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Submitted by
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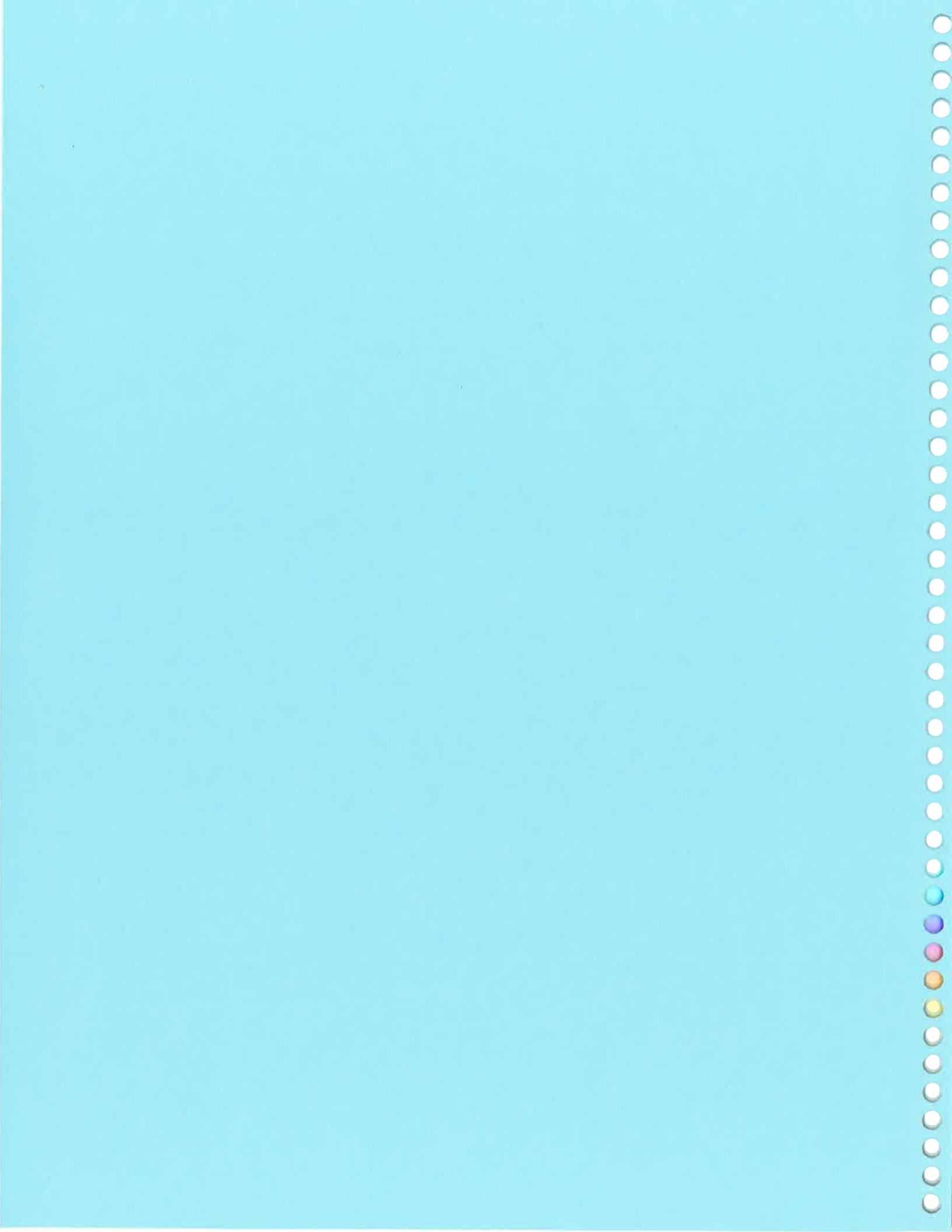


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Climatic summary for the 2002 calendar year at the Western Triangle Research Center, Conrad, MT.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total or average
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Precipitation (inches)													
Current Year	0.11	0.13	0.48	0.33	1.29	5.86	1.36	3.03	2.00	0.68	0.18	0.07	15.52
Average 18 yr	0.20	0.22	0.49	0.85	1.80	2.82	1.52	1.42	1.30	0.51	0.36	0.16	11.65

Mean Temperature (°F)													
Current Year	26.6	30.7	18.1	34.2	47.2	59.2	69.6	61.0	55.2	37.3	42.6	30.9	42.7
Average 17 yr	23.0	24.6	33.4	43.4	52.9	60.1	66.2	66.1	57.5	45.2	32.2	24.7	44.1

Last killing frost in Spring
 2002----- June 11 (32°)
 Average----- May 17

First killing frost in Fall
 2002----- Sept 25 (31°)
 Average----- Sept 23

Frost free period (days)
 2002----- 107
 Average----- 129

Maximum summer temperature---- 99° (July 15)
 Minimum winter temperature----- -24° (March 11, 2002)

Summary of climatic data by month for the 01-2002 crop year (Sept - August) at the Western Triangle Research Center, Conrad, MT.

	Sep 2001	Oct 2001	Nov 2001	Dec 2001	Jan 2002	Feb 2002	Mar 2002	Apr 2002	May 2002	June 2002	July 2002	Aug 2002	Total or Average
Precipitation (inches)													
Current year	0.52	0.03	0.35	0.01	0.11	0.13	0.48	0.33	1.29	5.86	1.36	3.03	13.50
Average 18 yr	1.26	0.50	0.37	0.17	0.20	0.22	0.49	0.85	1.80	2.82	1.52	1.42	11.62
Mean Temperature (°F)													
Current year	60.4	46.7	39.4	25.9	26.6	30.7	18.1	34.2	47.2	59.2	69.6	61.0	43.3
Average 17 yr	57.6	45.7	31.5	24.3	23.0	24.6	33.4	43.4	52.9	60.1	66.2	66.1	44.1

Last killing frost in Spring
 2002----- June 11 (32°)
 Average----- May 17

First killing frost in Fall
 2002----- Sep 25 (31°)
 Average----- Sept. 23

Frost free period (days)
 2002----- 107
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Maximum summer temperature----- 99° (July 15)

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2002 Winter Wheat Variety Evaluations in the Western Triangle Area.

Location: Western Triangle Research Center, Conrad, MT.

Personnel: Gregory D. Kushnak and Ron Thaut, Research Center, Conrad; and Dr. Phil Bruckner, MSU Plant Science Dept.

Winter wheat variety trials were grown on station at Conrad, and an off-station trial at the Knees area east of Brady. Drought conditions prevailed at both locations from planting time through the following spring. The Conrad trials were planted on reduced-tillage fallow, and the Knees trial was no-till planted on chemical fallow.

Results: Data for 2002 and five-year averages are presented in Tables 1 and 2, respectively. Limited soil moisture at Conrad resulted in weak fall stands and poor winter survival. The chemical fallow system at the Knees allowed conservation of adequate soil moisture for good fall stand establishment and winter survival. The trials at Conrad were not harvested. Sawfly wasps and larval infestation were abundant at the Knees, but harvest was accomplished before sawfly stem breaking occurred. Consequently, solid stem lines ranked lower for yield than they normally do at this location.

MTS 0031, a sawfly resistant experimental, yielded nearly 3 bu higher than sawfly-resistant Vanguard. MTS 0031 has good stem solidness, and its winterhardiness is much higher than Vanguard and Rampart, and equal to Rocky. Heading date of MTS 0031 is slightly earlier than Vanguard, and one day later than Rocky. Protein of MTS 0031 was slightly higher than Vanguard and 1.3% higher than Rocky. Another sawfly resistant line, MTS 0023, has shown no improvement in winterhardiness over Vanguard, and was much later in maturity and lower in yield than MTS 0031. The sawfly-resistant variety Rampart was not included in the 2002 trial due to a seed problem.

Big Sky and Tiber were agronomically similar at the Knees over the five-year period, and were among the top yielders. Rocky had the highest average yield, and was 2 bu/a higher than Big Sky and Tiber, and 3.5 bu/a higher than the sawfly-resistant variety Vanguard.

Detailed descriptions of most of the varieties tested are included in Extension Bulletin 1098 "Performance Summary of Winter Wheat Varieties in Montana", available at County Agent Offices. Additional observations concerning the varieties are presented in the following pages.

Winter Wheat Variety Notes & Comments

Western Triangle Agricultural Research Center, Conrad, MT

Winterhardiness ratings: 5 = very good; 1 = poor.

Coleoptile length: Long = 3.4" or more; Short = 3" or less.

Quality ratings: 4 = good; 3 = average; 2 = poor; 1 = very poor.

Above (CO, 2001): IMI resistant (imazamox or 'Beyond' herbicide), as part of American Cyanimid's Clearfield System. 'Beyond' controls cheatgrass, goatgrass and wild oats. (MSU has IMI resistant lines of Tiber, Rampart, Big Sky and NuWest currently being evaluated).

Agassiz (ND, 1983): Recommended for District 6 only to replace Froid (Eastern Montana). High winterhardiness (4), slightly less than Roughrider. Tall very weak straw, lodges bad. Long coleoptile. Medium late maturity. Shatter resistance fairly good. Low yield, high protein. Quality = 3.

Arapaho (Nebr, 1989): Winterhardiness medium (3). Medium-short height with long coleoptile and moderate straw strength. Early heading. Heterozygous (mixed) resistance to Great Plains strain of Hessian fly, moderate tolerance to Cephalosporium stripe. Medium yield, low test weight.

Archer (NAPB): Winterhardiness less than Centurk, but greater than Vona (probably should classify as a 2). Not widely adapted for Montana. Short straw and good lodging resistance. Early maturity. Good shatter resistance. Sometimes can have test weight problems due to its massive tillering. Low protein.

Big Sky (MT9432, 1999): Nuwest/Tiber cross, hard red kernels, white chaff. Good winterhardiness (4), greater than Judith, and equal or slightly better than Tiber. Strong, stiff straw, very good lodging resistance, height equal to Tiber. Long coleoptile. Medium maturity, heading 1-2 days later than Rocky, but 2 days earlier than Neeley and Tiber. Yield about equal to Rocky and Neeley, and 2-3 bu higher than Tiber. High test wt and protein, protein = Tiber. Post-harvest seed dormancy is high, like Tiber. Septoria and tan spot resistance is good. A good alternative to Tiber.

Blizzard (ID 0297) (Idaho/Oregon/USDA, 1989): Probably similar to Weston for winterhardiness which is not very high (2-3). Long coleoptile. Snow mold resistance, for high elevation areas under snow. Better dwarf bunt resistance than Weston or Manning. Tough to thresh; lots of spikelets in grain sample. High protein.

Bighorn (WPB): Winterhardiness somewhat tender in Triangle area tests, but others rate it a 3. Short straw. Medium coleoptile. Medium early maturity. Susceptible to stem rust but resistant to dwarf smut. Fairly good yield. Protein is medium.

Centurk (Nebr, 1971): Medium low winterhardiness (2), less than Redwin and Tiber. Medium stiff straw. Long coleoptile. Early maturity, which sometimes allows escape from sawfly. High yield. Very susceptible to yellow berry expression under low nitrogen conditions. Medium-low protein.

Cheyenne: Medium winterhardiness. Tall straw. Medium maturity. Medium to high yield, shatters bad -(see 'Cree' for an improvement). High protein.

Cree (MSU, 1983): Shatter resistant version of Cheyenne. Identical to Cheyenne in other respects except has red head and brown chaff. Winterhardiness medium (3). Tall straw. Medium maturity and highly vulnerable to sawfly. Medium to high yield. High protein. Seed supply no longer maintained.

Elkhorn (ND, 1994): Good winter hardiness (4). Medium height and straw strength. Long coleoptile. Medium-late maturity. Better yield than Agassiz and Roughrider, but lower protein than Roughrider. Recommended only for eastern Montana, not competitive in other areas. Quality = 3.

Erhardt (MT8719, MSU, 1996): White chaff. Good winterhardness (4), equal to Roughrider. Five inches shorter than Roughrider and 3 inches shorter than Rocky. Strong straw, much better lodging resistance than Roughrider, and somewhat better than Rocky & Neeley, but not as strong as McGuire or Tiber. Medium coleoptile. Medium maturity, 2 days later than Judith & Rocky, one day earlier than Tiber, 2 days earlier than Neeley. Resistant to stem rust & leaf spot complex. Susceptible to WSMV, stripe rust, dwarf bunt, RWA & sawfly. Hetero (mixed) resist to GP Hessian fly. Yield 19% higher than Roughrider, and 5% lower than Tiber, Neeley & Rocky unless the latter three suffer winter injury. Moderately susceptible to shatter. Higher test wt than Roughrider, Judith & Neeley, and similar to Tiber & Rocky. High protein (similar to Redwin) & excellent quality. Intended to replace Roughrider, Agassiz and Seward in NE Montana.

Falcon (CDC, WPB, Sask. 1998): Good winterhardness. Short coleoptile. Straw 4" shorter than Rocky. 1 day later than Rocky. Medium yield. Protein similar to Rocky.

Eidel (Amer Cyanamid). IMI herbicide resistant (see 'Above').

Froid: High winterhardness (5). Low yield and tall weak straw.

Halt (Colorado, 1994): Winterhardness (2). Short semidwarf. Medium coleoptile. Early maturing. Has Russian wheat aphid resistance. (No seed available).

Harding (SD, 2000): Med winterhardness? Very long coleoptile. Height = Rocky. 1 or 2 days later than Rocky. Medium yield. High protein.

Hawk (AgriPro): Winterhardness moderate to poor, probably less than Centurk. Short straw & good lodging resistance. Medium coleoptile. Early maturity. Sometimes yields high, but not consistently. Adapted to Southern Great Plains.

Jerry (ND, 2001): Winterhardness high (5). Med-high protein.

Judith (MT 8039, MSU, 1989): Winterhardness = 3, higher than Rocky and Cheyenne, and equal to Redwin. Low vernalization requirement. Medium short straw; straw less stiff than Neeley, Tiber and Redwin; but stiffer than Rocky and Centurk. Short coleoptile. Heading slightly later than Rocky, but earlier than Tiber. However, it had more sawfly damage than Rocky & Tiber at the Knees plot in 1991. Stripe and stem rust resistant. Yields fair to good, sometimes equal to Rocky and Tiber. Medium shatter resistance. Test weight is sometimes low, and may be a problem. Judith represents the lower limit for test weight check. Protein is medium: equal to Tiber, greater than Centurk, and less than Redwin. Quality = 3.

Kestrel (Sask, Can, 1993): Winterhardy and high yielding in Canada (hardiness = 5, similar to Norstar). Shorter straw & slightly better lodging resistance than Norstar. Short coleoptile. Medium late; three days earlier than Norstar (similar maturity as Redwin). Probably will not tolerate drought stress very well. Very susceptible to physiological leaf spot. Susceptible to stem, stripe, & leaf rust. Higher yield than Norstar. Test weight and protein less than Norstar (very low). Dockage for low protein is almost certain with this variety.

McGuire (MT88046, MSU, 1996): Red chaff. Winterhardness intermediate (3), similar to Neeley & Judith. Height 2 inches shorter than Neeley & Judith. Long coleoptile. Good lodging resistance, similar to Tiber & Redwin and superior to Neeley & Rocky. Very early maturity, 1 to 2 days earlier than Rocky. Resistant to stem rust. Susceptible to stripe rust, dwarf bunt, WSMV, RWA and sawfly. Low to medium yield; similar to Redwin and 7bu/a lower than Neeley. Test weight intermediate, similar to Rocky. Has the highest protein and baking quality of any winter wheat tested in our lab. Very high protein, 1% higher than Redwin. Possibly useful for specialty markets.

Meridian (Idaho, 1991): Poor winterhardness (2). Good straw strength; developed for irrigated conditions in Idaho. Medium coleoptile. Very late maturity (several days later than Neeley). Too late in maturity for satisfactory performance in the Triangle area; needs long, moist growing season. Moderate resistance to stripe rust, snow mold and dwarf bunt. Susceptible to stem rust. Yields rank from low to very high depending on year. Medium to low test weight. Low to very low protein.

Morgan (Sask & WPB, S89-142, 1996): Norstar/Archer. Excellent winterhardiness (5). Height similar to Rocky. Very short coleoptile. Three days later to head and slightly later maturity than Rocky; heading similar to Neeley. Yield avgs 1 bu less than Rocky. Test wt 1 lb less than Rocky or Tiber. Protein equal or slightly higher than Rocky, similar to Neeley, and about 1% less than Tiber and Rampart. Milling and baking acceptable, about equal to Neeley. Recommended for areas needing high levels of winterhardiness.

MT 8713 (MSU): Experimental; sister seln of Erhardt with similar traits, but much shorter. Very good winterhardiness (similar to Norwin). Three inches taller than Norwin and 7" shorter than Redwin. Lodging resistance similar to Norwin. Early to medium maturity: 1-2 days later than Rocky & Judith. Stem rust resistant. Moderate yield, 2 bu/a higher than Norwin. Higher test wt than Norwin. Adequate quality and 1% higher protein than Norwin. Potential replacement for Norwin, but will not be released unless there is interest in another Norwin type.

MTS 9882R (MSU): Sawfly resistant, experimental. Much greater winterhardiness than Vanguard & Rampart, and slightly greater than Rocky. Medium coleoptile. Straw 4" shorter than Rocky. Maturity similar to Tiber. 9882 has high yield and test weight, equal to Rocky, but low protein. A reselection line is being evaluated, but probably won't show much improvement for protein, and appears to have lost some stem solidness.

MTS 0031 (MSU): Sawfly resistant, experimental. Good stem solidness. Winterhardiness much higher than Vanguard and Rampart, slightly less or equal to Rocky, and somewhat less than Tiber. Height similar to Vanguard, 2" shorter than Rocky, and 3" shorter than Tiber. Maturity half-day earlier than Vanguard, one day later than Rocky, one day earlier than Tiber. Yield 10% (or 3 bu) higher than Vanguard & Rampart, 3 bu less than Tiber, 4.5 bu less than Rocky. Test weight equal to Vanguard, 1.5 lb less than Tiber and Rocky. Protein equal to Vanguard & Big Sky, 0.5% higher than Tiber, 1.0% higher than Rocky. (A similar line MTS 0023 was less winter hardy, similar to Rampart, much later in maturity, and lower yield).

Neeley (Idaho, 1980): Winterhardiness medium to high (3); greater than Cheyenne, but less than Winalta. Medium short straw, slightly less stiff than Redwin and Tiber. Long coleoptile. Medium-late maturity, making it highly vulnerable to sawfly. Susceptible to stem rust. Very high yielder in good years, but does poor if stressed for moisture. Good shatter resistance. Protein & quality are erratic, ranging from low to high; apparently more sensitive to Nitrogen deficiency.

Norstar (Canada, 1977): Maximum Winterhardiness (5). Very tall straw, poor lodging resistance. Long coleoptile. Late maturity. Susceptible to stem rust & leaf spot. Low yield. Medium to low shatter resistance (head shattering occurred at Conrad in 1980). Protein medium-low; lower than Roughrider. Quality = 3.

Norwin (MSU, 1984): Winterhardiness = 5 (high). Licensed in Canada. Very short semidwarf straw, but not a tripledwarf. Too short for dryland. Very short coleoptile. Medium maturity. Severe Pseudomonas bacterial leaf blight symptoms. Medium yield. Good shatter resistance. Protein medium to low. Quality = 2.

Paul (MT 9426, MSU, 2001): Winterhardiness higher than Neeley, and equal to Tiber & Big Sky. Height 2" shorter than Neeley, 3" shorter than Tiber & Big Sky. Medium coleoptile length, shorter than Tiber & Big Sky. Heading 0.5 day earlier than Neeley, Tiber & Big Sky. Yield 1 bu higher than Neeley, and 3 bu higher than Tiber & Big Sky. Test weight slightly lower than Neeley, and 1 pound lower than Tiber & Big Sky. Protein equal to Neeley, 0.5% less than Tiber, and 1% less than Big Sky.

Promontory (Utah, 1990): Red head. Winter hardiness poor (2). Medium short, strong straw, good lodging resistance. Short coleoptile. Medium-late maturity. Excellent stripe rust & dwarf smut resistance; susceptible to stem rust. Yield and test weight higher than Manning. Protein medium low.

Pronghorn (Nebr, SD & Wyo, 1995): Med-low WH. Tall straw. Long coleoptile. Early maturity.

Prowers 99 (CO, 1999): WH was good (1st year). Long coleoptile. Similar height and maturity as Rocky. 3 bu lower yield and 0.5% higher protein than Rocky. Russian Wheat Aphid resistance.

Quantum 542 (WPB?): An F₁ hybrid; needs new seed each year. Planting F₂ (second generation) seed may result in yield reduction and development of ergot due to sterility in a small percentage of florets (ms ratio less than 3:1). F₁ vs F₂ tests in 1992 indicated a 12% yield reduction from planting 2nd generation seed. Winterhardiness is fairly good (3), but less than Winalta. Medium short height, but taller than 547, giving an advantage in dry conditions. Lodging resistance equal to Rocky. Long coleoptile. Early maturity like Rocky. Susceptible to stem rust. High yield. Protein as good as Rocky (medium low). Recommended in 1991 for districts 2,3,4, & 5 (but not for dwarf smut areas).

Quantum 547 (Hybritech, 1994): F₁ hybrid. Tested as XNH1609 in 1993-94. Winterhardiness = 3. Shorter straw than 542, giving an advantage in high rainfall areas. Short coleoptile. Yielded higher than Neeley in 1994 & 1995. Quality may be marginal.

Quantum 555 (Hybritech): F₁ hybrid (see Q 542). Awnletted. Good winterhardiness. Semidwarf. Short coleoptile. Excellent straw strength. Intended for irrigated only. Two days later than Centurk.

Quantum 566 (Hybritech, 1994): F₁ hybrid. Tested as XNH1727 in 1994. Short coleoptile. Late maturing; mainly intended for eastern Montana & South Dakota. Yielded higher than Neeley in 1994 & 1995.

Quantum 7424 (Hybritech, 1997): F₁ hybrid. Formerly XNH1824. Long coleoptile.

Rampart (MTS92042, MSU, 1996): Sawfly resistant (sister line to Vanguard). Red chaff, upright head. May have some improvements over Vanguard for yield, stem solidness, and quality. Equal or marginally better winterhardiness than Vanguard (1.5 to 2) but slightly less than Rocky. Should not be grown in areas where high levels of winterhardiness are needed, unless protected by stubble. Height 1 inch shorter than Judith & Neeley. Very long coleoptile. Matures 1 day later than Judith & Rocky, 2 days earlier than Neeley. Some resistance to stem rust, and some tolerance to wheat streak mv. Yield averages 6% higher than Vanguard; and 4% less than Rocky in the absence of sawflies, but equal to Rocky under heavy sawfly conditions. Does not seem as prone to shatter as Vanguard. Good test weight, protein and quality.

Ransom (ND, 1998): Good winterhardiness. Med-long coleoptile. Medium height, maturity and protein. Low yield.

Readymade (W188) (Canada, 1994): Selection from Redwin by Agr Canada at Lethbridge. Winter hardiness (3), yield and maturity similar to Redwin. Medium-short height, stiff straw. Long coleoptile. Had similar leaf spot problems as Redwin at Conrad 1992, and is susceptible to leaf & stem rust. Head color same as Redwin; but stems are yellow, whereas Redwin stems are mixture of red and yellow. Redwin has a mix of small spring wheat-like seeds with large seeds. Readymade is all large seed that grade properly under the Canadian system. Slightly lower protein, and larger kernels than Redwin.

Redwin (MSU, 1979): Red head. Winterhardiness = 3, greater than Cheyenne but slightly less than Winalta. Medium short height. Very stiff straw, (along with Tiber, is among the stiffest available among Mta wheats). Long coleoptile. Medium-late maturity, medium yield. Very susceptible to leaf spot fungi and bacterial leaf blight. Good shatter resistance. Yields similar to Winalta. Tiber and Readymade were selected from Redwin. Redwin is among the highest protein winter wheats.

Rocky (Agripro, 1978): A selection from Centurk for soil borne mosaic resistance. Medium low winterhardiness (2), less than Redwin and Tiber. Medium stiff straw, medium height. Long coleoptile. Early maturity, which sometimes allows escape from sawfly. High yield. Very susceptible to yellow berry expression under low Nitrogen conditions. Rocky is lower quality than Centurk. Medium protein.

Roughrider (ND, 1975): Good winter hardiness (5). Tall, but more lodging resistant than Winalta. Long coleoptile. Medium-late maturity. For Eastern Montana. Susceptible to leaf spot diseases. Heterogeneous for GP biotype Hessian fly. Low yield. Has a shatter problem in the Triangle area. Protein slightly greater than Winalta (high).

Seward (ND, 1987): Winterhardiness of Winalta (4). Medium height and is shorter and stiffer than Winalta (about like Rocky). Good lodging resistance. Medium late maturity. Susceptible to leaf rust & leaf spot. Low yield at Conrad. Medium shatter resistance. Low protein & poor quality (2).

Tam 107 (Texas): Red head. Winterhardiness medium to low. Short straw. Early maturing. Moderate resistance to wheat curl mite infestation, and thus may be able to escape wheat streak mosaic virus. However, wheat streak symptoms were observed on Tam 107 at Conrad in 1993 (average level).

Tiber (MSU, 1988): Dark Red head, (darker than redwin); blackish red in years of favorable moisture. This trait makes Tiber popular for wheat weaving and other crafts. Winterhardiness comparable to Redwin (3), greater than Cheyenne, and slightly lower than Winalta. Medium short height with good lodging resistance. Stiff straw - stiffer than Judith, but not quite as stiff as Redwin. Straw stiffness may cause it to thresh a little harder than weaker-strawed varieties. Tiber straw seems to persist longer after tillage, thus may enhance conservation compliance. Long coleoptile. Very resistant to sprouting, causing some dormancy problems. Medium maturity, slightly earlier than Redwin, but still late enough to be sawfly vulnerable. Much greater tolerance to leaf spot diseases than Redwin. Susceptible to stem rust. Among highest yielders. Equal, or sometimes 1 bushel less than Neeley. Higher yielding and more tillers than Redwin. Good shatter resistance. Protein is medium: higher than Rocky, and similar to Neeley; 1/2% less than Redwin. Good milling and baking quality. See Big Sky for alternative.

Vanguard (MTSF2238) (MSU, 1995): Sawfly resistant. (Lew/Tiber//Redwin cross). Good stem solidness. White chaff, nodding head. Winterhardiness slightly less than Rocky (1.5 to 2, marginal to poor). Straw slightly stiffer and 1 inch shorter than Rocky, but moderately susceptible to lodging under high-yield conditions. Heterogeneous for height. Long coleoptile. Medium head date, 1 day later than Rocky, 3 days earlier than Neeley. Good wheat streak mv tolerance. Susceptible to stem & stripe rust. Yield is 8-12% lower than Rocky and 5% less than Redwin; but under heavy sawfly infestation, yield was equal to Rocky and Tiber, and greater than Neeley and Judith. May have a tendency to shatter. Test weight = Rocky. Protein high (similar to Redwin); quality adequate. Not a satisfactory variety for non-sawfly areas, and should not be grown where high levels of winterhardiness are needed unless protected by stubble.

Vista (Nebr, 1992): Winterhardiness (3). Semidwarf. Very short coleoptile. Early heading. Resistance to Hessian fly, leaf rust & stem rust. Medium to low yield.

Vona (Colorado): Winterkilled fairly often in Triangle area tests, but yields high if it survives without injury. Short stiff straw. Very early maturity if not winter-injured. Poor milling and baking quality.

Warrior (Nebr): Tall straw and medium maturity. Yields lower than Cree. Medium shatter resistance. May be resistant to the Great Plains strain of Hessian fly. High protein. Seed supply no longer available.

Winalta: Good winterhardiness (4). Tall weak straw. Medium yield. Good shatter resistance. High protein. Redwin and Tiber offer improvements.

Windstar (Nebr, 1997): Winterhardiness medium. Very short coleoptile. Early maturity. Yield similar to Redwin (med-low) in 1998.

Wings (Private variety): Winterhardiness less than Centurk. Sister to Vona, but a little more winterhardiness. Early maturity.

Hard White Winter Wheat

Golden Spike (UT, Gen Mills, 1998): Hard white. Winterhardiness and height similar to Rocky. Medium coleoptile. Medium yield. Low protein.

NuPlains (Nebr, Gen Mills, 1998): Hard white. Medium winterhardiness. Medium coleoptile. Straw 5" shorter than Rocky. Yield slightly lower than Nuwest. High protein.

Nuwest (MT 7811) (MSU, General Mills, 1994): Hard white winter wheat for specialty markets. Dual purpose, noodle and bread. Winterhardiness equals Tiber & Redwin (3). 1 or 2 inches shorter than Rocky. Stiffer strawed than Neeley & Rocky. Very short coleoptile, 30% shorter than Rocky & Neeley. Two days later than Rocky, 3 days earlier than Neeley. Resistant to stem rust but susceptible to stripe rust, dwarf bunt, and WSMV. Susceptible to sawfly, RWA, and Hessian fly. Medium high yield and well adapted to Montana. Yield about 3% less than Neeley, 1% less than Rocky, & equal to Tiber. Medium test weight and protein, 1 lb/bu lower than Rocky & Tiber, but 1 lb/bu higher than Judith. Good resistance to preharvest sprouting – Many hard whites tend to sprout as they lack the polyphenolic cpds that occur in the bran of red wheat. But sprouting is usually not a problem for hard whites in Montana (In 1993, everything sprouted - red or white). Contains 1 red kernal/1000. Protein medium to high, about 0.5% less than Redwin. Good quality.

NuSky (MTW 9441) (MSU): Nuwest/Tiber, hard white. (Sister line to the hard red var BigSky). Good dual purpose quality for noodles & bread. Good winterhardiness, similar to Nuwest. Height and straw strength similar to Nuwest & Rocky. Short coleoptile. Heading similar to Nuwest, Tiber & Neeley; and 3 days later than Rocky. Yield similar to Nuwest. Test weight similar to Nuwest, and higher than Neeley. Medium to high protein, similar to Nuwest & Tiber, and greater than Neeley. Quality similar to Nuwest. High level of post-harvest dormancy (similar to Tiber), and thus does not have the sprouting problems common to other hard white wheats. NuSky is a public release.

Platte (Agripro/ConAgra): Hard white for Kansas and Colorado. Winterhardiness and adaptation to Montana unknown.

Snow White (Goertzen/Cargill): Hard white for Kansas and Colorado. Winterhardiness and adaptation to Montana unknown.

Winter Triticale

Decade (Canada): Shorter than most other winter triticales, but still as tall as some of the taller winter wheats; earlier and higher yield and shorter strawed than Winteri. Thus Decade may be the better choice. May have a head snap problem.

Flora: Short strawed (like Rocky w.wht.) and good yield, but had very low test weight. Survived winter of 1989 OK, but winterhardiness is questionable. Straw breakage observed in 1988.

Grace: Poor winterhardiness (May be a spring type). Stem-breakage and crinkle-joint.

Winteri (Canada): Very tall and late maturing.

Table 1 **Dryland Winter Wheat** variety trial grown near the **Knees**, 2002. Mont. Agr. Expt. Station, Western Triangle Ag. Res. Center, Conrad, MT.

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Spring survival class 1/	% protein
MT 9982		48.8	58.6	31		13.4
ROCKY		48.8	59.1	34	2	12.9
TIBER		46.3	58.3	35	3	14.7
JUDITH		44.6	57.0	34	3	14.0
GOLDEN SPIKE	*	43.6	58.1	31		12.9
BIGSKY		43.3	60.0	32	4	14.1
MT 9951		42.9	56.5	34		13.6
RANSOM		42.7	55.3	32		13.0
MTS0031	**	42.8	57.5	31	2	14.2
NUWEST	*	42.7	58.5	32	3	12.8
PAUL (MT 9426)		42.5	56.3	27	4	13.4
MTR9997		41.7	59.2	29		14.0
BIGHORN		41.1	58.7	26	3	13.3
MTS0023	**	39.9	55.5	31	1.5	14.8
CDC FALCON		39.6	58.4	28		13.4
MTS 9719	**	39.4	55.2	31		14.0
PROMONTORY		39.3	58.8	30	2	12.5
VANGUARD	**	39.1	58.4	31	1.5	13.8
NUSKY	*	38.9	59.0	32	2	12.5
MORGAN		37.3	57.3	32	5	12.3
MCGUIRE		35.2	59.7	33	3	15.6
NUPLAINS	*	35.1	61.0	25	2	14.4
NORSTAR		34.9	57.8	33	5	13.2
NEELEY		34.1	57.3	31		12.2

Cooperator: Dan Picard.

Location: Thirty miles east of Brady, Chouteau County.

Fertilizer: 100# 11-52-0 (N-P-K).

Rainfall: April to harvest = 7 inches.

Previous crop: No-till chem-fallow.

Date seeded: Sept. 19, 2001. Date harvested: Aug. 12, 2002.

Stored soil water at seeding: 3 inches.

* = Hard white wheat.

** = Sawfly resistant variety.

1/ = Spring survival class: 5=best; 1=very low; based on several location-years of observation.

Yield exp. mean: 41.03 Error degrees of freedom: 46

F test for var. = 3.70, --- C.V. 2 = 5.12, --- LSD (0.05) = 5.97

Table 2 **Five-year summary** on dryland **Winter Wheat** varieties grown near the **Knees**. 1997 - 1998 - 2000 - 2001 - 2002. Mont. Agr. Expt. Sta., Western Tri. Ag. Research Center, Conrad, MT.

Variety	5 - year comparable average			
	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Protein
ROCKY	43.8	53.3	28.3	14.0
BIGSKY	41.8	59.0	29.6	15.0
JUDITH	41.8	58.2	29.9	14.8
TIBER	41.5	59.8	29.5	14.8
VANGUARD	** 40.2	59.7	27.2	14.9
NUWEST	* 40.2	58.7	27.4	14.5
RAMPART	** 38.5	58.7	27.6	15.0
PROMONTORY	38.3	59.6	28.5	13.8
NEELEY	38.0	58.2	28.5	14.3
BIGHORN	38.1	60.1	24.6	14.5
MORGAN	38.1	58.3	29.2	14.1
NUSKY	* 37.7	59.3	27.9	14.4
NUPLAINS	* 37.4	62.8	25.0	15.0
MCGUIRE	35.6	59.8	27.6	16.0
NORSTAR	35.3	58.6	32.2	14.7

Cooperator: Dan Picard.

Location: Thirty miles east of Brady.

(Chouteau County)

* = Hard white wheat.

** = Sawfly resistant varieties.

2002 Spring Wheat Variety Evaluations In The Western Triangle Area.

Year: 2002

Location: Western Triangle Research Center, Conrad, MT.

Personnel: Gregory D. Kushnak and Ron Thaut, Research Center, Conrad; and Dr. Luther Talbert, MSU Plant Science Dept.

Off-station spring wheat variety trials were grown in Teton County near Choteau, Toole County near Oilmont, Glacier County near Cut Bank, and Chouteau County in the Knees Area. These four locations represent diverse environments with Teton having deep soil and typically favorable moisture; the Knees with deep soil, intermediate moisture and warmer temperatures; Oilmont having less than favorable moisture; and Cut Bank with short, cool growing season. The Cut Bank, Knees and Choteau trials were no-till planted on chem-fallow. Trials at the Knees and on station at Conrad included both spring wheat and durum. Conrad trials were grown on both dryland and irrigated conditions. Data for the trials at Conrad are presented in Tables 3-7, and include the 2002 data and five-year averages.

Spring wheat data for the harvested off-station locations are presented in Tables 8-11, and include the 2002 data and five-year averages. Spring wheat varieties were also tested under no-till recrop conditions, and are discussed in the "no-till variety" section of this report. Durum data are presented in Tables 12-17.

Results: An unusual spring storm severely stressed the nursery at Cut Bank, resulting in substantial reductions in tillering and plant height. Stress on the nursery is reflected in the unusually high coefficient of variation (C.V.=12.07), and therefore, little information can be gained from the 2002 data. The Oilmont trial was not established due to drought, and the Choteau trial was lost to hail.

At the Knees location, the top yielders were Hiline, McNeal, Reeder, Hank, and the sawfly-resistant line MT 9929. The sawfly-resistant varieties Scholar and Ernest also ranked high. Sawfly resistance is highly desirable, if not essential, at the Knees location; and the performance of MT 9929 is encouraging. MT 9929 had a very solid stem, more so than Fortuna; and yielded higher than Ernest.

At Conrad, Reeder, Hank and McNeal were the top yielding entries over the five-year period. The sawfly-resistant MT 9929 was among the top yielders in 2002 for both dryland and irrigated trials.

Comments on spring wheat varieties are presented in the following pages. Also refer to MSU Extension Bulletin 1093 for descriptions of many of the varieties tested.

Spring Wheat Variety Notes & Comments

Western Triangle Agricultural Research Center, Conrad MT

Far-Go herbicide tolerance:

Most Tolerant: Argent, Bergen, Bronze Chief, Butte-86, Dalen, Ernest, Fortuna, Glenman, Grandin, Gus, Hank, Kodiak, Len, Marshall, McNeal, NK 751, Pioneer 2398, Pioneer 2731, Rambo, Stoa, Vanna, Westbred 926 & 936. Scholar is tolerant per initial test.

Least Tolerant: Alex, Amidon, Borah, Border, Centennial, Ellar, Era, Erik, Express, Fergus, Fremont, Hiline, Kulm, Lew, Newana, Pondera, Pioneer 2375, Russ, Sharp, Sonja, Sprite, Teal, Waldron.

How to plant is just as important as what to plant. For best results plant with a hoe drill rather than a double-disc drill. A hoe drill moves the Far-Go treated soil out and away from the seed row so at normal planting depths the seed will go under the treated layer, where it's less susceptible to injury. If using a disc drill, choose tolerant varieties. Seeding depth should be 1.5 to 2 inches. Run tillage equipment 3" deep or less which will incorporate Far-Go at 1.5" deep. Weather and soil type are also important. Cold, wet weather can delay the wheat's emergence and increase its chance of damage from the Far-Go in the soil. Wait until soil temps are warmer and increase seeding rate by 10% if planting less tolerant varieties. If the soil is light and has little organic matter, injury to the spring wheat is more likely.

Cereal Quality Ratings: 5 = superior; 3 = average; 2 = poor; 1 = very poor.

Sawfly Resistant Hard Red Spr Wheat Varieties

(Resistance among varieties ranges from low to high; none have total resistance)

Amidon (ND606, ND, 1988): Bearded. Medium tall; lodges worse than Fortuna; weak broken stems. Partial sawfly resistance (30% less solid than Fortuna); sawfly resistance not sufficient for severely infested areas. Medium-late; same maturity as Lew, slightly later than Pondera. Some tolerance to dryland root rot. Moderately susceptible to septoria. Has shown good tolerance to wheat streak mv (3 on scale of 1-3). Susceptible to Septoria. Yield and test weight is medium to high. Slightly higher yield than Lew. Does well in dry areas. High protein like Fortuna. Quality = 4.5.

Border, Westbred (WPB, 1994): Bearded semidwarf. Solid stem in some years, moderate sawfly resistance (about like Rambo). Early maturity (4 days earlier than Fortuna). Too tough to thresh, resulting in dockage discounts. Susceptible to leaf rust. Medium yield and protein. Quality = 5.

Conan (BZ992598; WPB, 1998): Rambo/906R cross. Semidwarf. Sawfly resistance slightly better than Rambo, equal to Scholar, greater than Amidon, and less than Fortuna. Similar in yield and appearance to Rambo. Two days earlier than Rambo. Some tolerance to Wheat Streak M V. Protein 0.5-0.9% higher than Rambo, and better protein quality than Rambo.

Cutless (ND): Bearded. Tall-semidwarf; poor lodging resistance. Very good sawfly resistance (slightly more so than Fortuna). Moderately susceptible to septoria. Among lowest yielders. Medium test weight. Protein high.

Eatonia (Ag Canada Sask; Agripro): Tall; straw strength poor, slightly less than Leader. Greater sawfly resistance than Leader. Maturity similar to leader. Better resistance to common root rot than Leader. Larger kernels and 3% higher yield than Leader (Leader has low yield).

Ernest (ND677) (ND, 1995): Bearded. Tall, weak straw. Sawfly resistance fairly good (slightly less than Lew, Fortuna & Cutless). Moderately late maturing (like Amidon), slightly earlier than McNeal. Poor threshability, similar to Amidon. Tolerant to Far-go. Resistant to prevalent races of leaf & stem rust. Yield slightly less than Amidon, but greater than Lew, Fortuna and Cutless. High protein and test weight, greater than Amidon. Quality = 4.5.

Fortuna (ND): Beardless, tall straw. Too tall for irrigated conditions, where it becomes vulnerable to lodging. Solid stemmed and has very good sawfly resistance. Early maturing. Tolerant to Fargo. Very susceptible to Septoria. Medium to low yield except under severe sawfly conditions, where Fortuna often ranks high for yield. Somewhat susceptible to shattering, especially in conditions favoring development of large kernels. High test weight and protein. Quality = 4.5.

Glenman (MSU, 1985): Beardless semidwarf, poor lodging resistance, (weak straw for a semidwarf). Sawfly resistance has been very good in Triangle area tests (better than Amidon & Rambo), but the variety tends to produce some hollow stems under certain conditions, especially at Bozeman. Thus, it is rated "moderately" resistant (27% less solid than Fortuna). Medium-late maturity. Fair tolerance to wheat streak mv (2.5 on scale of 1-3). High yield; higher than Lew most years, and about equal to Rambo. Hard to thresh. Low test weight and protein (1% < Lew, 2% < Fortuna). Quality = 2 (poor).

Lancer (Sask. Canada): Beardless. Tall; tangled lodging mess due to weak straw. Fairly good sawfly resistance. Among lowest yielders and seldom a protein advantage over Lew and Fortuna. Test weight medium-low.

Leader (Canada): Tall. Fairly good sawfly resistance. Among lowest yielders. Seldom a protein advantage over Lew and Fortuna.

Lew (MSU, 1976): Beardless. Tall; medium weak straw. Good sawfly resistance (10 to 15% less than Fortuna, but 22% more resistant than Amidon). Medium late mat. 3 days later than Fortuna. Susceptible to Fargo. Avenge herbicide cannot be used. Septoria tolerance moderate. Average yield similar to Fortuna. Better shatter resistance than Fortuna. Medium to high test weight. Medium protein, less than Fortuna. Quality = 5.

MT 9929 (MSU, possible release in 2004): Very solid stem, more solid than Fortuna. Yield 1.5 bu higher than Ernest, and 2 bu less than McNeal, and 6 bu less than Outlook.

Rambo, Westbred (WPB, 1986): Bearded. Semidwarf; short stiff straw, but medium lodging resistance. Partial sawfly resistance (36% less solid than Fortuna). Threshes easily. Some tolerance to dryland root rot. May have more tolerance to septoria than Fortuna, but is still moderately susceptible. High yield, similar to Glenman. Test weight high. Medium-low protein similar to Glenman, but 1% lower than Lew and 2% lower than Fortuna.

Scholar (MT9433; MSU, 1999): Bearded. Medium tall, but slightly shorter than Fortuna, 1 inch shorter than Amidon. Moderate lodging resistance. Partial resistance to sawfly (semi-solid stem), slightly better than Amidon and Rambo, and equal to Conan. Maturity medium-late, like McNeal and Amidon. Good yield, agronomics and quality; higher yield than Amidon. Intended to replace Amidon. Marberg is in the parentage, which had a high tolerance to dryland root rot. It is not yet known if this tolerance has been transferred to Scholar. Good resistance to Septoria & tan spot.

Tioga (ND): Beardless. Tall; susceptible to lodging. Good sawfly resistance. Septoria tolerant. Low yield. Good shatter resistance. Medium test weight, high protein.

Hollow-Stem, Sawfly Susceptible Hard Red Spr Wheat Varieties

Alex (ND, 1981): Beardless tall; medium lodging. Medium-late mat. Good shatter resistance. Good test weight and medium-high protein. Quality = 3.

Barrie (Canada): Beardless. Height and lodging resistance medium. Good test weight and high protein at Conrad 1997, but reportedly low elsewhere.

Bergen (Agripro, 1991): Bearded semidwarf for Minnesota. Stiff straw, good lodging resistance. Medium-late maturity. Tends to shatter. Tolerant to Septoria. Medium test weight, medium-low protein. Quality = 2.

Bronze Chief (GP Seed & Research Inc, 1985): Bearded semidwarf. Very low yield and tough threshability. Very high protein. Used in specialty milling market at Three Forks, MT.

Butte 86 (ND): Bearded. Medium tall, medium straw strength. Early maturity. Septoria susceptible. Low yield. Medium test weight, med-high protein. Quality = 3.

Copper (Idaho): Bearded semidwarf. Straw weaker than Pondera and 906R. Late maturity. Intended to replace McKay (higher quality) in Idaho, but acreage was less than expected. Test weight and protein is 1% less than Pondera.

Dalen (Agripro, 1991): Bearded semidwarf; stiff straw. Medium early maturity. Tolerant to Far-go. Shatter susceptible. Protein medium to low. Quality = 2.

Express, Westbred (WPB, 1991): Bearded semidwarf with very strong straw. 6" shorter than McNeal. Medium maturity, 1 day earlier than McNeal. Reported to be tolerant to Avenge herbicide, but very susceptible to FarGo. Resistant to Septoria. High yield. For irrigated conditions. Medium protein, similar to Glenman. Quality = 4.

Fergus, Westbred (WPB, TR983239): Red chaff. Bearded semidwarf. Good straw strength, same height as Newana. Medium early maturity, 4 days earlier than Newana and 3 days earlier than McNeal. Maturity similar to Hiline and WB926, but is shatter resistant, and susceptible to dryland root rot. Slightly susceptible to Fargo. Moderate resistance to stripe & stem rust. More suited for dryland (while 936 is better for irrigated). Protein slightly less than McNeal, but 1% higher than Newana. Quality = 4.

Ejeld (Agripro): Short stiff straw. Medium maturity. Medium yield. Low test weight and protein.

Glupro (ND, 1995): Bearded. Tall, weak straw. Late maturity. Medium protein. Quality = 4. Not tested at Conrad.

Grandin (ND, 1989): Bearded semidwarf; good lodging resistance. Maturity similar to Pondera (medium-early). Moderately susceptible to leaf spot. Yields less than Pondera and Hi-Line. Medium high protein. Quality = 5. To replace Stoa in North Dakota.

Gunner (Agripro): Standard height. For scab tolerance in eastern ND and MN.

Gus (ND, 1989): Bearded semidwarf for high yield areas of Eastern Montana. Good lodging resistance. Medium-late maturity (like Newana). Susceptible to leaf rust. Lower yield than Pondera and Hi-Line. Very high protein. Quality= 5.

Hagar (Agripro): Intermediate height, medium-late maturity. Medium yield and high protein.

Hamer (Agripro, 1995): Bearded. Semidwarf; strong straw. Med-late maturity. For scab tolerance in ND. Test wt & protein are medium. Quality = 2.

Hank (WPB): Shatter resistant line from 926/936 cross, and probably will replace WB-926. Height similar to 926, and 3" shorter than McNeal & Reeder. Heading date 5 days earlier than McNeal, 2 days earlier than Reeder, 1 day later than 926. Yield 1 bu less than Reeder, 1 bu higher than McNeal, and 4 bu higher than 926. Better shatter resistance than 926. Test weight 1 pound lower than 926 & McNeal, 2 pounds lower than Reeder. Good tolerance to dryland root rot, tolerant to Far-go. Protein 0.3% higher than McNeal, equal to Reeder, and 0.2% less than 926.

Hi-Line (MT8402) (MSU, 1991): Bearded. Semidwarf; strong straw; better lodging resistance than McNeal. Height is 1 inch shorter than Pondera & McNeal. Hi-Line contains a small percentage of tall plants, giving the variety a ragged appearance. This trait is probably due to an unstable chromosome carrying the semidwarf gene, and it may not be possible to purify the variety for uniform height. Medium maturity; 3 days earlier than McNeal (maturity similar to Lew & Pondera). Fair tolerance to wheat streak mv (2.5 on scale of 1-3). Somewhat susceptible to dryland root rot, more so than McNeal. Susceptible to leaf rust. Hi-Line yields greater than Newana on dryland, but similar to Newana on irrigated. Hi-Line yields similar to Pondera on dryland, but is 3 bu/a better than Pondera on irrigated. Test weight slightly higher than Newana, and slightly less than Pondera. High protein; similar to Pondera, higher than Newana and McNeal. Quality = 4.

Kamut (T. polonicum 4x): Polish wheat: about like durum; seeds larger than durum. 4 to 6" taller than Fortuna, too tall for irrigation. Four days later to mature than Pondera. Claimed to have non-allergenic gluten. 1% more protein than Pondera. For pasta & cereal products.

Keene (ND, 1996): Bearded. Medium tall, weak straw. Medium late maturity. Possible replacement for Amidon in North Dakota.

Krona (Agripro, 1991): Bearded Semidwarf. Strong straw, good lodging resistance. Late maturity. Moderate resistance to Septoria. High yield, low protein. Quality = 2.

Kulm (ND, 1994): Bearded. Med-tall, good straw strength. Early maturing. Fairly high protein. Quality = 4. Intended to replace Butte-86 in N Dakota in areas where early maturity is desired.

Lars (Agripro, 1995): Bearded semidwarf. Short stiff straw. Med-late maturity. High yield under good growing conditions. Low protein.

Len (ND, 1979): Bearded semidwarf. Straw not as stiff as Newana. Medium maturity. Tolerant to septoria. Yields similar to Pondera and Hi-Line. Good shatter resistance. Good test weight. High protein, but slightly less than Hi-Line & Pondera. Quality = 5.

McKay (Idaho): Bearded semidwarf. Very late maturing. High yield if water lasts, otherwise low yield. Lower quality than Copper.

McNeal (MT8849, MSU, 1994): Red chaffed. Bearded semidwarf but slightly taller and more uniform height than Hiline. Good lodging resistance, but lodged more than Hiline in the high rainfall year of 1995. Straw is less resilient, and is prone to breaking over in strong wind. Medium maturity, 1 day earlier than Newana and 3 days later than Hiline. Fair tolerance to wheat streak mv (2.5 on scale of 1-3). Some tolerance to dryland root rot, more so than Hiline. Higher yield than Hiline. Not as tough to thresh as Pondera and Glenman, but may have a tendency toward toughness. Test weight about equal to Newana & Hiline, but 1#/bu less than Pondera. Very good quality with high protein and loaf volume. Quality = 4.

Newana (MSU, 1976) - Bearded semidwarf. Good lodging resistance. Medium-late maturity, 3 days later than Pondera and Hi-Line. Very susceptible to sawfly. Tolerant to septoria. Very Good yield on irrigation; medium on dryland. Yields similar to Hi-Line on irrigation, but has less protein than Hi-Line. Yields lower than Hi-Line on dryland. Good shatter resistance. Protein medium. Quality = 3.

Nomad, Westbred (WPB): Beardless semidwarf, good lodging resistance. Medium-early maturity, medium test weight (but higher than Glenman), medium protein.

Nora (Agripro): Short strong straw. Medium early maturity. For scab tolerance in ND.

Norlander (Agripro, 1995): Bearded semidwarf. Medium strong straw. Early maturing. Intended for eastern Montana. High yield under good conditions. Medium protein. Quality = 2.

Olaf (ND): Bearded semidwarf. Medium lodging. Septoria leaf blotch tolerant. Medium-low yield. Medium to low shatter resistance. Medium high protein, but most of it is concentrated in the bran, resulting in low flour protein.

Outlook (MT 9874; MSU, 2002): Russian Wheat Aphid resistant. Height equal to McNeal & Reeder. Heading 0.5 days later than McNeal, 2 days later than Reeder. Yield 2bu higher than McNeal, and equal to Reeder. Test weight slightly lower than McNeal. Protein 0.2% lower than McNeal, and 0.5% lower than Reeder.

Parshall (ND): Standard height, tall. Maturity 3 days earlier than McNeal, and equal to Hiline.

Pioneer 2369 (ND, 1993): Bearded semidwarf, good lodging resistance. High yield and test weight on irrigated. Protein medium. (All pioneer materials turned over to NDSU).

Pioneer 2371 (ND, 1991): Bearded semidwarf, strong straw. Medium maturity. Medium protein. Quality = 3.

Pioneer 2370 (ND, 1990): Bearded semidwarf, strong straw. Medium maturity. Medium protein. Quality = 2.5.

Pioneer 2375 (ND, 1990): Bearded semidwarf, medium straw strength. Med-early maturity. Medium yield on dryland, high on irrigated. Medium to high protein, depending on level of N fertilizer. Protein response to fertilizer was higher than for other varieties in 1995. Quality = 2.5.

Pioneer 2398 (ND, 1995): Bearded semidwarf with shorter and stronger straw than 2375. Medium late maturity (similar to Amidon). Low protein. Quality = 2.

Pondera (MSU): Bearded semidwarf with good lodging resistance. Medium-early maturity, 3 days earlier than Newana. Sawfly susceptible. Tolerant to septoria. Good on irrigation or dryland. High yield and test weight. Higher protein than Newana. Replaced by Hi-Line on recommended list.

Probrand 751 (NK): Bearded semidwarf. Short stiff straw. High yield on irrigated. For irrigation only. Good shatter resistance. Low test weight and protein.

Reeder (ND, 1999): Bearded semidwarf. Maturity slightly later than McNeal. Similar to McNeal for agronomics and quality.

Sharpshooter (WPB, 1998). Bearded. Medium tall. Early maturity. For scab tolerance in ND.

Sonja (Agripro, 1992): Bearded semidwarf; short strong straw and very good lodging resistance. Medium late maturity. Good leaf disease resistance, but very susceptible to Fusarium head blight. High yield under irrigated conditions. Protein is medium.

Stoa (ND, 1984): Bearded med-tall height; medium straw strength. Med-late maturity; later to mature than Pondera and Grandin. Poor yield in triangle area. Lew and Pondera compete with it quite well in Triangle area. To be replaced in ND by Grandin. Medium protein. Quality = 3.

Teal (Sask Can, 1991): Beardless tall. Medium straw strength. Med-late maturity. High protein.

Telemark (Agripro): Semidwarf with short stiff straw. Medium early maturity. Good yield with irrigation. Good protein.

Thatcher: Beardless tall. Very low yield. Used as quality check.

Trenton (ND673; ND, 1995): Bearded tall. Medium straw strength. Hollow stem, sawfly susceptible. Med-late maturity. High protein. Quality = 2.5.

Vandal (Idaho): For irrigated only.

Westbred - See also Border, Conan, Express, Fergus, Hank, Nomad, Pristine, Rambo, Zeke.

Westbred 926R (WPB, 1987): Bearded semidwarf. Good straw strength; 2 inches shorter than Newana, and 4 inches shorter than McNeal. Maturity equal to Hiline, and 3 days earlier than McNeal. Susceptible to Avenge herbicide; good tolerance to FarGo. Has some resistance to Washington race of Hessian fly. Fairly good tolerance to dryland root rot. Among highest yielders. Tendency to shatter. Test weight similar to McNeal and slightly less than Newana. Protein higher than Newana and similar to McNeal. See also Fergus & WB-936. Quality = 4.5. See Hank.

Maier (ND, 1998): Medium height, slightly taller than Laker; good lodging resistance. Late maturity. High yield. Medium large kernels, high protein and good quality = 4.

Medora (Manitoba Can, 1983): Tall, with poor lodging resistance. Dryland only, medium maturity. Good yield on dryland, better than Monroe. Test weight medium to high. Large kernel size, high protein. Strong gluten; quality = 4.

Melita (Canada, 1995): Tall straw, moderately susceptible to lodging. Medium maturity. Large kernels, medium protein. Quality = 4.

Monroe (ND, 1985): Tall, medium lodging resistance for dryland. Early maturity, dryland only. Medium test weight, large kernel size. Medium high protein. Strong gluten; quality = 4.

Morse (Can): Medium short, good lodging resistance. Med late maturity. Medium protein, good quality.

Mountrail (ND, 1998): Medium-tall, but fair lodging resistance. Medium-late maturity. Medium to high yield. Medium large kernel and medium protein; good quality.

Munich (ND, 1995): Medium-short, slightly taller than Laker. Strong straw. Med-late maturity. High yield, higher yield than Renville, Sceptre and Medora. Medium kernel size and protein. Strong gluten; quality = 4.

Navigator (Can): Med short, good lodging resistance. Med late maturity. Medium protein, good quality.

Pathfinder (Can): Med tall, weak straw. Med late maturity. Med low protein, good quality.

Pelissier (Canada): Black-bearded. Wheat weaving.

Pierce (ND): Medium height, good lodging resistance. High test weight. Medium protein, good quality.

Plaza (ND): Med short straw, good lodging resistance. Late maturity. Medium yield. Low protein, medium quality.

Plenty (Canada, 1990): Very tall weak straw; lodges easily. Late maturing. High yield. Medium test weight, large kernel size, high protein. Strong gluten; quality = 4.

Regold, Westbred (WPB): (Originally named Regal). Tall straw, susceptible to lodging. For dryland areas of Montana and North Dakota. Resistant to Septoria and most races of leaf & stem rust. Medium yield and test weight. Med-low protein. Good semolina color and strong gluten.

Renville (ND, 1988): Medium-tall, lodges bad; thus, even though it yields good on irrigation, its weak straw renders it unsuitable for irrigation. Has a niche in the low yield/low rainfall areas. Med-late maturity, one day later than Vic. Medium test weight, kernel size and protein. Strong gluten; quality = 4.

Rolette (ND): Tall, but good lodging resistance. Early maturing. Susceptible to leaf spot diseases. Low yield. Good shatter resistance and test weight. Good quality.

Rugby (ND, 1973): Tall, weak straw. Medium maturity. Moderately susceptible to septoria. Good shatter resistance. Medium test weight and kernel size. Weak gluten, poor quality (2).

Sceptre (Sask. Can): Tall to medium height, but fairly stiff straw. Taller than Laker, but shorter than Medora and other standard height varieties. Medium maturity. Susceptible to leaf rust. High yield. Strong gluten; quality = 4. Ben is a similar choice.

Utopia (Private, General Mills, 1997): 933, DU2. Black awns. Awn color may not fully express under stress conditions. Short semidwarf, shorter than McNeal spring wheat. Stiff straw. Early maturity. High yield. Sensitive to Avenge herbicide. Grown under contract with General Mills.

Vic (ND, 1979): Tall weak straw. Medium-early maturity. Susceptible to leaf rust and leaf spotting diseases; highly susceptible to WSMV. Low to medium yield. Good shatter resistance. High test weight, large kernel size, medium high protein. Strong gluten; quality = 4.

Voss (Agripro, 1994): Short semidwarf, shorter than McNeal spring wheat. Very stiff straw. Latest maturing of all entries in 1995 at Conrad. Medium kernel size, low protein. Quality = 3. Intended to replace Stockholm.

Ward (ND, 1972): Tall, with only fair lodging resistance for dryland. Medium maturity. Tolerant to septoria. Test weight medium. Good shatter resistance. Weak gluten; quality = 2.

Table 14 **Dryland Durum** variety trial grown north of **Conrad**, 2002. Montana Agr. Experiment Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Head date	% Protein
KYLE	51.0	62.5	36	187	13.6
MOUNTRAIL	49.5	62.2	29	187	12.3
AC AVONLEA	47.8	61.6	31	186	13.4
MCNEAL (wheat)	46.8	61.5	30	186	12.7
LAKER	46.4	63.5	29	187	11.5
WPB YU 894-75	44.6	61.8	27	183	13.5
Munich	44.4	60.5	27	185	12.6
MAIER	43.6	61.9	28	187	13.1
PLAZA	43.4	61.2	27	186	11.5
GM 90015	42.9	60.6	25	183	13.3
LEBSOCK	42.6	62.2	29	186	11.6
GM 90005	42.0	61.8	30	187	16.2
SCEPTRE	41.4	61.2	29	186	11.9
UTOPIA	40.8	61.6	26	182	13.4
BEN	40.6	62.2	32	185	12.7
MEDORA	40.6	61.5	34	186	13.5
RENVILLE	39.4	61.5	32	186	13.0
VIC	37.7	61.6	31	186	13.0
MONROE	37.7	61.5	30	183	13.3
WARD	37.1	60.2	32	186	13.9

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 Fertilizer: 11-52-0 (N-P-K)
 Previous crop: Fallow
 Date seeded: April 25, 2002.
 Date harvested: August 22, 2002.
 Rainfall: From planting to maturity was 10.1 inches.
 Stored soil moisture at planting: 3 inches.
 Yield experimental mean: 43.01
 Error degrees of freedom: 38
 F test for var.: 2.30
 C.V. 2: 5.93
 LSD (0.05): 7.30

Table 15 **Five-year summary for Dryland Durum varieties**
 grown north of **Conrad, MT.** 1998 - 1999 - 2000
 - 2001 - 2002. Mont. Agr. Expt. Station,
 Western Triangle Ag. Res. Center, Conrad, MT.

5 - year comparable average					
Variety	Yield bu/ac	Test wt lbs/bu	Plant hgt. inches	Head date	% Protein

AVONLEA	51.0	61.4	31.9	179	12.3
MAIER	48.3	61.8	29.8	181	12.1
MOUNTRAIL	47.1	60.2	31.4	181	11.6
PLAZA	47.0	61.0	27.5	180	11.2
KYLE	46.2	61.4	36.5	183	12.4
MUNICH	46.2	60.7	29.4	180	12.0
UTOPIA	46.1	60.0	24.7	178	12.1
LAKER	46.0	61.6	29.0	181	11.4
LEBSOCK	45.0	62.1	29.8	181	11.8
MONROE	42.0	60.7	31.8	177	12.6
RENVILLE	42.0	60.5	33.9	181	12.2
SCEPTRE	41.9	60.0	31.3	181	11.9
MEDORA	41.5	61.8	34.0	180	12.4
BEN	41.5	61.8	32.7	181	12.3
VIC	40.9	61.4	32.8	180	12.1
WARD	38.5	60.4	34.2	180	12.9

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)

Table 16 Irrigated Durum variety trial grown north of Conrad, 2002. Montana Agr. Experiment Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Head date	% Protein
LAKER	105.1	64.3	33	186	12.1
PLAZA	100.5	63.6	32	187	12.1
UTOPIA	98.2	62.9	28	185	13.3
WPB YU 894-75	93.6	63.6	31	185	13.5
GM90005	92.7	64.0	35	184	12.8
Munich	92.6	62.8	34	184	13.5
AC AVONLEA	91.5	62.6	38	185	13.9
MOUNTRAIL	89.0	63.4	35	185	13.5
MCNEAL (wheat)	87.2	62.3	34	185	13.0
MAIER	85.4	63.6	35	184	13.4
LEBSOCK	83.3	63.4	38	185	14.0
GM90015	82.1	62.7	29	185	12.8
SCEPTRE	81.7	61.9	36	186	13.9
KYLE	79.2	62.2	42	186	13.7
RENVILLE	75.3	62.8	38	185	13.7
BEN	72.8	63.3	38	185	13.3
VIC	71.5	63.2	38	186	13.9
MONROE	65.1	62.4	37	184	13.8
WARD	61.4	62.5	38	184	13.6
MEDORA	59.4	61.9	38	185	14.6

Cooperator: Western Triangle Ag. Research Center.

Location: Ten miles north of Conrad, MT. (Pondera County)

Applied fertilizer: 71-52-0 (N-P-K).

Previous crop: Fallow

Date seeded: April 25, 2002.

Date harvested: Sept. 10, 2002.

Moisture Data: Rainfall from seeding to harvest was 13.4 inches, with two applications of sprinkler irrigation. (3.5" each)

Yield experimental mean: 83.37

Error degrees of freedom: 38.00

F test for var.: 8.71

C.V. 2: 5.20

LSD (0.05) : 12.42

Table 17 **Five-year summary for Irrigated Durum varieties** grown north of **Conrad, MT.** 1998 - 1999 - 2000 - 2001 - 2002. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety	5 - year comparable average				
	Yield bu/ac	Test wt lbs/bu	Plant hgt. inches	Head date @	% Protein
PLAZA	75.1	63.4	29.9	181	11.4
LAKER	74.6	62.7	30.7	181	11.4
MOUNTRAIL	74.6	62.5	35.1	180	11.8
AVONLEA	72.1	62.4	35.8	179	12.7
UTOPIA	71.7	62.1	26.6	179	12.2
MUNICH	71.6	62.3	33.0	181	12.2
MAIER	68.7	63.0	33.0	179	12.4
LEBSOCK	66.4	62.8	33.0	180	12.7
SCEPTRE	65.9	61.6	34.2	180	12.7
KYLE	63.5	62.1	40.2	183	12.8
MEDORA	63.0	62.3	37.1	179	13.2
BEN	61.8	63.2	36.5	181	12.3
VIC	60.5	62.8	37.1	181	12.3
RENVILLE	60.3	62.3	35.9	180	11.9
MONROE	58.9	62.0	35.1	178	12.6
WARD	54.6	61.7	37.3	181	13.0

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 @ = Head dates based on 4 years average. (1998-1999-2001-2002)

2002 Barley Variety Evaluations In The Western Triangle Area.

Location: Western Triangle Research Center, Conrad, MT.

Personnel: Gregory D. Kushnak and Ron Thaut, Research Center, Conrad; and
Dr. Suzanne Mickelson, MSU Plant Science Dept.

Off-station barley variety trials were grown in Teton County near Choteau, Toole County near Oilmont, Glacier County near Cut Bank, and Chouteau County in the Knees Area. These four locations represent diverse environments with Teton having deep soil and typically favorable moisture; the Knees with deep soil, intermediate moisture and warmer temperatures; Oilmont having less than favorable moisture; and Cut Bank with short, cool growing season. The Cut Bank, Knees and Choteau trials were no-till planted on chem-fallow. Trials on station at Conrad included both dryland and irrigated conditions. Data for the trials at Conrad are presented in Tables 18-25, and include the 2002 data and five-year averages.

Barley data for the harvested off-station locations are presented in Tables 26-29, and include the 2002 data and five-year averages. Barley varieties were also tested under no-till recrop conditions, and are discussed in the "no-till variety" section of this report.

Results: An unusual spring storm severely stressed the nursery at Cut Bank, resulting in substantial reductions in tillering and plant height. Stress on the nursery is reflected in the unusually high coefficient of variation (C.V.=9.70), and therefore, little information can be gained from the 2002 data. The Oilmont trial was not established due to drought, and the Choteau trial was lost to hail.

The feed varieties Haxby and Baroness were among the top yielding entries at all dryland locations over the 5-year period. Haxby yielded about 3% less than Baroness, and had the heaviest test weight of all entries. Valier ranked about medium for yield. The malt variety Conlon ranked lowest at all locations in 2002, yielding substantially lower than Harrington.

The experimental feed barley lines MT960228 and MT960099 were also among the top yielders for the 5-year period across all locations. At Conrad, MT960228 was superior to Baroness for yield and test weight. These two lines are currently under evaluation in feeding trials for potential high nutritional value.

In the irrigated trials, the highest yielding entries included the feed varieties Haxby, Baroness, Calgary, MT960099, and MT 960228. Gallatin and Valier, along with the malt variety Merit, ranked about medium. The malt varieties Harrington, Conlon, and Legacy ranked lowest for yield.

Comments on barley varieties are presented in the following pages. Also refer to MSU Extension Bulletin 1094.

Barley Variety Notes & Comments

Western Triangle Agricultural Research Center, Conrad, MT

Azure (ND, 1982): 6-row malt. Medium height, stiff straw. Medium maturity.

BA 1202 (Busch Ag): 2-row malt. Stiffer strawed & higher yield than Klages. Requires good rainfall or irrigation. Maturity 2 days later than Harrington. Very good yield.

BA 2601 (Busch Ag): 6-row malt for parts of the triangle area. Erect head. Maturity later than Harrington. Very high irrigated yield.

Bancroft (ID, 1998): 2-row feed. Slightly higher yield than Hector.

Baronesse (Ackermann-Germany): Seed produced in USA by Western Plant Breeders. 2-row feed. Short straw and good lodging resistance; 2.5" & 3" shorter than Harrington & Gallatin, respectively. One to four days later maturity than Pirolina and Gallatin; equal or slightly later maturity than Harrington; thus, may possibly rank lower for yield in dry years without irrigation. Among highest yielders when tested in favorable moisture conditions (not tested in dry years yet). Test weight is 1 lb less than Gallatin, but % plump is higher. Recommended list for irrigated and dryland.

Bearpaw (MT 81616) (MSU): 2-row feed. One day later than Clark and Hector, but slightly earlier than Harrington. Medium yield, but better than Clark and Harrington in most cases (Harrington will usually outyield Bearpaw in extremely high fertility conditions). Test weight is sometimes low on dryland, possibly due to its medium-late maturity. May sprout and skin easily. Malt tolerance is 7% skinning, thus may be difficult to manage. Has exceeded the limits in morphology of malt quality. Can "go out of condition" (germ dropped 60% in 2 years), probably due to high DP (Harrington also does this). Probably worse than Harrington for sprouting at low moisture content (ie. Bin sweat). In spite of very high malt extract, Bearpaw was dropped for consideration as a malt variety and was also dropped from the recommended list for feed.

Bowman (ND, 1984): 2-row feed. Medium height; weak straw (severe stem breakage at Oilmont, 1999). Strictly for drought conditions. Early maturing, large seeded. Highest yielder on dryland in drought years; but in wet years, only medium to low yield. Stark is a possible alternative.

Bridge (Lethbridge Can): 2-row feed. Similar to Harrington for height and lodging resistance. Higher yield than Adeo and Harrington. Good test weight and plump seed. Reportedly does well under drought conditions in Alberta. (Hector/Pirolina/Zephyr parentage).

Calgary: 2-row. Tested in 2001 & 2002.

Chinook (MT140523) (MSU, 1995): 2-row feed. Medium-short straw; one to two inches shorter and 30% less lodging than Hector. Med-late maturity; one day earlier than Harrington; slightly earlier than Hector. Moderate resist to net blotch; moderate suscept to scald. Higher yield and test weight than Harrington. Recommended for dryland and irrigated.

Clark (MSU, 1981): 2-row feed. Medium height & straw strength. Medium maturity. Better yield and earlier maturity than Klages. Does not have the malt quality of Harrington. Dryland primarily.

Colter (Id/Ore/Wash): 6-row feed. Stiffer straw than Steptoe. Very low yield and test weight in Triangle area tests in 1993. Tested as ID 71966 in Western Regional (79Ab10719-66).

Columbia: 6-row feed. Short, stiff straw, and is among the best for lodging resistance. Comparable to Steptoe yield (very high).

Crest (WA, OR, ID). 2-row malt for eastern Washington & Idaho.

Conlon (ND, 1996): 2-row malt. Medium height, weak straw, slightly weaker than Bowman. Early maturity, 1-2 days earlier and higher test weight than Bowman. Developed for areas of heat & drought stress. High resistance to net blotch; susceptible to spot blotch & Fusarium head blight.

Crystal (78AB6871) (ID): 2-row malt (AMBA for Idaho & Montana). (Klages cross). Same height and head date as Klages, but better lodging resistance. Good tolerance to Pseudomonas Kernel Blight. 5% greater yield than Klages but 2% less than Clark. Did not "store" well in Idaho (lost germination in six months), and thus was dropped from production by Coors.

Drummond (ND 15477): 6-row, potential malt. Height similar to Stander, stronger straw than other 6-row malt types. Improved yield over Morex, Robust and Foster. Plump higher than Morex.

Eight-Twelve (Id/Oregon): 6-row winter barley. Feed. Not adapted to winter conditions of the Triangle area.

Excel (Minn, 1990): 6-row malt for upper Midwest. Combines the superior agronomics of Robust and the malt quality of Morex. Good alternative to Robust and Morex. Stiff straw. Later maturity and higher yield than Morex.

Foster (ND, 1995): 6-row malt for North Dakota. Med-short; stiff straw. Medium maturity. Medium yield.

Galena (Coors): 2-row malt in Colorado. Short stiff straw. Among latest to mature at Conrad 1993. High irrigated yield. Probably will replace Moravian III & Triumph in Coors program.

Gallatin (MSU, 1986): 2-row feed. Med-short height; stiff straw and good lodging resistance (more than Hector, Klages, Lewis, and Clark). Medium maturity, slightly earlier than Hector, and earlier than Bearpaw. Yields high in both dry and wet conditions; thus a broadly adapted feed barley. Good drought tolerance.

Gamet (ID, 1998): 2-row malt. Similar to Harrington.

H3860224 (MSU, 1999). Released to Oregon. Similar to Valier.

Harrington (Sask. Can): 2-row malt. Medium height; medium weak straw, lodging resistance better than Klages. Late maturity, but earlier than Klages. Sensitive to hot dry areas; yields good in moist areas. Can sprout or germinate (internal falling number) at a lower moisture content than any other barley except perhaps Bearpaw. Sweating in the bin has been suspected of being sufficient enough to ruin the germination. Susceptible to skinning unless carefully threshed. Montana AMBA. See notes on Bearpaw.

Haxby (MSU 2002, MT950186): 2-row feed. 3 inches taller and two days earlier than Baronesse. Yield is equal to Baronesse, and is among highest yielders in Triangle Area. Highest test weight of all varieties. Non-Baronesse derived, providing good diversity. Haxby, along with Valier, should replace all other feed barleys in Montana.

Haybet (MSU): 2-row, hooded hay barley. Later to mature than Horsford, and higher forage yield. Similar to Horsford for grain yield, which is low. (See also Westford). Caution: any cereal grain grown for hay should be tested for nitrate level prior to cutting.

Hector (Lethbridge Can, 1973): 2-row feed. Weaker strawed and slightly later to mature than Gallatin (medium maturity). High yield on dryland (similar to Gallatin); yields less than Gallatin on irrigated.

Idagold (Coors): 2-row feed. Late maturing. Lower irrigated yield than Galena at Conrad 1993. May be marketed by WPB??

Jersey: 2-row European. Short, stiff straw. High yield, irrigated.

Karla (Idaho): 6-row feed. Tall, but fairly good lodging resistance. Medium-high yield. Low test weight on dryland. Rejected for malt.

Kendall: Irr malt.

Kimberly (Idaho): 2-row. Poor lodging resistance. Later to mature than Harrington. Slightly lower yield than Harrington in dry conditions, but slightly higher in moist conditions.

Klages (ID): 2-row malt. Late maturity; for irrigation or high rainfall only. Replaced on contracted acres by Harrington, BA 1202, etc.

Lacy (M98, MN 1999): 6-row malt. Intended to replace Robust. Height intermediate between Robust & Stander.

Lamont (ID): 2-row feed. Rejected by AMBA. (74Ab10167).

Legacy (Busch Ag 2978; 6B932978): 6-row malt. 2 to 4 inches taller than Harrington. Higher yield than Morex, but lower than Harrington. Has 30% resistance to vomatoxin.

Lewis (MSU): 2-row feed. Similar yield to Gallatin but not as stiff strawed. Higher yield than Clark and Klages. Lewis (and Gallatin) are good for both dry and wet conditions. Rejected by AMBA due to flavor.

Logan (ND, 1995): 2-row feed. Medium height & straw strength. Medium maturity.

Manley (TR 409) (Canada): 2-row. Slightly stiffer strawed and three days later than Harrington, (approx. Klages maturity); longer shelf life than Harrington - does not lose its germination as bad. May replace Harrington in Canada; but only in high rainfall, stripe rust areas.

Medallion, Westbred (WPB): 6-row feed. Semidwarf with very stiff straw, but can be lodged in very high yield conditions (see WB 501, which reportedly "cannot" be lodged). Very high yield at Conrad 1993 under high rainfall conditions. Not intended for dryland as test weight may drop unless high rainfall.

Meltan (Wash): 2-row. Short stiff straw; very good lodging resistance. Late maturing irrigated type.

Mennet (Netherlands): Marketed by Cenex. 2-row feed. Short stiff straw.

Merit (Busch Ag): 2-row malt. Late maturing, too late for dryland. Lodges easier than 1202 and Harrington, but yields higher.

Merlin, Westbred (WPB): Waxy seed, semidwarf. Better yield and lodging resistance than Waxbar, but quality not accepted by Japan markets yet.

Metcalf : Irr malt.

Morex (Minn, 1978): 6-row malt. Tall; medium straw strength. Early maturity. Shatters readily - swathng advised. Agronomically the worst malting barley on the list. Excel may be a better choice.

Nancy (Wash): 2-row. Short stiff straw; very good lodging resistance. Late maturing irrigated type.

Nebula (WPB): 6-row feed. Short stiff straw. Late maturity. Low test weight.

Piroline: 2-row. Medium yield, except during drought years it yielded high relative to most varieties.

Prowashonupana (line 3) (MSU): 2-row hullless. Does not have soluble B-glucan unless they can find a way to steam process it out. Potential specialty market.

Robust (Mn, 1983): 6-row malt per ND AMBA list; but not Montana's. Tall; medium straw strength. Medium maturity. The 1992 Robust crop in Minnesota did not malt due to dormancy for unknown reasons. Growers therefore switched to 'Stander' in 1993.

Russell (Idaho): 6-row (tested in 83-85 as ID 789009). Greater yield and plump, but less protein than Morex and Robust. Shatters; swathing advised.

Shonkin (MSU): Waxy 2-row hulless. Stands up better than Wanubet, but has weak straw and low yield. Heads slightly later than Hector. Up to 10% or more of the grain may not thresh free from the hulls. Shonkin is LR 247 from Wanubet (a separate variety from Wanubet) and is a "clean seed" source of Wanubet to allow a more pure line. Special use, with no recommendation.

Sissy, Westbred (WPB): 2-row feed. Intended for irrigated/high rainfall.

Stander (M-64, Minn, 1993): 6-row malt for upper Midwest. Med-short straw, stiffer than other 6-row malt types. Medium-late maturity. Better yield stability and kernel-plump than Excel, but Excel seems to be preferred by growers.

Stark (ND 9866, ND, 1991): 2-row feed. Medium height; weak straw (some straw breakage, Oilmont 1999). Med-late maturity. Medium to high yield. Related to Bowman; but yields higher than Bowman except in extremely dry conditions. Probably not as drought tolerant as Bowman. Birds selectively damaged this variety 3 years in a row.

Steptoe (Wash): 6-row feed. Among the highest yielders on irrigation or dryland. Very low test weight dryland.

Stratus (Can): 2-row feed. Short semidwarf. Very late maturing, needs long growing season (Yellowstone valley).

Targhee(78-Ab10099) (Id/Wash/Ore): 2-row feed. Two inches shorter than Hector, but straw too weak for irrigated. Lower test weight and yield than Hector.

Triumph: 2-row. Malt type in Europe, but does not fit USA malt requirements (germinates too slow). Very high yields on irrigation, but very late to mature, and thus not recommended except for "lower Yellowstone valley type" of growing season.

Valier (MSU 1999): 2-row feed. Lewis/Baroness cross 10% better feed efficiency (rumenal digestibility) and 10% better ADG in cattle. Agronomically superior to Gallatin and Lewis, but less than Baroness. Better head extension out of boot than Baroness. H3860224 (MSU): Released as a germplasm. Slightly higher feed value than Valier.

Wanubet (MSU, 1990): Waxy 2-row hulless. The B-glucan line that will most likely be industrialized. Weak straw and low yield (70% of Hector or Gallatin). Med-late mat. Up to 10% or more of the seed may not thresh free from the hulls.

Waxbar, Westbred (WPB): Waxy barley grown under contract in 1994 & 1995 for export to Japan. Standard height and fairly late to mature. See Merlin.

Westford, Westbred (WPB): 6-row hooded hay barley. Maturity considerably later than Horsford and Whitford, allowing for greater forage production. Seed yield low (similar to Horsford). Hay yields considerably higher than Horsford. Hooded barleys are sometimes vulnerable to ergot, but the amount is slight. Caution should be taken to avoid high nitrate levels when using any small grain as a forage. Test forage for nitrate before the crop is harvested.

Westbred_501 (WPB): 6-row feed. Very stiff straw (supposedly doesn't lodge). Marketed mainly in Idaho.

Xena (WPB bz594-19): baroness/stark cross. 2-row feed. Two inches taller and better boot emergence than Baroness. Lodging resistance equal to Baroness. Late maturity, similar to Baroness. Better adapted to dryland than Baroness, (higher test wt and plump than Baroness on dryland). Equal or better yield than Baroness on dryland.

Table 18 **Dryland Intrastate Barley** variety trial grown north of **Conrad**, 2002. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	% Plump	% Thin	Head date	% Protein
MT960228	97.7	51.9	29	94	1.0	187	12.5
MT981091	93.0	52.9	26	96	1.0	187	12.2
H3860224	89.7	51.1	30	95	2.0	187	12.9
MTLB 13	87.7	52.5	28	97	1.0	186	12.7
Baronesse	87.4	49.6	26	86	4.0	186	12.3
MT960100	87.4	51.5	25	90	2.0	187	12.6
MT981030	87.3	54.5	30	98	1.0	189	11.6
MT960099	86.5	50.3	25	84	3.0	187	12.1
NORD 1958	85.4	49.4	26	93	2.0	189	13.2
MT981060	85.2	46.8	29	85	4.0	186	12.8
MT960101	84.8	52.4	29	94	1.0	186	11.7
MT000237	84.5	49.8	30	95	2.0	190	13.2
Valier	84.5	53.1	31	98	.7	188	13.2
MT981210	84.4	52.6	28	98	.5	187	13.0
MT000157	83.2	51.0	28	83	4.0	186	13.1
MT000180	82.6	53.7	29	99	.3	186	12.9
6B952482	82.1	49.2	32	93	1.0	186	13.6
Harrington	81.4	52.6	29	97	1.0	187	12.5
MT970148	80.4	48.7	26	88	3.0	186	12.2
MT981212	80.4	51.6	29	97	1.0	186	13.7
MT970110	80.3	51.0	33	91	2.0	188	12.3
MT000138	80.2	53.3	32	99	.3	187	14.0
WPB BZ596-11	80.0	52.1	28	99	.4	186	13.4
MT960226	79.6	49.7	29	98	.5	186	12.9
MT000239	79.2	48.6	27	87	4.0	188	12.9
MT970026	79.1	50.6	30	88	4.0	188	12.9
MT970155	78.9	51.3	27	96	.6	188	13.3
MT910189	78.9	51.9	25	97	1.0	184	12.6
MT000156	77.8	52.1	29	97	1.0	184	13.0
MT000066	77.6	52.2	31	97	1.0	187	12.6
WPB BZ594-20	77.4	50.8	25	99	.4	182	13.0
HAXBY MT950186	77.0	52.8	26	93	1.0	186	12.1
MT000063	76.9	51.4	28	88	3.0	186	13.8

(Continued on next page)

(Dryland Intrastate Barley, continued)

MT981006	76.7	49.7	25	95	1.0	186	13.3
MT981177	76.6	49.5	26	86	3.0	186	13.1
Gallatin	76.6	49.2	29	79	6.0	186	12.7
MT990172	76.5	49.8	27	96	2.0	186	13.1
MT000130	75.8	51.6	28	98	.6	185	12.2
B99AL-621	75.7	47.8	25	70	6.0	187	13.3
MT000040	75.6	51.6	27	87	3.0	188	14.2
MT000125	75.3	49.1	28	83	5.0	188	13.1
MT981004	75.1	48.1	27	87	2.0	187	12.7
MT981042	75.0	53.4	27	97	1.0	187	12.3
MT970229	74.8	52.9	29	97	1.0	187	13.3
NORD 1963	74.8	47.1	24	88	3.0	189	12.6
MT000045	74.6	51.3	28	91	2.0	187	13.6
MT960222	74.3	51.8	27	98	.5	186	12.1
MT000153	74.2	50.9	27	96	1.0	186	13.3
MT000178	73.9	50.2	30	95	1.0	186	13.7
MT000159	73.8	49.0	26	85	2.0	185	13.3
Garnet	73.3	49.9	29	97	1.0	188	13.3
MT970116	72.9	53.5	33	97	.6	185	12.1
MT000092	72.8	50.6	27	97	.5	185	12.3
MT990106	72.6	48.6	25	87	3.0	187	14.1
Merit	72.4	47.3	28	83	5.0	187	13.3
MT000047	72.1	49.2	26	75	6.0	187	13.7
N96/1116	70.5	47.2	26	76	9.0	188	12.6
MT000177	70.1	50.4	29	99	.4	187	13.7
MT990249	69.4	54.0	27	98	.4	183	14.5
MT990244	68.1	51.6	26	98	.5	183	15.0
Legacy	67.5	46.6	31	78	5.0	185	13.3
Haybet	66.7	46.3	30	69	9.0	184	14.3
MT981238	66.1	50.7	27	92	2.0	185	12.9
Conlon	61.4	50.4	25	99	.2	183	13.4

Cooperator: Western Triangle Ag. Research Center.

Location: Ten miles north of Conrad, MT. (Pondera County)

Applied fertilizer: 100# 11-52-0 (N-P-K)

Previous crop: Fallow.

Date seeded: April 25, 2002. Date harvested: Aug. 12, 2002.

Stored soil moisture at seeding: 3 inches.

Rainfall: From planting to harvest was 9.6 inches.

Yield experimental mean: 78.02 Error degrees of freedom: 126

F test for var.: 1.71, --- C.V. 2: 6.56, --- LSD (0.05): 14.32

Table 19 **Dryland Intrastate Barley** variety trial grown north of Conrad, 2002. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

(**Abbreviated list**)

Variety	Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	% Plump	% Thin	Head date	% Protein
MT 960228	97.7	51.9	29	94	1.0	187	12.5
Baronesse	87.4	49.6	26	86	4.0	186	12.3
MT960100	87.4	51.5	25	90	2.0	187	12.6
MT 960099	86.5	50.3	25	84	3.0	187	12.1
Valier	84.5	53.1	31	98	.7	188	13.2
Harrington	81.4	52.6	29	97	1.0	187	12.5
HAXBY MT950186	77.0	52.8	26	93	1.0	186	12.1
Gallatin	76.6	49.2	29	79	6.0	186	12.7
Garnet	73.3	49.9	29	97	1.0	188	13.3
Merit	72.4	47.3	28	83	5.0	187	13.3
Legacy	67.5	46.6	31	78	5.0	185	13.3
Haybet	66.7	46.3	30	69	9.0	184	14.3
Conlon	61.4	50.4	25	99	.2	183	13.4

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 Applied fertilizer: 100# 11-52-0 (N-P-K)
 Previous crop: Fallow.
 Date seeded: April 25, 2002.
 Date harvested: Aug. 12, 2002.
 Stored soil moisture at seeding: 3 inches.
 Rainfall: From planting to harvest was 9.6 inches.
 Yield experimental mean: 78.02
 Error degrees of freedom: 126
 F test for var.: 1.71
 C.V. 2: 6.56
 LSD (0.05): 14.32

Table 20 **Five-year** summary for **Dryland Barley** varieties grown north of **Conrad, MT.** 1998 - 1999 - 2000 2001 - 2002. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety	5 - year comparable average						
	Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	% Plump	% thin	Head date *	% Protein
MT 960228	77.2	51.5	27	77	8	181	12.7
BARONESSE	74.5	50.5	26	76	7	181	12.9
MT 960099	72.7	50.9	25	62	14	182	12.8
VALIER	71.8	52.7	29	73	8	182	13.5
HAXBY	71.3	54.2	28	81	5	180	12.7
GALLATIN	66.6	50.7	29	72	9	179	13.3
HARRINGTON	65.1	49.4	27	77	7	181	13.0
MERIT	62.5	48.0	27	77	7	181	13.3
LEGACY	53.7	47.1	31	63	10	180	13.3

Cooperator: Western Triangle Ag. Research Center.

Location: Ten miles north of Conrad, MT. (Pondera County)

* = Head dates based on 4 years. (1998-1999-2000-2002)

Table 21 **Irrigated Intrastate Barley** variety trial grown north of **Conrad**, 2002. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test wt. lb/bu	Plant hgt. inches	% Plump	% Thin	Head Date	% Protein
MT 960099	130.9	51.4	29	92	3.0	185	12.3
MT 970229	128.4	52.9	33	98	.2	185	13.1
Calgary	127.4	52.8	25	98	.4	185	13.0
MT 981006	127.1	52.4	31	96	1.0	185	13.8
MT 970116	126.5	52.3	34	96	1.0	185	13.4
MT 981177	126.0	51.9	28	97	1.0	185	13.8
MT 000237	125.7	51.1	38	97	.8	188	13.1
WPB BZ594-20	125.5	51.3	29	96	.5	181	13.2
MT 000047	125.3	51.3	31	95	2.0	184	13.5
MT 000040	125.2	52.6	28	95	1.0	186	14.0
MT 000153	125.1	52.1	29	96	1.0	185	14.0
MT 960101	125.1	51.4	30	95	2.0	188	12.7
HAXBY 950186	124.1	54.3	34	98	.4	186	13.0
MT 970110	124.0	52.3	31	98	.6	184	13.3
MT 981091	123.9	52.4	27	96	1.0	185	13.3
MT 981004	122.5	52.1	29	98	.7	185	13.5
MT 960100	122.1	52.3	30	95	1.0	185	13.0
MT 970148	121.8	50.7	30	96	1.0	184	12.7
MT 000125	121.4	51.4	31	95	1.0	184	12.7
Justina	121.2	51.6	27	99	.8	184	12.9
MT 981212	121.1	52.5	32	98	.7	186	13.8
MT 990172	121.0	51.6	31	99	.7	184	13.1
Baronesse	121.0	51.8	30	99	.4	185	12.8
B99AL-621	120.9	50.9	29	96	1.0	185	13.6
WPB BZ596-117	120.5	53.1	30	98	1.0	184	14.3
MT 000156	119.4	51.2	29	96	1.0	182	14.2
MT 000180	119.1	51.6	32	97	1.0	185	14.1
MT 960228	118.6	52.6	30	96	1.0	186	12.4
MT 000066	118.1	51.8	30	96	1.0	185	14.4
MT 000159	118.0	51.0	33	95	1.0	187	14.1
Gallatin	118.0	52.1	34	95	2.0	183	13.0
MT 970155	117.6	51.8	30	97	.6	186	13.1
MT 981042	117.0	52.4	29	97	1.0	186	13.8

(Continued on next page)

(Irrigated Intrastate Barley, continued)

MT 000130	116.9	51.2	31	96	1.0	184	12.8
Merit	116.8	50.4	31	99	.6	186	13.5
MT 960226	116.5	52.5	33	99	.2	184	13.0
MTLB 13	116.3	50.5	29	92	2.0	186	14.1
MT 981210	116.1	52.3	31	96	1.0	186	13.5
MT 000239	115.9	51.8	31	98	.5	186	13.5
MT 960222	115.8	52.7	33	99	.3	185	13.1
Nord 1958	115.8	51.2	27	97	1.0	187	13.3
MT 981030	115.1	53.9	34	98	1.0	186	13.1
MT 000092	115.0	52.0	34	98	.7	186	13.2
MT 000063	114.9	52.3	32	93	2.0	186	13.1
MT 000138	114.1	52.4	32	97	1.0	183	14.7
H3 860224	114.0	51.9	28	98	.6	186	13.4
MT 000177	112.8	52.0	30	99	.2	185	14.2
MT 970026	112.5	53.4	31	98	.3	185	13.3
MT 981238	110.9	52.7	30	98	.7	182	14.3
MT 910189	108.8	51.0	27	94	2.0	183	13.3
MT 000178	107.2	52.0	32	99	.3	185	14.4
MT 990106	107.0	53.0	30	96	1.0	185	14.1
MT 000157	106.4	54.1	33	99	.2	185	14.0
Valier	106.3	52.3	31	98	1.0	186	13.6
Conlon	105.6	51.4	28	99	.2	181	14.3
MT 981060	105.4	46.1	30	76	6.0	185	13.2
MT 990244	105.3	52.1	27	97	1.0	184	14.9
Harrington	105.3	51.2	32	97	1.0	185	13.3
Legacy	105.0	49.1	33	98	.4	184	14.1
Garnet	104.5	51.5	36	98	.5	187	13.8
MT 000045	102.1	51.0	29	94	2.0	184	13.9
6B952482	99.1	48.7	29	98	.6	185	14.7
NORD 1963	90.6	50.7	26	98	.7	186	13.5
Haybet	77.2	44.7	34	47	15.0	185	15.5

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 Applied fertilizer: 71-52-0 (N-P-K)
 Previous crop: Fallow.
 Date seeded: April 25, 2002. Date harvested: Aug. 26, 2002.
 Moisture Data: Rainfall from planting to harvest was 10.1" with
 two applications of sprinkler irrigation. (approx. 3.5" each)
 Yield exp. mean = 116.01, Error degrees of freedom = 126
 F test for var. = 4.06 --- C.V. 2 = 4.06 --- LSD (0.05) = 13.19

Table 22 **Irrigated Intrastate Barley** variety trial grown north of **Conrad**, 2002. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

(**Abbreviated list**)

Variety	Yield bu/ac	Test wt. lb/bu	Plant hgt. inches	% Plump	% Thin	Head Date	% Protein
MT 960099	130.9	51.4	29	92	3.0	185	12.3
Calgary	127.4	52.8	25	98	.4	185	13.0
HAXBY(9501866)	124.1	54.3	34	98	.4	186	13.0
Justina	121.2	51.6	27	99	.8	184	12.9
Baronesse	121.0	51.8	30	99	.4	185	12.8
MT 960228	118.6	52.6	30	96	1.0	186	12.4
Gallatin	118.0	52.1	34	95	2.0	183	13.0
Merit	116.8	50.4	31	99	.6	186	13.5
Valier	106.3	52.3	31	98	1.0	186	13.6
Conlon	105.6	51.4	28	99	.2	181	14.3
Harrington	105.3	51.2	32	97	1.0	185	13.3
Legacy	105.0	49.1	33	98	.4	184	14.1
Garnet	104.5	51.5	36	98	.5	187	13.8
Haybet	77.2	44.7	34	47	15.0	185	15.5

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 Applied fertilizer: 71-52-0 (N-P-K)
 Previous crop: Fallow.
 Date seeded: April 25, 2002. Date harvested: Aug. 26, 2002.
 Moisture Data: Rainfall from planting to harvest was 10.1" with
 two applications of sprinkler irrigation. (approx. 3.5" each)
 Yield exp. mean = 116.01
 Error degrees of freedom = 126
 F test for var. = 4.06
 C.V. 2 = 4.06
 LSD (0.05) = 13.19

Table 23 **Five-year summary for Irrigated Barley varieties** grown north of **Conrad, MT.** 1998 - 1999 - 2000
2001 - 2002. Mont. Agr. Expt. Station, Western
Triangle Ag. Research Center, Conrad, MT.

Variety	5-year comparable average						
	Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	% Plump	% thin	Head date *	% Protein
MT 960099	113.6	52.2	28	79	9	181	11.4
MT 960228	112.9	53.8	31	91	3	182	10.8
BARONESSE	110.0	52.6	30	88	4	181	11.0
HAXBY	106.8	54.5	33	92	2	180	11.4
GALLATIN	100.5	53.0	33	85	6	178	11.3
VALIER	100.4	52.9	32	84	7	182	12.1
MERIT	97.7	49.2	31	89	3	181	11.7
HARRINGTON	91.6	50.5	31	85	8	181	11.4
LEGACY	86.3	49.0	34	78	12	180	12.8

Cooperator: Western Triangle Ag. Research Center.

Location: Ten miles north of Conrad, MT. (Pondera County)

* = Head date based on four years only. (1998-99-01-2002)

Table 24 **Irrigated Malt Barley** variety trial grown north of **Conrad**, 2002. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test wt. lb/bu	Plant hgt. inches	% Plump	% Thin	Head Date	% Protein
Calgary	140.8	51.6	30	95	1.0	185	13.0
MT960101	130.3	52.6	31	97	1.0	186	12.8
H 3860224	127.8	52.8	33	98	.6	185	12.8
Baronesse	125.1	52.8	32	98	.6	184	13.2
MT970116	124.1	52.6	39	98	.5	185	12.7
Merit	122.1	50.1	32	98	.8	187	12.3
Stratus	119.1	50.4	33	98	.6	186	14.1
HAXBY MT950186	118.5	53.8	34	98	.7	185	12.4
Metcalfe	115.7	51.6	38	96	1.0	185	13.0
Busch Agr 1202	114.9	50.0	30	97	.8	185	13.6
Kendall	114.6	51.6	35	98	.6	187	13.4
Gallatin	114.2	52.7	36	97	1.0	184	13.0
Foster	112.7	49.1	34	98	.6	182	13.8
Conlon	110.0	51.2	31	93	2.0	185	13.3
Stander	109.5	50.0	36	94	1.0	185	12.6
Excel	108.8	48.7	37	93	1.0	185	12.7
Harrington	107.9	48.5	32	88	3.0	185	13.6
Valier	107.8	52.8	34	96	1.0	186	13.2
Legacy	107.8	48.5	37	94	1.0	185	12.8
Garnett	107.2	51.7	35	98	.5	187	13.2
Coors 37	102.3	51.3	26	97	1.0	185	14.1
Drummond	102.1	49.0	37	94	1.0	185	14.0
Robust	87.8	48.8	38	89	3.0	185	13.3
Morex	75.6	49.0	34	90	2.0	184	15.0

Cooperator: Western Triangle Ag. Research Center.

Location: Ten miles north of Conrad, MT. (Pondera County)

Applied fertilizer: 56-31-0 (N-P-K)

Previous crop: Fallow.

Date seeded: April 25, 2002.

Date harvested: Aug. 26, 2002.

Soil moisture stored at seeding: 3 inches.

Moisture Data: Rainfall from planting to harvest was 10.1" with two applications of sprinkler irrigation. (approx. 3.5" each)

Yield exp. mean = 112.78

Error degrees of freedom = 46

F test for var. = 7.21 ----C.V. 2 = 4.43 ----LSD (0.05) = 14.23

Table 25 **Three-year summary for Irrigated Malt Barley**
 varieties grown north of Conrad, MT. 2000 -
 2001 - 2002. Mont. Agr. Expt. Station, Western
 Triangle Ag. Research Center, Conrad, MT.

Variety	3-year comparable average						
	Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	% Plump	% thin	Head date *	% Protein
BARONESSE	102.1	53.3	28	93	2	181	11.1
MERIT	93.3	49.9	29	82	3	183	11.1
BUSCH AG. 1202	93.0	51.1	28	96	1	182	11.5
GALLATIN	88.8	53.2	32	92	2	181	11.2
HARRINGTON	88.5	50.4	29	90	3	182	11.5
FOSTER	85.4	49.4	31	90	3	179	11.6
GARNETT	85.2	51.9	30	93	1	182	11.9
EXCEL	84.0	49.7	31	87	3	181	11.1
COORS 37	84.1	51.9	24	92	3	181	11.3
LEGACY	83.9	49.2	32	87	3	182	11.1
CONLON	83.3	51.9	28	89	4	179	11.2
STANDER	72.4	50.5	30	92	2	182	11.8
MOREX	58.6	49.5	32	79	5	180	12.4

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 * = Head date based on two years only. (2001 - 2002)

Table 26

Dryland Barley variety trial grown north of
Cut Bank, 2002. Mont. Agr. Expt. Sta., Western
 Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test wt. lbs/bu.	% Plump	% Thin	% Protein
H3860224	45.2	51.1	97	1	14.7
Xena	44.0	51.6	96	2	12.8
Valier	44.0	50.7	95	2	14.5
Harrington	41.3	50.5	95	2	14.4
MT 970229	40.4	51.4	96	2	13.8
Gallatin	40.2	49.0	93	3	14.7
MT 960100	38.4	50.9	95	2	13.6
Baronesse	38.3	51.5	95	2	13.7
MT 970116	37.3	52.5	97	1	13.4
MT 960226	36.4	51.8	98	1	13.8
Lewis	36.1	50.6	95	2	14.8
MT 960099	36.0	50.9	94	2	12.2
MT 960228	35.1	51.4	96	2	12.8
MT 960101	33.7	50.3	94	2	13.9
Conlon	32.5	51.8	94	2	13.0
HAXBY (MT950186)	28.1	53.1	96	2	14.2

Cooperator: Kevin Bradley.

Location: Fifteen miles north of Cut Bank, MT. (Glacier Co.)

Applied fertilizer: 11-52-0 (N-P-K)

Date seeded: May 2, 2002.

Date harvested: September 11, 2002.

Previous crop: No-till chem fallow (wheat stubble)

Rainfall: From planting to harvest was 12 inches.

Stored soil moisture at seeding: 5 inches.

Yield experimental mean: 37.93

Error degrees of freedom: 30

F test for var: 1.54

C.V. 2: 9.70

LSD (0.05): 10.62

Table 27

Five-year summary for **Dryland Barley** varieties grown near **Cut Bank, MT.** 1998 - 1999 - 2000 - 2001 - 2002. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

5 - year comparable average						
Variety	Yield bu/ac	Test wt. lbs/bu.	Plant hgt.* inches	% Plump	% thin	% Protein

XENA	61.3	52.5	31	80	6	13.0
BARONESSE	56.6	51.6	28	62	13	14.0
HAXBY	55.1	54.2	32	70	10	13.6
MT 960228	54.7	52.4	30	65	13	13.5
GALLATIN	54.1	52.3	32	68	11	14.5
VALIER	53.0	52.2	30	49	19	14.9
MT 960099	52.5	52.3	27	45	22	13.8
LEWIS	51.8	52.9	32	61	14	14.8
HARRINGTON	51.3	51.4	29	60	15	14.8

Cooperator: Kevin Bradley.

Location: Fifteen miles north of Cut Bank. (Glacier County)

* = Plant heights based on 4 years average. (1998-99-00-2001)

Table 28 **Dryland Barley** variety trial grown east of the **Knees**,
2002. Mont. Agr. Expt. Sta., Western Triangle Ag.
Research Center, Conrad, MT.

Variety	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Plump	% Thin	% Protein
Baronesse	51.1	45.7	25	64	11	17.2
MT 970229	50.5	49.2	25	94	1	16.8
Gallatin	50.3	47.4	27	66	12	16.8
MT 960228	49.9	45.7	25	64	9	15.9
Valier	48.8	47.2	25	55	17	17.6
Xena	48.6	46.6	26	73	7	15.1
Lewis	47.2	47.1	26	51	22	17.4
MT 960100	46.6	46.4	22	49	19	18.1
HAXBY (MT950186)	46.5	50.4	25	85	4	15.8
MT 960226	45.5	47.8	25	87	2	15.7
MT 960099	44.8	47.1	22	48	20	16.8
MT 970116	44.5	49.2	26	88	3	16.3
Harrington	42.9	46.3	25	70	9	17.3
H 3860224	42.4	46.2	25	75	9	17.4
MT 960101	41.2	46.4	22	63	17	17.2
Conlon	40.2	44.5	25	45	20	16.3

Cooperator: Dan Picard.

Location: Thirty miles east of Brady, MT. (Chouteau, County)

Applied fertilizer: 11-52-0 (N-P-K)

Previous crop: No-till chem fallow (wheat stubble).

Date seeded: April 22, 2002.

Date harvested: Aug. 11, 2002.

Stored soil moisture at seeding: 5 inches.

Rainfall: From planting to harvest was 7.5 inches.

Yield experimental mean: 46.31

Error degrees of freedom: 30

F test for var.: 2.33

C.V. 2: 4.87

LSD (0.05): 6.52

Table 29

Four-year summary for **Dryland Barley** varieties grown near the **Knees**. (1999 - 2000 - 2001 - 2002) Montana Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

4 - year comparable average

Variety	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Plump	% thin	% Protein
BARONESSE	50.2	47.5	24	40	27	17.2
HAXBY	48.5	51.7	26	48	24	15.8
MT 960228	48.0	48.0	25	38	27	15.9
XENA	47.5	47.6	27	47	23	15.5
MT 960099	46.8	47.9	22	27	43	16.9
GALLATIN	45.1	47.7	27	39	31	16.4
VALIER	42.8	48.5	25	37	32	17.2
LEWIS	42.3	48.6	25	37	34	17.0
HARRINGTON	40.7	46.7	24	44	26	16.8

Cooperator: Dan Picard.

Location: Thirty miles east of Brady, MT. (Chouteau County)

Title: Small grain variety performance under no-till conditions.

Year: 2002.

Location: Western Triangle Research Center, Conrad, MT.

Personnel: Gregory D. Kushnak, Research Center, Conrad; Luther Talbert and Suzanne Mickelson, MSU Plant Science Dept.

Objectives: Identify small grain varieties which are adapted to no-till conditions.

Methods: Spring wheat and barley varieties were no-till planted into barley stubble at right angles to the previous crop. Crop history for the site was barley in 2001, fallow in 2000, and barley in 1999. Planting was accomplished with a double-disk no-till plot planter constructed by our Research Center Staff. Row space was 12 inches. Fertilizer included 100 pounds/acre ammonium phosphate (11-52-0) and 60 pounds/acre actual nitrogen top-dressed as urea. Roundup herbicide was used for preplant weed & volunteer control. Achieve and Bronate herbicides were used for wild oat and broadleaf control, respectively.

Results: Data for 2002, along with 5-year averages, are presented in Tables 30 and 31 for spring wheat, and Tables 32 and 33 for barley.

There was no interaction between spring wheat and cropping system over the five-year period. Variety rankings on no-till continuous-crop were similar to those on summerfallow, with Reeder the top yielder in both systems. The same was true for barley, with Baroness, Haxby, MT960228, and MT 960099 the top yielders in both systems.

Levels of disease were minimal for no-till in 2002, and similar to those in fallow-system plots.

Future Plans: Continue the no-till continuous-crop variety evaluations in efforts to include seasons of disease and environmental stress.

Table 30

Dryland Recrop No-till Spring Wheat variety trial grown north of **Conrad**, 2002. Mont. Agr. Expt. Station. Western Triangle Ag. Research Center, Conrad, Montana.

Variety	Yield bu/ac.	Test wt. lbs/bu.	Plant hgt. inches	Head date	% protein
Reeder	45.2	61.7	29	185	14.1
MT 9806	45.0	61.5	31	186	14.4
OUTLOOK (MT9874)	45.0	59.3	30	186	13.1
WESTBRED 926	43.8	60.7	30	183	13.7
NEWANA	43.5	60.0	26	186	12.8
FORTUNA *	43.1	62.1	33	185	12.9
CONAN *	42.7	60.6	26	185	14.1
MT 9929 *	41.8	61.1	28	185	13.7
MTHW 9420 **	41.8	61.0	27	185	12.5
LEW *	41.7	61.6	34	186	13.1
EXPLORER **	41.7	61.0	28	184	13.8
MCNEAL	41.7	60.4	29	186	13.0
RAMBO *	41.6	61.4	28	187	13.0
WESTBRED 936	41.2	61.4	26	183	14.1
HANK	41.1	60.3	28	183	14.3
HI-LINE	40.5	61.2	28	185	14.4
ERNEST *	40.3	60.8	35	185	13.7
SCHOLAR *	37.3	61.1	34	186	14.2
AMIDON *	35.5	59.8	35	186	12.7
WESTBRED EXPRESS	33.8	61.5	24	183	14.2

Cooperator: Western Triangle Ag. Research Center.

Location: Ten miles north of Conrad, MT. (Pondera County)

Applied fertilizer: 71-52-0 (N-P-K)

Previous crop: Barley.

Method of seeding: Double-disc drill into standing stubble.

Date seeded: April 29, 2002.

Date harvested: August 12, 2002.

Stored soil moisture at seeding: 3 inches.

Rainfall: From planting to harvest was 9.6 inches.

* = Sawfly resistant varieties. (Amidon, Conan, Rambo and Scholar have partial resistance.)

** = Hard white wheat.

Yield experimental mean: 41.41

Error degrees of freedom: 38

F test for var: 1.07 ---- C.V. 2: 6.93 ---- LSD (0.05): 8.21

Table 31 **Five-year summary for No-till Recrop Spring Wheat** varieties grown near **Conrad, MT.** 1998 - 1999 - 2000 - 2001 - 2002. Mont. Agr. Expt. Station, Western Triangle Agr. Research Center, Conrad, MT.

Variety	5 - year comparable average				
	Yield bu/ac	Test wt lbs/bu	Plant hgt. inches	Head date @	% Protein
REEDER	31.5	60.0	27	178	14.2
WESTBRED 926	30.9	59.2	26	178	14.5
CONAN *	30.7	59.7	26	179	14.0
NEWANA	30.5	59.3	25	181	12.9
WESTBRED 936	30.3	59.6	24	177	14.3
ERNEST *	30.0	60.1	30	180	14.1
HI-LINE	29.6	59.7	26	178	14.3
MCNEAL	29.3	57.9	28	180	13.6
RAMBO *	29.3	59.0	26	181	13.6
EXPLORER **	29.1	60.2	25	178	14.3
LEW *	29.0	56.8	29	181	13.4
SCHOLAR *	28.8	59.1	30	180	14.3
MTHW9420 **	28.3	58.2	26	178	13.6
AMIDON *	28.3	57.3	31	180	13.4
FORTUNA *	27.8	59.2	30	179	13.8
WESTBRED EXPRESS	26.9	58.9	24	179	14.1

Cooperator: Western Triangle Ag. Research Center.
 Location: North of Conrad, MT. (Pondera County)

* = Sawfly resistant varieties. (Amidon, Rambo Scholar and Conan have partial resistance.)

** = Hard white wheat.

@ = Head dates based on 4 years average. (1998-99-01-02)

Table 32 **Dryland Recrop No-till Barley** variety trial grown north of **Conrad**, 2002. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test wt. lb/bu	Plant hgt. inches	% Plump	% Thin	Head Date	% Protein
MT 970116	76.6	51.4	28	85	5	185	13.9
HAXBY (MT950186)	75.7	51.9	27	72	5	183	13.6
Valier	73.6	50.3	24	70	9	187	14.3
MT 960100	73.6	48.4	26	49	21	187	14.3
MT 960228	73.2	48.0	25	60	14	185	13.8
Gallatin	72.0	48.8	26	59	14	185	16.2
MT 970229	71.3	49.5	24	81	5	185	15.1
MT 960099	69.9	47.8	23	33	27	187	14.6
Baronesse	69.9	46.9	24	59	12	187	14.6
Harrington	68.7	47.3	23	67	13	186	14.4
MT 960101	68.6	47.2	25	55	18	188	14.3
Xena	67.9	47.5	28	51	15	185	13.8
MT 960226	66.2	47.8	26	73	9	185	14.2
Conlon	64.3	45.5	24	41	20	186	14.6
H 3860224	63.6	46.0	24	64	12	187	15.2
Lewis	63.5	49.5	25	60	14	186	15.9

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 Applied fertilizer: 71-52-0 (N-P-K)
 Previous crop: Barley.
 Method of seeding: Double-disc drill into standing stubble.
 Date seeded: April 29, 2002.
 Date harvested: Aug. 12, 2002.
 Stored soil moisture at seeding: 3 inches.
 Rainfall: From planting to harvest was 9.6 inches.
 Yield experimental mean: 69.91
 Error degrees of freedom: 30
 F test for var.: 0.65
 C.V. 2: 7.30
 LSD (0.05): 14.74

Table 33 **Five-year** summary for **Recrop Dryland No-Till Barley** varieties grown north of **Conrad, MT.** 1998 - 1999 - 2000 - 2001 - 2002. Mont. Agr. Expt. Station, Western Triangle Agr. Res. Center, Conrad, MT.

Variety	5 - year comparable average						
	Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	% Plump	% thin	Head date *	% Protein
BARONESSE	50.8	49.1	24	57	19	182	13.5
HAXBY	50.6	52.0	25	65	18	179	13.2
MT 960099	50.6	49.1	22	38	32	181	13.7
XENA	50.5	49.7	26	59	19	181	12.8
MT 960228	50.3	49.5	25	55	22	180	13.2
VALIER	49.0	51.2	25	58	22	182	13.9
GALLATIN	48.8	49.5	25	62	22	181	13.2
HARRINGTON	46.4	48.1	24	63	19	182	13.7
LEWIS	45.1	51.0	26	58	20	182	14.0

Cooperator: Western Triangle Ag. Research Center.

Location: Ten miles north of Conrad, MT. (Pondera County)

* = Head dates based on 4 years average. (1998-1999-2001-2002)

Title: Dryland *Brassica juncea* (canola oil quality, oriental mustard) variety evaluation.

Year: 2002

Location: Northeast of Cut Bank, MT on the Don Bradley farm.

Personnel: Grant Jackson and John Miller, Western Triangle Ag. Research Center, Conrad, MT 59425.

Objectives: To evaluate the performance of mustard varieties or hybrids under dryland conditions.

Procedures:

Five *Brassica juncea* lines were seeded into chemical fallow with a six-row, 12 inch spaced, double disk, no-till plot drill. Nitrogen, potash, and sulfur fertilizers were broadcast and phosphorus was placed with the seed while planting. Plot size was 6 x 12 feet with three replicates. Seeding rate was seven lbs seed/a. Plots were swathed with a Swift plot swather, then threshed with a Hege plot combine.

Results:

The data are summarized in Table 1s. The results were affected by drought conditions in May, cold temperatures in June, and severe heat stress in July.

Table 1s. Dryland *Brassica juncea* variety test. The experiment was located North of Cut Bank, MT on the Don and Kevin Bradley farm. Western Triangle Ag. Research Center, Conrad, MT. 2002.

Variety	Seed yield (lb/a)	Oil content (%)
PC 141	605.1	
PC 140	591.6	
PC 98-44	579.2	
PC 98-45	509.8	
PC 138	482.1	

Summary Statistics

Experimental Means	553.5	
Error Mean Square	119.2	
P-value	0.5313	
C.V.: (s/mean)*100	21.5	
LSD (0.05)	NS	

Notes:

Seeding Date: 5/6/02

Swathed: 9/4/02

Threshing Date: 9/20/02

Growing Season ppt: No data.

Planting Rate: 7 lbs/a

Previous Crop: Chemical fallow

Herbicide: Sprayed on 6/21/02 with Poast @ 2 pt/a.

Fertilizer: 60-30-30-20

Soil Test Summary

Depth	K ----- ppm -----	Olsen P	EC mmhos/cm	OM %	pH
0 - 6"	406	22.4	0.23	2.07	8.0
			NO ₃ -N		
Soil Depth			----- lbs/ac -----		
0 - 1			21.5		
1 - 2			30.8		
2 - 3			21.2		
3 - 4			9.3		
4 - 5			6.2		

Title: Irrigated Canola and *Brassica juncea* variety evaluation.

Year: 2002

Location: Western Triangle Agriculture Research Center, Conrad, MT.

Personnel:

Grant Jackson and John Miller, Western Triangle Ag. Research Center, Conrad, MT 59425.

Objectives:

To evaluate the performance of canola and *Brassica juncea* varieties or hybrids under irrigation.

Procedures:

Seventeen canola or *Brassica juncea* varieties were seeded into fallow with a six-row, 12 inch spaced, double disk, plot drill. Nitrogen, potash, and sulfur fertilizers were broadcast and phosphorus was placed with the seed while planting. Plot size was six by 12 feet with four replicates. Seeding rate was seven lbs seed/a. Plots were swathed with a Swift plot swather, then threshed with a Hege plot combine.

Results:

The data are summarized in Table 2s. Data were affected by a dry May, a cold, wet June, and a very hot July.

Table 2s. Irrigated canola and *Brassica juncea* variety test. The experiment was located at Western Triangle Ag. Research Center, Conrad, MT. 2002.

Variety	Crop	Seed yield (lb/a)	Oil content (%)
Magnum	Canola	2697.7	
Gladiator	Canola	2584.9	
KAB 36	Canola	2554.3	
2061	Canola	2349.5	
Nex 720	Canola	2224.1	
PC 141	<i>Brassica juncea</i>	2207.4	
289	Canola	2190.8	
Dakota RR	Canola	2172.4	
401	Canola	2168.6	
Minot	Canola	2144.1	
767	Canola	2090.7	
PC 140	<i>Brassica juncea</i>	2043.9	
Nex 715	Canola	2023.9	
PC 98-44	<i>Brassica juncea</i>	2009.8	
Crosby	Canola	2004.5	
PC 138	<i>Brassica juncea</i>	1884.0	
PC 98-45	<i>Brassica juncea</i>	1789.1	

Summary Statistics

Experimental Means	2184.1	
Error Mean Square	525.9	
P-value	0.6123	
C.V.: (s/mean)*100	24.1	
LSD (0.05)	NS	

Notes:

Seeding Date: 4/26/02 and 5/1/02¹ Swathed: 8/20/02 Threshed: 8/29/02
 Growing Season ppt: 9.98" plus approximately 3.00" of irrigation water was applied.
 Planting Rate: 7 lbs/a Previous Crop: Fallow
 Herbicide: None
 Fertilizer: 120-30-25-20

¹ There were two planting dates for the irrigated canola and mustard variety trials in 2002. There was no significant difference due to date, therefore the data set are combined for yield analysis.

Title: Effect of nitrogen (N) and phosphorus (P) on seed yield and quality of canola.

Year: 2002.

Location: North of Cut Bank, MT on the Don and Kevin Bradley Farm.

Personnel: Grant Jackson, and John Miller, Western Triangle Agricultural Research Center, Conrad, MT 59425.

Objectives: To study canola response to N and P fertilization with emphasis on P soil test calibration.

Procedures: Plots were planted in chemical fallow with a six-row planter with one-foot row spacing. Nitrogen rates were 15, 30, and 60 lbs N/acre applied in combination with P rates of 0, 10, 20, and 30 lbs P₂O₅ / acre. Phosphorus fertilizer (as monoammonium phosphate) was applied with the seed and N (as urea) and potassium (K, as KCl) fertilizers were broadcast during planting.

Results and Discussion: This location had a small seed yield response to N, but did not respond to P fertilization probably because of the high P soil test of 23 ppm. Seed yields were very low (average was about 200 lbs/acre) due to the adverse weather conditions of cold temperatures during June and severe heat stress during July.

Table 3s. Effect of N and P on canola yield and quality. The experiment was located North of Cut Bank, MT at the Don and Kevin Bradley Farm. Western Triangle Ag. Research Center, Conrad, MT. 2000.

Fertilizer N (lbs./a)	Fertilizer P (lbs./a)	Grain Yield (lbs/a)	Oil (%)
60	30	330.2	
60	10	263.5	
60	20	246.2	
60	0	238.5	
30	20	216.3	
15	30	179.1	
15	0	166.2	
15	20	164.4	
15	10	135.0	
30	0	128.4	
30	30	127.4	
30	10	126.7	

Summary Statistics

	Grain Yield (lbs/a)	Oil (%)
Experimental Means	193.5	
Error Mean Square	131.1	
Interaction P-Value	0.9134	
C.V. 1: (s/mean)*100	67.8	
LSD (0.05)	NS	

Nitrogen Summary

15	161.2	
30	149.7	
60	269.6	
P-value	0.0262	
LSD (0.05)	94.3	

Phosphorus Summary

0	177.7	
10	175.1	
20	209.0	
30	212.2	
P-value	0.8435	
LSD (0.05)	NS	

Notes:

Varieties: Hyola 357 RR

Seeding Date: 5/6/02

Swathed: 9/4/02

Harvest Date: 9/20/02

Growing Season ppt:

Previous Crop: Chemical Fallow

Fertilizer: Nitrogen as urea was broadcast while planting, and P was seed placed as mono-ammonium phosphate. Blanket applications of 20 lbs S/a and 25 lbs K₂O/a were applied as ammonium thiosulfate and KCl, respectively. The potash fertilizer was applied broadcast, and the S fertilizer was applied as a liquid band two inches away from the seed row.

Herbicide: Sprayed with Roundup Ultra 2 pt/a on 6/21/02.

Soil Test Summary¹:

Depth	K ----- ppm -----	Olsen P	EC mmhos/cm	OM %	pH
0 - 6"	406	22.4	0.23	2.07	8.0
Depth (ft)			NO ₃ -N (lbs/a)		
0 - 1			21.5		
1 - 2			30.8		
2 - 3			21.2		
3 - 4			9.3		
4 - 5			6.2		

¹The soil was sampled during spring of 2002.

Title: Effect of Sulfur (S) and the timing of S application on yield and quality of canola.

Year: 2002

Location: 1) East of Sunburst, MT on the Herb Karst farm.
2) Northwestern Ag. Research Center (NWARC), Creston, MT

Personnel: Rick Engle, Dept. Land Resources and Environmental Sciences, Bozeman, MT 59717.
Grant Jackson and John Miller, Western Triangle Agricultural Research Center, Conrad, MT 59425.

Objectives: To determine canola response to S as ammonium thiosulfate (ATS) when applied at planting and topdressed at the rosette growth stage and S soil tests;

Procedures: Four S rates (0, 10, 20, and 30 lbs S/a), as liquid ammonium thiosulfate (ATS, 12-0-0-26), was applied at planting and when canola was in the rosette stage. Ammonium thiosulfate was dribbled on the soil surface about two inches from the seed row while planting and applied broadcast at the rosette stage via a 4-wheeler at the rate of 10 gallons liquid/a. With this method of broadcast application, ATS was diluted to apply the 10 and 20 S/a rates and applied as concentrated ATS for the 30 S/a rate. Nitrogen and potash fertilizers were broadcast while planting, and phosphorus fertilizer was placed with the seed. Urea, potassium chloride, and monoammonium phosphate were the fertilizer materials used. Plot size was 6 by 25 feet with four replicates. Plots were planted with a six-row, 12 inch spaced, double disk, no-till plot drill capable of applying liquid fertilizer. Plant samples were collected at the rosette stage prior to applying ATS and at maturity for chemical analysis of N and S. Experiments were seeded into barley stubble, no-till at Sunburst. The plots at Creston were planted into tilled spring wheat stubble. Plots at Creston were direct cut with a Winterstieger plot combine, and the experiments at Sunburst were direct cut with a Hege plot combine.

Results: The data are summarized in Tables 4s through 9s. Seed yields were not increased by S fertilization this year at either location. Seed yield at Sunburst was affected by very cold temperatures in June and severe heat stress in July; however, August was relatively cool and pod fill was much better than expected; seed yields averaged about 500 lbs/acre. The plants were so affected (stunted, maximum height was about 12 to 15 inches) by the environmental conditions that chemical analysis was not performed. Sulfur fertilization increased the S content of the seed, and S applied at planting had a higher seed S content than when applied topdress at the rosette stage. At NWARC, Sulfur fertilization increased S content of the plants when sampled at the rosette and pod fill growth stages but decreased S content in the seed. Plant S content at pod fill was higher when S was applied at planting; seed S content was unaffected by S application time.

Table 4s. Effect of S and S application time on dryland canola seed yield. Experiment located East of Sunburst, MT at the Herb Karst farm. Western Triangle Ag. Research Center, Conrad, MT. 2002.

S-rate (lbs/a)	Time of application ¹	Seed yield (lbs/a)
20	PT	601.2
30	PT	554.9
10	PT	488.9
20	TD	486.5
0	PT	474.2
0	TD	467.7
10	TD	462.2
30	TD	415.4

Summary Statistics

Experimental Means	493.9
Error Mean Square	119.1
Interaction P-value	0.6233
C.V. 1: (s/mean)*100	24.1
LSD (0.05)	NS

Sulfur Rate Summary

20	543.9
30	485.1
10	475.6
0	470.9
Standard Error of the Mean	29.8
P-value	0.5940
LSD (0.05)	NS

Sulfur Application Time Summary

PT	529.8
TD	457.9
Standard Error of the Mean	59.6
P-value	0.1027
LSD (0.05)	NS

¹PT = ATS applied at planting; TD = ATS applied topdress at the rosette stage.

Table 5s. Effect of S and S application time on canola seed C, S, and N content. Experiment located east of Sunburst, MT. Western Triangle Ag. Research Center, Conrad, MT. 2002.

S-rate (lbs/a)	Time of application ¹	C (%)	S (%)	N (%)
30	PT	58.8	0.693	4.71
20	PT	59.0	0.674	4.63
10	PT	58.9	0.636	4.68
20	TD	59.3	0.624	4.57
0	PT	59.1	0.585	4.53
10	TD	59.1	0.578	4.60
30	TD	59.1	0.575	4.63
0	TD	59.2	0.556	4.62

Summary Statistics

Experimental Means	59.1	0.615	4.62
Error Mean Square	0.33	0.0458	0.0756
Interaction P-value	0.9563	0.2710	0.0879
C.V. 1: (s/mean)*100	0.563	7.450	1.636
LSD (0.05)	NS	NS	NS

Sulfur Rate Summary

20	59.1	0.650	4.60
30	59.0	0.634	4.67
10	59.0	0.607	4.64
0	59.2	0.570	4.57
Standard Error of the Mean	0.083	0.012	0.019
P-value	0.6918	0.013	0.0813
LSD (0.05)	NS	0.048	NS

Sulfur Application Time Summary

PT	59.0	0.647	4.64
TD	59.2	0.583	4.60
Standard Error of the Mean	0.166	0.023	0.038
P-value	0.0775	0.0008	0.2286
LSD (0.05)	NS	0.034	NS

¹PT = ATS applied at planting; TD = ATS applied topdress at the rosette stage.

Soil Test Summary

Depth (ft)	EC (mmhos/cm)	O.M. (%)	nH	K	Olsen P	NO ₃ -N (mg/Kg)	SO ₄ -S
0 - 0.5	0.307	3.57	5.9	436	39.5		
0 - 1						24.5	7.9
1 - 2						9.5	16.0
2 - 3						1.6	17.4
3 - 4						1.2	31.6
4 - 5						1.8	74.9

Notes:

Variety: Hyola 357 RR

Planting Date: 5/13/02

Swathing Date: None

Harvest Date: 9/10/02

Growing Season ppt: 13.35"

Planting Rate: 13 seeds/ft²

Previous Crop: Barley

Herbicide: Canola: Roundup Ultra @ 2 pt/a. Herbicide was applied on 6/20/02.

Fertilizer: Canola 120-30-30

Table 6s. Effect of S and S application time on irrigated canola seed yield and oil content.
Experiment located at Northwestern Ag. Research Center, Creston, MT. 2002.

S-rate (lbs/a)	Time of application ¹	Seed yield (lbs/a)	Oil content (%)
10	TD	1825.4	
10	PT	1794.9	
20	TD	1744.2	
0	TD	1724.7	
30	TD	1670.0	
20	PT	1610.9	
0	PT	1494.1	
30	PT	1482.7	

Summary Statistics

Experimental Means	1666.5	
Error Mean Square	225.6	
Interaction P-value	0.9124	
C.V. 1: (s/mean)*100	13.54	
LSD (0.05)	NS	

Sulfur Rate Summary

10	1810.1	
20	1677.5	
0	1592.9	
30	1576.3	
Standard Error of the Mean	56.4	
P-value	0.1599	
LSD (0.05)	NS	

Sulfur Application Time Summary

TD	1742.2	
PT	1595.6	
Standard Error of the Mean	112.8	
P-value	0.1384	
LSD (0.05)	NS	

Table 7s. Effect of S on canola C, S, and N content when sampled at the rosette growth stage.
 Experiment located at Northwestern Ag. Research Center, Creston, MT. 2002.

S Rate (lbs S/a)	C (%)	S (%)	N (%)
10	40.0	0.880	6.32
30	40.4	0.869	6.45
20	40.0	0.833	6.33
0	39.6	0.550	6.26
Summary Statistics			
Standard Error of the Mean	0.114	0.014	0.035
P-value	0.2979	0.0010	0.4664
Experimental Means	40.0	0.783	6.34
Error Mean Square	0.454	0.056	0.140
C.V. 1: (s/mean)*100	1.13	7.18	2.20
LSD (0.05)	NS	0.112	NS

Table 8s. Effect of S and S application time on canola C, S, and N content when sampled at pod fill. Experiment located at Northwestern Ag. Research Center, Creston, MT. 2002.

S-rate (lbs/a)	Time of application ¹	C (%)	S (%)	N (%)
0	PT	45.9	0.618	1.81
0	TD	45.7	0.617	1.85
20	TD	45.5	0.622	1.87
20	PT	45.7	0.784	1.68
10	TD	45.6	0.610	1.64
30	PT	45.3	0.847	1.52
10	PT	45.6	0.625	1.73
30	TD	45.4	0.682	1.85

Summary Statistics

Experimental Means	45.6	0.676	1.74
Error Mean Square	0.442	0.080	0.155
Interaction P-value	0.9531	0.1724	0.1465
C.V. 1: (s/mean)*100	0.969	11.79	8.87
LSD (0.05)	NS	NS	NS

Sulfur Rate Summary

0	45.8	0.618	1.83
10	45.6	0.618	1.68
20	45.6	0.703	1.77
30	45.3	0.764	1.69
Standard Error of the Mean	0.049	0.0016	0.006
P-value	0.3759	0.0164	0.3408
LSD (0.05)	NS	0.099	NS

Sulfur Application Time Summary

TD	45.5	0.633	1.80
PT	45.6	0.718	1.69
Standard Error of the Mean	0.098	0.0032	0.012
P-value	0.6558	0.0199	0.881
LSD (0.05)	NS	0.070	NS

Table 9s. Effect of S and S application time on canola seed C, S, and N content. Experiment located at Northwestern Ag. Research Center, Creston, MT. 2002.

S-rate (lbs/a)	Time of application ¹	C (%)	S (%)	N (%)
30	TD	59.0	0.447	3.74
20	TD	59.1	0.473	3.80
20	PT	58.9	0.468	3.65
0	PT	59.0	0.476	3.75
10	TD	58.9	0.481	3.72
30	PT	58.8	0.449	3.72
10	PT	59.0	0.479	3.81
0	TD	58.7	0.506	3.57

Summary Statistics

Experimental Means	58.9	0.472	3.72
Error Mean Square	0.42	0.026	0.11
Interaction P-value	0.5776	0.6278	0.0330
C.V. 1: (s/mean)*100	0.71	5.60	2.94
LSD (0.05)	NS	NS	0.16

Sulfur Rate Summary

0	58.8	0.491	3.66
10	59.0	0.480	3.77
20	59.0	0.470	3.72
30	58.9	0.448	3.73
P-value	0.8621	0.0255	0.3048
LSD (0.05)	NS	0.027	NS

Sulfur Application Time Summary

TD	58.9	0.477	3.71
PT	58.9	0.468	3.73
P-value	0.8535	0.3563	0.5146
LSD (0.05)	NS	NS	NS

Soil Test Summary

Depth (ft)	EC (mmhos/cm)	pH	K	Olsen P	NO ₃ -N (mg/Kg)	SO ₄ -S
0 - 1	0.64	7.9	195	11.0	41.3	42.6

Notes:

Variety: Hyola 357 RR and McNeal

Seeding Date: 4/30/02

Planting Rate: 16 seeds/ft² and 25 seeds/ft²

Harvest Date: 8/29/02

Growing Season ppt: 8.00"

Previous Crop: Tilled spring wheat stubble.

Herbicide: : Canola: Roundup Ultra @ 2 pt/a. All herbicide was applied on 6/12/02.

Fertilizer: Canola 180-30-30

Plant tissue sampling dates: first date:6/12/02; second date: 7/23/02

¹ Timing of fertilizer application: TD = Top dressed and PT = During planting.

Title: Pulse Crop Variety Performance Trials.

Year: 2002.

Locations: (1) North of Cut Bank, MT on the Bruce Bradley farm.
(2) Western Triangle Ag. Research Center, Conrad, MT 54925

Personnel: Grant Jackson and John Miller, Western Triangle Agricultural Research Center, Conrad, MT 59425.

Objectives: To evaluate spring pea, lentil, and chickpea varieties under dryland conditions.

Procedures:

Plots were planted no-till into chemical fallow or fallow with a six-row plot drill using 12" row spacing. Seeding rate was about 7 seeds/ft². Granular inoculum and P-fertilizer were placed with the seed. Plot size was six x 12 feet with three replications for dryland pea and four replications for the remainder of the pulse crop trials. Pea were swathed, then threshed with a Hege plot combine using lift fingers on the cutter bar. Lentil were pulled by hand and threshed when dry. Chickpea were harvested direct with a Hege combine.

Results:

Dryland pea seed yield data are summarized in Table 10s. Habitus of pea varieties are shown in Table 11s. Top yielding varieties were CDC 1475, Grande, and Explorer. The low and variable seed yields were caused by cold temperatures in June and excessive wind after swathing.

Irrigated pea seed yield, 1000 seed weight, and test weight data are summarized in Table 12s. Top yielding varieties were Granger, Majoret, CDC Mozart, Toledo, and Trapper. In general, seed yields were affected by extreme cold temperatures in June and severe heat in July. All dwarf and semi-dwarf varieties showed excellent standability.

Lentil seed yield, 1000 seed weight, and pod shatter data are summarized in Table 13s. Habitus and usage of lentil varieties are shown in Table 14s. Easton, Richlea, and Vantage were the top yielding varieties. Severe pod shattering probably affected the lower yielding varieties.

Chickpea seed yield and 1000 seed weight data and *ascochyta* disease ratings are summarized in Table 15s. Seed yield generally follow the *ascochyta* disease rating; seed yields were inversely related the *ascochyta* resistance or seed size. The market class of each variety was unknown when this report was prepared, but the larger seed cultivars were probably large seed kabuli's and the smaller seed size were probably dezi's.

Table 10s. Dryland spring pea performance nursery located north of Cut Bank. Western Triangle Agricultural Research Center, Conrad, MT. 2002.

Variety	Seed Yield (lbs/a)
Granger	1841.3
Cruiser	1684.3
Swing	1430.6
CDC Mozart	1258.5
Toledo	1178.5
Eclipse	1163.3
Espace	837.4
Trapper	767.7
Majoret	694.7
CDC Handel	608.6

Summary Statistics

Experimental Means	1119.0
Error Mean Square	574.1
P-Value	0.1977
C.V. 1:(s/mean)*100	51.3
LSD (0.05)	NS

Notes:

Planted: 5/6/02

Swathed: 8/23/02

Harvested: 9/3/02

Previous crop: Chemical fallow

Growing season ppt.= 12.43"

Fertilizer: 6 lbs N/a and 30 lbs/a P₂O₅ as mono-ammonium phosphate, and 15 lbs K/a as KCl.

Herbicide: Sprayed with Basagran 2 pt/a, Poast 1pt/a, Crop oil 2 pt/a, and Ammonium sulphate 2 pt/a on 6/25/02.

Table 11s. Habitus of spring pea varieties.

Variety	Cotyledon Color	Seed Size	Leaf Type	Vine Type
Majoret	Green	Medium	Leafless	Semi-dwarf
Espace	Green	Large	Leafless	Semi-dwarf
Explorer	Green	Medium	Leafless	Semi-dwarf
Jasmine	Yellow	Large	Leafless	Semi-dwarf
Grande	Yellow	Medium	Normal	Tall
Toledo	Green	Very Large	Leafless	Semi-dwarf
Granger	AWP ⁴	Small	Leafless	Tall
Trapper	Yellow	Large	Normal	Tall
Victoria	Yellow	Small	Normal	Tall

Table 12s. Irrigated spring pea nursery located at Western Triangle Agricultural Research Center, Conrad, MT. 2002.

Variety	Grain Yield	1000 Seed Weight (g)	Test Weight (lbs/bu)
Granger	3937.5	196.8	64.80
Majoret	3872.0	238.8	65.00
CDC Mozart	3824.0	252.3	64.60
Toledo	3821.7	270.3	64.00
Trapper	3749.3	239.5	63.90
Eclipse	3455.6	243.8	64.70
CDC Handel	3317.4	199.3	64.00
Espace	3144.5	268.8	63.60
Cruiser	2992.0	222.3	64.30
Swing	2670.7	231.0	64.10

Summary Statistics

Experimental Means	3478.4	236.3	64.3
Error Mean Square	1067.8	62.3	0.88
P-Value	0.7336	0.7431	0.4336
C.V. 1:(s/mean)*100	30.7	26.4	1.4
LSD (0.05)	NS	NS	NS

Notes:

Planted: 4/26/02.

Swathed: 8/20/02

Harvested: 8/29/02

Previous crop: Fallow

Growing season ppt: 9.98" plus approximately 3.00" of irrigation water was applied.

Fertilizer: 6 lbs N/a, 30 lbs/a P₂O₅ as mono-ammonium phosphate, and 30 lbs/a K₂O as potash.

Herbicide: Sprayed with Basagran 2 pt/a, Poast 1pt/a, Crop oil 2 pt/a, and Ammonium sulphate 2 pt/a on 6/18/02.

Table 13s. Dryland lentil performance nursery trial located at Western Triangle Agricultural Research Center, Conrad, MT. 2002.

Variety	Seed Yield (lbs /a)
Easton	1882.1
CDC Richlea	1870.2
CDC Vantage	1837.7
Laird	1776.7
CDC Milestone	1773.
CDC Glamis	1766.7
Pardina	1599.4
Brewer	1462.8
Red Chief	1414.4
Crimson	1381.8

Summary Statistics

Experimental Means	1676.5
Error Mean Square	253.5
P-Value	0.0413
C.V. 1: (s/mean)*100	15.1
LSD (0.05)	367.8

Notes:

Planted: 4/29/02

Swathed: 8/12/02

Harvested: 8/27/02

Previous Crop: Fallow

Growing Season ppt.: 9.53"

Fertilizer: 6 lbs N/a, 30 lbs/a P₂O₅ as mono-ammonium phosphate and 30 lbs/a KCl.

Herbicide: None.

Table 14s. Habitus and usage of lentil varieties Western Triangle Agricultural Research Center, Conrad, MT. 2002.

Variety	Cotyledon Color	Seed Size	Usage
CDC Richlea	Yellow	Large	Food
Red Chief	Red	Large	Specialty Food
Pardina	Yellow	Small	Food
Laird	Yellow	Very Large	Food
Brewer	Yellow	Large	Food
Crimson	Red	Small	Specialty Food
Eston	Yellow	Small	Specialty Food
CDC Glamis ¹	Yellow	Large	Food
CDC Milestone ¹	Yellow	Small	Food
CDC Vantage ¹	Yellow	Large	Food

¹New varieties released by Crop Development Centre, Saskatoon, Saskatchewan, Canada. These varieties are replacements for Laird (Glamis), Eston (Milestone), and Brewer (Vantage) and are *Aschochyta* resistant.

Table 15s. Dryland chickpea performance nursery located at Western Triangle Agricultural Research Center, Conrad, MT. 2002.

Variety	Seed Yield (lbs /a)	1000 Seed Wt (g)	Disease Rating ¹
CDC Anna	2785.6	236.8	1.3
CDC Nika	2294.0	298.3	1
CDC Desiray	2248.8	218.3	1.3
Myles	2231.7	214.3	1
CDC Yuma	2020.5	431.0	1.8
CDC Chico	1708.5	259.8	1.5
Sierra	1397.8	479.3	3.3
Stanford	1386.5	419.3	3.8
Dwellely	1336.7	425.0	3.8
Evans	1174.5	402.3	4.0
CDC Xena	1143.3	447.8	5.5

¹*Aschochyta* Disease Rating conducted on August 15: 1 is a healthy plant and 9 is a dead plant.

Summary Statistics

Experimental Means	1792.9	348.3	2.5
Error Mean Square	258.6	27.9	0.48
P-Value	0.0000	0.0000	0.0000
C.V. 1: (s/mean)*100	14.4	8.0	18.8
LSD (0.05)	373.4	40.3	0.69

Notes:

Planted: 4/29/02

Harvested: 9/26/02

Previous Crop: Fallow

Growing Season ppt.: 13.46

Fertilizer: 6 lbs N/a, 30 lbs/a P₂O₅ as mono-ammonium phosphate and 30 lbs/a KCl.

Herbicide: Sprayed with Poast at 2 pt/a on .

Title: Response of chickpea and pea cultivars to irrigation and planting rates.

Year: 2002

Location: Western Triangle Agriculture Research Center, Conrad, MT.

Personnel: Grant Jackson and John Miller, Western Triangle Ag. Research Center, Conrad, MT 59425;
Perry Miller and John Riesselmann, Dept. of Plant Sciences and Plant Pathology, Bozeman, MT 59717.

Objective: To study the response of chickpea and pea to differential irrigation and planting rates.

Procedures: Three chickpea cultivars and one pea cultivar were planted into fallow with a six-row, 12 inch spaced, double disk, planter. Potash fertilizer was broadcast and phosphorus fertilizer was placed with the seed while planting. Plot size was 6 x 17 feet with four replicates. The following planting rates were used: kabuli chickpea (cultivar – Dwelly) – 3 and 6 pls/ft² and desi chickpea (cultivars- Amit and Miles) and dry pea (cultivar-Espace) – 4 and 8 pls/ft². Both species were inoculated with appropriate *Rhizobium* inoculant. Irrigation was supplied with a line source through the center of the plot with water levels decreasing as distance from the source increased. Three irrigation water regimes, low, moderate, and high, were established as well as rainfed. Plots were direct cut with a Hege plot combine.

Results: The data are summarized in Table 16s. Pea yields were affected by hail that occurred the first week in September. The dryland moisture regime peas were harvested on 8/29/02 and the dryland moisture regime of chickpea was harvested on 9/26/02. The remaining moisture regimes were harvested on 10/7/02. Pea yields were affected by hail (about 30 to 50 % loss) after the initial harvest date for the dryland moisture regime, under the high moisture regime, pea yields would have approached 6000 lbs/acre. Chickpea were unaffected by the hail. The desi chickpea were eventually infected with *Ascochyta* after the August 15 disease ratings were made. Seed yields of all chickpea cultivars declined with increasing irrigation water, but the affect was most pronounced with the kabuli cultivar, Dwelly.

Table 16s. Effect of irrigation, planting rate, and cultivar on seed yield and Ascochyta infection of chickpea and pea. Western Triangle Ag. Research Center, Conrad, MT. 2002.

Cultivar ¹	Seeding Rate ²	Irrigation Level	Seed yield (lb/a)	Disease Rating (1-9) ³
Espace	8	Dryland	3934.3	
Espace	8	Moderate	3273.2	
Espace	4	Dryland	3170.2	
Espace	4	High	3155.5	
Espace	8	High	2993.2	
Espace	4	Moderate	2932.7	
Myles	4	Dryland	2819.5	1
Amit	4	Dryland	2586.1	1
Amit	8	Dryland	2545.0	1
Myles	8	Dryland	2427.1	1
Espace	8	Low	2130.7	
Espace	4	Low	2045.1	
Myles	8	Low	1827.0	1
Dwelly	6	Dryland	1663.6	2.3
Amit	8	Low	1604.2	1
Amit	4	Low	1390.0	1
Myles	4	Low	1388.2	1
Dwelly	3	Dryland	1349.1	1.8
Myles	4	High	458.5	1
Myles	4	Moderate	269.6	1
Myles	8	High	252.0	1.3
Dwelly	6	High	237.0	4.8
Myles	8	Moderate	233.8	1
Amit	8	Moderate	232.2	1
Dwelly	6	Low	188.8	3.8
Dwelly	3	Low	182.6	3.5
Amit	8	High	163.5	1
Amit	4	Moderate	149.3	1
Amit	4	High	136.4	1
Dwelly	3	Moderate	25.2	3.5
Dwelly	3	High	19.4	4
Dwelly	6	Moderate	14.3	5.3

¹ Chickpea: Desi = Amit and Myles; Kabuli = Dwelly. Dry pea = Espace

² Planting Rate: pls/ft² = pure live seed per square foot

³ Disease Rating is 1 - 9, 1 is a healthy plant and 9 is a dead plant. Disease notes taken 8-15.

Summary Statistics

Experimental Means	1440.6	1.9
Error Mean Square	511.2	0.48
Interaction P-value	0.7014	0.2646
C.V.: (s/mean)*100	35.5	25.6
LSD (0.05)	NS	NS

Variety Summary

Cultivar	Seed Yield (lbs/acre)	Disease Rating (chickpea only)
Espace	2954.4	
Myles	1209.5	1.0
Amit	1100.9	1.0
Dwelly	467.2	3.6
P-value	0.0000	0.0000
LSD	257.9	0.24

Seeding Rate Summary

Planting Rate, pls/ft ²	Seed Yield (lbs/acre)	Disease Rating (chickpea only)
8 or 6	1502.3	2.0
4 or 3	1379.8	1.7
P-value	0.2692	0.0000
LSD	NS	0.20

Water Level Summary

Irrigation Level	Seed Yield (lbs/acre)	Disease Rating (chickpea only)
Dryland	2561.9	1.3
Low	1344.5	1.9
Moderate	891.3	2.1
High	949.2	2.2
P-value	0.0000	0.0040
LSD	257.9	0.28

Precipitation and Applied Water

Water Level	Total Irrigation Water (inches)	Total Precipitation (inches)	Total Water (inches)
Low	2.4	13.6	16.0
Moderate	7.0	13.6	20.6
High	8.5	13.6	22.1
Dryland Pea	0	10.2	10.2
Dryland Chickpea	0	13.2	13.2

Notes:

Planting Date: 5/15/02

Harvest Dates: 8/29/02; 9/26/02; 10/7/02

Previous Crop: Fallow

Herbicide: None

Fertilizer: 6-30-30-0

Title: Effect of Sulfur (S) and S Application Time on yield and quality of spring wheat.

Year: 2002

Locations: 1) East of Sunburst, MT on the Herb Karst farm.
2) Northwestern Ag. Research Center (NWARC), Creston, MT

Personnel: Rick Engle, Dept. Land Resources and Environmental Sciences, Bozeman, MT;
Grant Jackson, and John Miller, Western Triangle Agricultural Research Center,
Conrad, MT 59425.

Objectives: To determine spring wheat response to S fertilizer when applied preplant and topdress at tillering and to correlate results with S soil tests.

Procedures: Four S rates (0, 10, 20, and 30 lbs S/a) applied at planting and at Feeke's stage 5. Sulfur was applied as liquid ammonium thiosulfate (ATS; (12-0-0-26)). Ammonium thiosulfate was dribbled on the soil surface about two inches from the seed row while planting, and when the wheat was at the designated growth stages, ATS was applied via a sprayer mounted on a 4-wheeler at the rate of 10 gallons liquid/a. With this method of broadcast application, ATS was diluted to apply the 10 and 20 S/a rates and applied as concentrated ATS for the 30 S/a rate. Nitrogen and potash fertilizers were broadcast while planting. Phosphorus was placed with the seed while planting. Urea, potassium chloride, and monoammonium phosphate were the fertilizer materials used. Plot size was 6 by 25 feet with four replicates. Plots were planted with a six-row, 12 inch spaced, double disk, no-till plot drill capable of applying liquid fertilizer. Plots were seeded into barley stubble at Sunburst. The plot at Creston was seeded recrop into worked spring wheat stubble. Plots at Creston were direct cut with a Winterstieger plot combine. Plots at Karst's were direct cut with a Hege small plot combine.

Results: The data are summarized in Tables 17s through 24s. Neither location had grain yield or protein responses due to S fertilization. Grain yields were very good, averaging 76 bu/acre at NWARC and 62 bu/acre at Sunburst. At Sunburst plant S content when sampled at tillering and seed S content was increased by S fertilization, but plant S content decreased with increasing S when sampled at heading. Seed or plant S content at heading was increased when S was applied at planting rather than applied topdress at tillering. Seed or plant S content at NWARC was unaffected by S fertilization or S application time.

Table 17s. Effect of S and S application time on yield and quality of dryland spring wheat.
 Experiment located East of Sunburst, MT on the Herb Karst farm. Western Triangle
 Ag. Research Center, Conrad, MT. 2002.

S-rate (lbs/a)	Time of application ¹	Grain yield (bu/a)	Test weight (lb/bu)	Protein (%)
20	PT	64.1	59.8	16.4
0	PT	62.9	59.1	16.2
30	TD	62.5	59.2	16.5
0	TD	61.9	59.3	16.2
20	TD	61.8	59.8	16.1
30	PT	61.6	59.3	16.3
10	PT	61.5	59.7	16.0
10	TD	58.7	58.8	16.1

Summary Statistics

Experimental Means	61.9	59.3	16.2
Error Mean Square	2.46	0.75	0.36
Interaction P-value	0.4599	0.4694	0.6040
C.V. 1: (s/mean)*100	3.98	1.26	2.22
LSD (0.05)	NS	NS	NS

Sulfur Rate Summary

0	62.4	59.2	16.2
10	60.1	59.2	16.0
20	62.9	59.8	16.2
30	62.1	59.2	16.4
Standard Error of the Mean	0.62	0.19	0.090
P-value	0.1361	0.3222	0.1709
LSD (0.05)	NS	NS	NS

Sulfur Application Time Summary

TD	61.2	59.2	16.2
PT	62.5	59.5	16.2
Standard Error of the Mean	1.23	0.37	0.18
P-value	0.1462	0.4037	0.9729
LSD (0.05)	NS	NS	NS

Table 18s. Effect of S on C, S, and N content of spring wheat when sampled at tillering.
 Experiment located East of Sunburst, MT on the Herb Karst farm. Western Triangle
 Ag. Research Center, Conrad, MT. 2002.

S-rate (lbs/a)	Time of application ¹	C (%)	S (%)	N (%)
0	PT	42.3	0.294	4.21
10	PT	42.0	0.353	4.31
20	PT	42.1	0.379	4.32
30	PT	41.8	0.408	4.65

Summary Statistics

Experimental Means	42.0	0.358	4.37
Error Mean Square	0.59	0.022	0.25
Standard Error of the Mean	0.15	0.0056	0.062
C.V. 1: (s/mean)*100	1.40	6.24	5.65
P-value	0.6597	0.0003	0.1296
LSD (0.05)	NS	0.034	NS

Table 19s. Effect of S and S application time on C, S, and N, content of spring wheat when sampled at heading. Experiment located East of Sunburst, MT on the Herb Karst farm. Western Triangle Ag. Research Center, Conrad, MT. 2002.

S-rate (lbs/a)	Time of application ¹	C (%)	S (%)	N (%)
0	TD	45.4	0.172	1.86
10	PT	45.4	0.170	1.85
0	PT	45.4	0.203	1.99
30	PT	45.1	0.166	1.86
10	TD	45.4	0.174	1.82
20	TD	45.6	0.168	1.88
20	PT	45.4	0.178	1.93
30	TD	45.3	0.161	1.83

Summary Statistics

Experimental Means	45.4	0.174	1.88
Error Mean Square	0.27	0.014	0.06
Interaction P-value	0.5506	0.1074	0.3408
C.V. 1: (s/mean)*100	0.59	7.878	3.13
LSD (0.05)	NS	NS	NS

Sulfur Rate Summary

0	45.4	0.187	1.92
10	45.4	0.172	1.84
20	45.5	0.173	1.90
30	45.2	0.163	1.85
Standard Error of the Mean	0.07	0.003	0.015
P-value	0.2100	0.0157	0.0170
LSD (0.05)	NS	0.014	0.06

Sulfur Application Time Summary

TD	45.4	0.169	1.85
PT	45.3	0.179	1.91
Standard Error of the Mean	0.13	0.007	0.03
P-value	0.3638	0.0463	0.0132
LSD (0.05)	NS	0.010	0.04

Table 20s. Effect of S and S application time on C, S, and N, content of spring wheat seed.
 Experiment located East of Sunburst, MT on the Herb Karst farm. Western Triangle
 Ag. Research Center, Conrad, MT. 2002.

S-rate (lbs/a)	Time of application ¹	C (%)	S (%)	N (%)
0	TD	45.3	0.177	2.84
0	PT	45.2	0.179	2.84
10	TD	45.2	0.177	2.82
10	PT	45.3	0.180	2.80
20	TD	45.3	0.177	2.82
20	PT	45.4	0.184	2.87
30	TD	45.3	0.182	2.90
30	PT	45.3	0.186	2.87

Summary Statistics

Experimental Means	45.3	0.180	2.84
Error Mean Square	0.080	0.004	0.064
Interaction P-value	0.0181	0.5678	0.6163
C.V. 1: (s/mean)*100	0.178	2.12	2.25
LSD (0.05)	0.119	NS	NS

Sulfur Rate Summary

0	45.3	0.178	2.84
10	45.3	0.178	2.81
20	45.4	0.180	2.84
30	45.3	0.184	2.88
Standard Error of the Mean	0.020	0.001	0.016
P-value	0.0546	0.0114	0.1660
LSD (0.05)	NS	0.004	NS

Sulfur Application Time Summary

TD	45.3	0.178	2.84
PT	45.3	0.182	2.84
Standard Error of the Mean	0.040	0.002	0.032
P-value	0.8286	0.0091	1.0000
LSD (0.05)	NS	0.003	NS

Soil Test Summary

Depth (ft)	EC (mmhos/cm)	O.M. (%)	pH	K	Olsen P		NO ₃ -N	SO ₄ -S
					(mg/Kg)			
0 - 0.5	0.307	3.57	5.9	436	39.5			
0 - 1						24.5	7.9	
1 - 2						9.5	16.0	
2 - 3						1.6	17.4	
3 - 4						1.2	31.6	
4 - 5						1.8	74.9	