height. The spike is awned, white chaffed and erect at maturity. The kernels are hard, white and elliptical. The germ is large, with a mid-long brush, cheeks are rounded with a narrow straight crease. There is approximately one red kernel per 1500 white kernels. NuWest is resistant to prevalent races of stem rust found in Montana. It is susceptible to leaf rust, wheat streak mosaic virus and dwarf bunt. It is moderately susceptible to stripe rust and Cephalosporium stripe. It is susceptible to Russian wheat aphid and the wheat stem sawfly. This variety is protected under the Plant Variety Protection Act and can only be sold or advertised by variety name as a class of certified seed.

**Paul (MT9426)** – a hollow-stemmed, winter-hardy, high quality hard red winter wheat with yield potential similar to Judith and Neeley. Has improved winter hardiness and baking quality relative to Neeley. Test weight of Paul is low but slightly higher than that of Judith. Paul is of medium to late maturity, relatively short, with straw strength similar to Neeley. Paul is resistant to stem rust, but susceptible to leaf and stripe rust. Foundation seed will be available in fall of 2003. 'Paul' is named in honor of Paul L. Brown's long-term contributions to Montana dryland agriculture. PVP, Title V will be applied for.

**Promontory** – Released by the Utah Agricultural Experiment Station in 1991. It is a hard red winter wheat of medium height with awns and bronze chaff. The spike is lax, with medium length and wide glumes. The kernels are ovate, medium-wide, medium-deep crease and a medium length brush. Promontory is resistant to dwarf bunt.

**Prowers 99** – hard red winter wheat developed by Colorado State University and released by the Colorado Wheat Research Foundation in 1999. Awned, white-chaffed, medium tall. Improved resistance to Russian wheat aphid over Prowers. Tall, long coleoptile, medium late maturity, good quality characteristics. Above average test weight and average protein under Montana conditions.

This variety is protected under the Plant Variety Protection Act and can only be sold or advertised by variety name as a class of certified seed.

**Quantum 542** – A standard height, hard red winter wheat hybrid variety developed and released by Hybritech Seed International, Inc. in 1987. It is now owned by Western Plant Breeders. It is about four days earlier in heading than Redwin and Neeley, and equal in maturity to Rocky. It has a bearded, drooping head similar to Winalta and has good resistance to shattering. It is medium in winter-hardiness. Test weight and protein are similar to Neeley and Redwin. Hybrid varieties must be treated differently than standard wheat varieties. Only the F<sub>1</sub> seed you buy from the seed dealer is recommended.

**Rampart** – Released by the Montana Agricultural Experiment Station in 1996. It is an awned, red chaffed, solid-stemmed hard red winter wheat variety. The kernel is long with a sloping back and a heavy brush. The cheeks are rounded to angular with an open crease. Rampart is resistant to the wheat stem sawfly. It is resistant to prevalent races of stem rust. It is susceptible to stripe rust, leaf rust, dwarf smut and the Russian wheat aphid. Rampart has excellent milling and baking properties and is a sister line to Vanguard.

**Ransom** – hard red winter wheat released by the North Dakota Agricultural Experiment Station in 1998. Plant height 2' shorter than Elkhorn and similar to Redwin. Spikes mid-dense, fusiform, awned and white at maturity. Glumes medium length and wide with rounded shoulders and acuminate beak. Seeds ovate, with rounded cheeks and medium brush. Field resistant to prevalent races of stem rust. Moderately resistant to prevalent races of leaf rust. Average test weight and slightly below average protein for Montana conditions. This variety is protected under the Plant Variety Protection Act and can only be sold or advertised by variety name as a class of certified seed.

**Rocky** – A pure line selection from Centurk developed and released by Nickerson American Plant Breeders (now Agripro Seed Company) in 1978. Rocky is a hard red winter wheat that has white glumes and awns. It is similar in most characteristics to Centurk but differs in glume shape and beak length and has better resistance to soil born mosaic. Rocky tends to be about three to four days later in heading than Centurk but dries

down for harvest as early as Centurk. Rocky is adapted to the same areas as Centurk, but has superior yields under most conditions. Rocky has average milling and baking qualities when compared to Redwin.

**Tiber** – A standard height hard red winter wheat variety released by the Montana Agricultural Experiment Station in 1987. Tiber was selected from a Redwin population based on its tolerance to the leaf spot disease complex. Tiber is a bearded, brown chaffed, stiff-strawed variety. It has a high yield potential, good shatter resistance and good winter-hardiness (similar to Redwin). Tiber's resistance to lodging and shattering is equal to Redwin; shorter in straw height than Winalta. Tiber has moderate resistance to the leaf spot complex, but is susceptible to dwarf smut and very susceptible to stripe rust. Tiber has average milling and baking quality.

**Vanguard** – Developed by the Montana Agricultural Experiment Station and released in 1995. Vanguard is the first sawfly-tolerant winter wheat released in Montana since 1965. It is resistant to the wheat stem sawfly. It was released as an emergency measure to reduce yield losses due to the sawfly. Vanguard has awned spikes, with white chaff and the straw is white. The kernels are hard, red, long and elliptical. The germ is mid-sized with a short brush. Vanguard is susceptible to stem rust, stripe rust, leaf rust and dwarf smut.

### Soft White Winter Wheat

**Bruehl** – club type soft white winter wheat developed by Washington State University and released in 1999. Semi-dwarf, awned, late season maturity. Superior yield to Eltan, especially under snow mold pressure. Test weights similar to Eltan. Good resistance to snow mold and stripe rust. Moderately susceptible to leaf rust, stem rust, Cephalosporium stripe, and eyespot.

**Cashup** – soft white winter wheat developed by Columbia Basin Seeds, Moses Lake, WA in 1984. Awned, white glumed with stiff straw. Moderately resistant to leaf rust and stripe rust, but moderately susceptible to stem rust. Susceptible to common bunt and snow mold. This variety is protected under the Plant Variety Protection Act and can only be sold or advertised by variety name as a class of certified seed.

**Daws** – Developed cooperatively by USDA-ARS and the Washington Agricultural Experiment Station. Daws is a semidwarf soft white winter wheat. It was jointly released by the Washington, Oregon and Idaho Agricultural Experiments in 1976. The spike is awned, long, lax, mid-wide with white glumes. The kernels are white, soft, elliptical and mid-long, with a shallow crease. The kernel's germ is mid-sized. Daws is resistant to stripe rust races found in the tri-state area and resistant to common bunt. It is susceptible to dwarf smut (TCK), flag smut, leaf rust, stem rust and *Cercospora* foot rot.

**Eltan** – Developed cooperatively by USDA-ARS and the Washington Agricultural Experiment Station and released jointly by the Washington, Oregon and Idaho AES in 1990. Eltan is a semidwarf, soft white winter wheat. The spike is awned and white chaffed. It is resistant to dwarf bunt (TCK), snow mold and common bunt. Eltan is moderately susceptible to prevalent races of stripe rust, but susceptible to stem rust and leaf rust.

**Hill 81** – Developed cooperatively by USDA-ARS and the Oregon Agricultural Experiment Station and released in 1982. Hill 81 is a white chaffed, stiff strawed, soft white winter wheat. The spike is awned, fusiform, mid-dense and inclined. Glumes are white, glabrous, mid-long, mid-wide, with wanting shoulders. Kernels are white, mid-long, elliptical with mid-sized germ, narrow to mid-wide crease and rounded cheeks. Hill 81 is resistant to stripe rust, leaf rust, moderately susceptible to powdery mildew and Septoria. It has fair resistance to dwarf bunt.

**Kmor** – developed by the USDA-ARS and the Washington Agricultural Experiment Station. Kmor is a semidwarf, white chaffed, soft white winter wheat. It was released jointly by the Washington, Oregon and Idaho AES in 1990. Kmor is resistant to stripe rust, moderately resistant to *Cephalosporium*, common bunt, strawbreaker foot rot, and dwarf smut. It is susceptible to snow mold, leaf rust and stem rust.

**Lambert** – Developed by the Idaho AES and jointly released in 1995 by the Idaho, Oregon and Washington Agricultural Experiment Stations. Lambert is an awned, semidwarf, soft white winter wheat, The kernels are soft, white and ovate, with a mid-deep crease and a mid-sized germ. It is

resistant to stripe rust, more tolerant than Stephens to both *Cephalosporium* stripe and snow mold. Lambert is susceptible to strawbreaker foot rot and dwarf bunt. Lambert's quality characteristics have been accepted by industry.

**Lewjain** – developed and jointly released by the Washington AES and the USDA-ARS in 1982. It is a semidwarf, soft white winter wheat. It is white chaffed, awned, with a common head type. Lewjain is resistant to some races of common smut and dwarf smut. In the adult stage it is resistant to stripe rust and moderately resistant to *Cephalosporium gramineum*. It is susceptible to leaf rust, stem rust, flag smut and foot rot.

**MAC-1** – soft white winter developed by Plant Breeders 1, Moscow, ID in 1992. Currently licensed to Lake Seeds in Ronan, MT. Above average yield and test weight in first year of testing at Bozeman and Kalispell. High protein for soft white winter wheat. This variety is protected under the Plant Variety Protection Act and can only be sold or advertised by variety name as a class of certified seed.

**MacVicar** – Jointly released in 1980 by the Washington AES and the USDA-ARS. The spike is awned, white chaffed, fusiform and lax. Kernels are white, mid-long, ovate to elliptical, the crease is narrow and shallow. The brush is mid-long and cheeks are rounded. The glumes are glabrous, mid-long, mid-wide with narrow acuminate beaks and shoulders are wanting.

**Madsen** – developed by the USDA-ARS Wheat Genetics, Quality, Physiology and Disease Research Unit at Pullman, WA. It was jointly released in 1988 by USDA-ARS and the Washington, Oregon and Idaho AES, The spike is awned, the straw is white, but the glumes are both white and tan colored. The kernels are large, white, soft and ovate with a medium size germ. Madsen is resistant to strawbreaker foot rot, and expresses field resistance to prevalent races of stripe rust, leaf rust and stem rust in the Northwestern US. It is moderately susceptible to flag smut, powdery mildew and *Cephalosporium* stripe. Madsen has resistance to a few races of common bunt (smut). It is susceptible to dwarf smut (TCK).

**Malcolm** – Released as a soft wheat in 1987 by the Oregon AES. The spike is white chaffed, awned, oblong and mid-dense and nodding. Glumes are

glabrous, with white narrow shoulders and beaks. Kernels are white, mid-sized with a shallow crease and small germ. Malcolm is susceptible to leaf rust and Cephalosporium. It is moderately susceptible to Septoria and stripe rust.

**Rod** – Developed by Washington State University in cooperation with USDA-ARS. Released jointly by the Washington, Oregon and Idaho AES. Rod has some winter-hardiness (similar to Stephens), moderately weak straw and medium-late heading. Resistant to local races of stripe rust and common bunt, but susceptible to dwarf bunt, stem rust, leaf rust and snow mold.

**Stephens** – Developed and released by the Oregon AES in 1977. Stephens is a soft white winter wheat. It is a white chaffed, stiff strawed, semidwarf variety. The glumes are white, glabrous, and short to mid-long. The kernels are white with a small brush. Stephens is resistant to stripe rust, leaf rust and common bunt. It is moderately resistant to Septoria leaf blotch and susceptible to dwarf smut, flag smut and snow mold.

## 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.