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The 26th

ANNUAL RESEARCH REPORT

of the

WESTERN TRIANGLE AGRICULTURAL RESEARCH CENTER

Montana Agricultural Experiment Station

Conrad, Montana

2003

Submitted by

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Summary of climatic data by month for the '02-'03 crop year (September - August) at the Western Triangle Agricultural Research Center, Conrad, MT.

Month	Precipitation (inches)		Mean Temperature (°F)	
	Current Year	Average (19 yr)	Current Year	Average (18 yr)
September, 2002	2.00	1.30	55.2	57.5
October, 2002	0.68	0.51	37.3	45.2
November, 2002	0.18	0.36	42.6	32.2
December, 2002	0.07	0.16	30.9	24.7
January, 2003	0.05	0.19	26.0	23.2
February, 2003	0.22	0.22	25.6	24.7
March, 2003	0.31	0.48	29.7	33.2
April, 2003	1.96	0.91	46.5	43.6
May, 2003	1.52	1.79	49.1	52.7
June, 2003	2.40	2.80	59.6	60.1
July, 2003	0.12	1.45	71.1	66.5
August, 2003	0.18	1.35	71.3	66.4
Total	9.69			
Average		11.52	45.4	44.2

Last killing frost in Spring
2003---------- May 20 (31°F)
Average---------- May 17

First killing frost in Fall
2003---------- Sept. 17 (30°F)
Average---------- Sept. 23

Frost free period (days)
2003---------- 120
Average---------- 128

Maximum summer temperature------- 100°F (July 24 & Aug 11, 2003)

Minimum winter temperature---------- -15°F (Feb 24, 2003)

2003 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. The Conrad trials were planted on reduced-tillage fallow, and the Knees trial was no-till planted on chemical fallow.

Results: Data for 2003 are presented in Tables 1 and 2 for Conrad, and the Knees location in Tables 3 and 4. Favorable moisture in the fall and spring produced high yields. Moisture stress later in the season reduced test weights at the Knees.

MTS 0031, a sawfly resistant experimental, averaged 1.5 bu/a higher than sawfly-resistant Vanguard at the Knees. MTS 0031 had good stem solidness, although not as solid as Rampart. Its winterhardiness was much higher than Vanguard and Rampart, and slightly higher than Rocky. Heading date of MTS 0031 was slightly earlier than Vanguard, and one day later than Rocky. Test weight of MTS 0031 was above average. Protein of MTS 0031 was slightly higher than Vanguard and 1.3% higher than Rocky.

Rocky had the highest average yield at the Knees, and averaged 5 bu/a higher than the sawfly-resistant variety Vanguard. Other entries with good field performance included Falcon and Big Sky.

In the hard white varieties, field performance and protein of NuSky was similar to NuWest.

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). 'Above' has stiff straw, medium coleoptile, WH=2, early maturity, low yield and protein, poor quality.

AP502 CL (AgriPro): Clearfield system IMI resistant. Low yield.

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, and slightly less than Morgan. 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, Tiber and Morgan. 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.

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

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

Erhardt (MT8719, MSU, 1996): White chaff. Good winterhardiness (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 suscept 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 in NE Montana.

Expedition (SD, 2002): Winterhardiness 3, stiff straw, medium coleoptile, early maturity. Medium low yield, good quality.

Falcon (CDC, WPB, Sask. 1998): Good winterhardiness (4), similar to Morgan and greater than Tiber. Semidwarf, medium-stiff straw 4" shorter than Rocky. Short coleoptile. Straw 4" shorter than Rocky. The first true winterhardy semidwarf available for irrigated conditions in Montana. Heading 1 day later than Rocky, 2 days earlier than Neeley & Tiber. Medium yield on dryland, good performance for irrigated or high rainfall conditions. Test wt =Neeley, and 2# less than Rocky. Protein similar to Rocky & Neeley, and 1% less than Tiber.

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

Iagalene (AgriPro, 2002): Fair winterhardiness. Semidwarf, stiff straw, medium coleoptile. White chaff, good shatter resistance. Yield about 1 bu less than Rocky. Good test weight, good milling quality.

Jerry (ND, 2001): Winterhardiness high (5). Medium-stiff straw, medium coleoptile. Medium-late maturity. Yield advantage in winterkill areas. Med-high protein.

Judith (MT 8039, MSU, 1989): Winterhardiness = 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. Medium-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. Winterhardiness 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. Medium shatter. 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.

Millenium (Nebr): Early heading, average yield.

Morgan (Sask & WPB, S89-142, 1996): Norstar/Archer. Excellent winterhardiness (5). Semidwarf , medium-stiff straw, 2-3" shorter than 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.

MTR 9997 (MSU): Experimental. Russian Aphid resistant. Moderate winterhardiness. Yield = Neeley. Good test weight & protein. Acceptable quality.

MTS 0031 (MSU): Sawfly resistant, experimental. Good to intermediate stem solidness; thus, is being reselected from its 60 component lines, some of which are very solid. Winterhardiness much higher than Vanguard and Rampart, slightly less or equal to Rocky & Neeley, and somewhat less than Tiber. Height similar to Vanguard, 2" shorter than Rocky, and 3" shorter than Tiber. Long coleoptile. Maturity half-day earlier than Vanguard, one day later than Rocky, one day earlier than Tiber. Yield 5-10% (2-3 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 & Neeley.

MT 9982 & MT 00159 (MSU): Experimental lines, high yield.

Neeley (Idaho, 1980): Winterhardiness medium (3). Medium short straw, slightly less stiff than Tiber. Medium 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.

Paul (MT 9426, MSU, 2001): Winterhardiness (4), higher than Neeley, and equal to Tiber & Big Sky. Height 2" shorter than Neeley, 3" shorter than Tiber & Big Sky. Medium-stiff straw. Medium coleoptile length, shorter than Tiber & Big Sky. Heading 0.5 day earlier than Neeley, Tiber & Big Sky. Yield similar to Neeley, and slightly higher than Tiber & Big Sky. Test weight similar to 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.

Prowers 99 (CO, 1999): WH = 3. Medium-long coleoptile. Similar height as Rocky, medium-stiff straw. Maturity similar to Rocky. 3 bu lower yield and 0.5% higher protein than Rocky. Average TW. Russian Aphid resistance.

Pryor (WPB, 2002): (BZ9w96-919): Winterhardiness 3. Short stiff straw, medium coleoptile. Medium late. High yield. Medium protein, good quality.

Quantum 542 (WPB/Hybritech): An F_1 hybrid; needs new seed each year. Planting F_2 (second generation) seed may result in yield reduction and developement of ergot due to sterility in a small percentage of florets (ms ratio less than 3:1). F_1 vs F_2 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. Med-long coleoptile. Early maturity like Rocky. Susceptible to stem rust. Medium shatter resistance. High yield. Protein as good as Rocky (medium low). Recommended in 1991 for districts 2,3,4, & 5 (but not for dwarf smut areas).

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 (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, med-stiff straw. 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. Medium shatter resistance. 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.

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.

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 height with good lodging resistance. Stiff straw - stiffer than Judith. 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. Med-long coleoptile. Very resistant to sprouting, causing some dormancy problems. Medium maturity, but late enough to be sawfly vulnerable. Much greater tolerance to leaf spot diseases than Redwin. Susceptible to stem rust. Very resistant to shatter. Similar yield as Neeley. Higher yielding and more tillers than Redwin. Protein is medium: higher than Rocky. 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 (2, marginal to poor). Straw slightly stiffer and 1 inch 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. Medium shatter resistance. Test weight = Rocky. Protein high; 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.

Wahoo (Nebr & Wyo, 2000): Winterhardiness = 3. Semidwarf, 2" shorter than Rocky, stiff straw. Early maturity. High yield. Below average test wt, average protein, acceptable quality.

Hard White Winter Wheat

Gary (Idaho 550, 2001): Hard white. Winterhardiness 3. Semidwarf, med-weak straw. Med-late maturity. High yield, low test wt & protein.

Golden Spike (UT, Gen Mills, 1998): Hard white. Winterhardiness 3. Height similar to Rocky, med-stiff straw. Medium coleoptile. Medium maturity. Medium yield. Low protein.

NuFrontier (Gen Mills, 2001): Hard white. Winterhardiness 3. Stiff straw, medium coleoptile. Early maturity. Average yield, good test wt, low protein.

NuPlains (Nebr, Gen Mills, 1998): Hard white. Winterhardiness 3. Stiff straw, 5" shorter than Rocky, Medium coleoptile. Medium maturity. Yield slightly lower than Nuwest. High test wt & protein.

NuHorizon (Gen Mills, 2001): Hard white. Winterhardiness 3. Stiff straw, medium coleoptile. Early maturity. Average yield. High test wt, low protein.

Nuwest (MT 7811) (MSU, General Mills, 1994): Hard white winter wheat for specialty markets. Dual purpose, noodle and bread. Winterhardiness = 4, slightly more than Tiber. 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. Winterhardiness 4, slightly greater than Tiber. Height and straw strength similar to Nuwest & Rocky, med-stiff. Short coleoptile. Heading similar to Nuwest, Tiber & Neeley; and 3 days later than Rocky. Shatter resistant. High 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.

Table 1 **Dryland Winter Wheat** variety trial grown north of **Conrad**, 2003. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Head date	Spring survival class 1/	% protein
WAHOO		73.4	62.2	35	163	3	13.3
MT 00159		71.7	61.5	36	168		13.3
MTR 01108		70.6	63.4	33	166		13.3
BZ96-788		70.0	63.8	31	162		13.3
HYBRITECH 542		69.7	63.2	37	164	3	13.7
MT 0177		69.4	63.2	36	163		13.6
MTS 0131		69.2	61.9	38	166		14.1
CDC FALCON		69.0	63.0	31	165	4	13.2
NUHORIZON	*	67.5	65.3	30	161	3	13.3
ROCKY		67.4	64.2	38	165	2	13.9
VANGUARD	**	66.8	62.9	39	164	2	13.9
BIGHORN		66.2	62.8	32	166	3	13.9
PROWERS99		65.7	64.3	37	163	3	14.3
NUSKY	*	65.7	61.0	38	167	4	14.1
MT 9982		65.4	59.8	36	167		13.6
GM 10004	*	64.9	62.2	37	164		13.9
EXPEDITION		64.6	62.9	32	161	3	14.2
MILLENIUM		64.6	63.9	35	162		13.6
Jagalene		64.4	64.9	32	161		14.4
ABOVE		64.3	62.2	31	161	2	13.9
NEELEY		64.3	61.4	39	170	3	13.7
MTR 9997		64.1	62.1	35	164		14.4
JUDITH		64.0	60.5	37	166	3	13.3
PAUL		63.8	60.7	36	168	4	13.3
NUFRONTIER	*	63.4	63.4	35	164	3	13.0
MTW 01133		63.4	61.9	31	161		13.9
MT 9989		62.6	60.9	38	165		13.4

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Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Head date	Spring survival class 1/	% protein
NUWEST	*	62.3	61.5	39	166	4	13.6
PROMONTORY		62.3	64.2	34	165	2	12.9
MT 0097		62.1	61.3	37	165		13.8
ERHARDT		61.6	63.0	34	167	4	14.4
MORGAN		61.5	60.3	38	169	5	13.9
PRYOR		61.5	60.1	34	168	3	13.3
MTI 01158		61.0	62.9	34	166		14.2
MTW 01132		59.5	62.4	34	169		14.4
AP 502CL		59.3	61.3	29	160		14.1
JERRY		58.9	60.9	39	167	5	14.3
MT 01148		58.7	60.8	36	168		14.1
MTS 0031	**	58.7	61.2	37	166		14.0
TIBER		58.3	62.1	40	167	3	14.4
RAMPART	**	57.9	61.7	37	167	2	14.7
GARY	*	55.8	59.4	37	164	3	13.7
MTW 01143		55.6	60.1	38	170		13.8
MTS 0125		55.3	60.7	36	171		14.5
BIGSKY		55.1	61.8	40	167	4	14.7
MTW 01146		52.9	59.3	37	168		14.2
GOLDEN SPIKE	*	52.6	60.7	35	167	3	12.8
ELKHORN		50.2	59.3	45	170	4	14.8
NORSTAR		45.1	58.4	48	171	5	14.9

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, Pondera County.
Fertilizer: 60# 11-51-0 with the seed, + 45#N broadcast.
Previous crop: Fallow.
Date seeded: Sept. 9, 2002.
Date harvested: Aug. 4, 2003.
Rainfall: From April 1 to harvest was 6.02 inches.
* = Hard white wheat.
** = Sawfly resistant variety.
1/ = Spring survival class: 5=best; 1=very low; based several location-years of observation.
Yield experimental mean: 62.49
Error degrees of freedom: 96
F test for var. = 2.11, C.V. 2 = 6.36, LSD (0.05) = 11.16

Table 2 **Dryland Winter Wheat** variety trial grown north of **Conrad**, 2003. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

(ABBREVIATED LIST)

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Head date	Spring survival class 1/	% protein
WAHOO		73.4	62.2	35	163	3	13.3
HYBRITECH 542		69.7	63.2	37	164	3	13.7
CDC FALCON		69.0	63.0	31	165	4	13.2
NUHORIZON	*	67.5	65.3	30	161	3	13.3
ROCKY		67.4	64.2	38	165	2	13.9
VANGUARD	**	66.8	62.9	39	164	2	13.9
BIGHORN		66.2	62.8	32	166	3	13.9
PROWERS99		65.7	64.3	37	163	3	14.3
NUSKY	*	65.7	61.0	38	167	4	14.1
MT 9982		65.4	59.8	36	167		13.6
GM 10004	*	64.9	62.2	37	164		13.9
EXPEDITION		64.6	62.9	32	161	3	14.2
MILLENIUM		64.6	63.9	35	162		13.6
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MTR 9997		64.1	62.1	35	164		14.4
JUDITH		64.0	60.5	37	166	3	13.3
PAUL		63.8	60.7	36	168	4	13.3
NUFRONTIER	*	63.4	63.4	35	164	3	13.0
NUWEST	*	62.3	61.5	39	166	4	13.6
PROMONTORY		62.3	64.2	34	165	2	12.9
ERHARDT		61.6	63.0	34	167	4	14.4
MORGAN		61.5	60.3	38	169	5	13.9
PRYOR		61.5	60.1	34	168	3	13.3
MTI 01158		61.0	62.9	34	166		14.2
AP 502CL		59.3	61.3	29	160		14.1
JERRY		58.9	60.9	39	167	5	14.3
MTS 0031	**	58.7	61.2	37	166		14.0
TIBER		58.3	62.1	40	167	3	14.4
RAMPART	**	57.9	61.7	37	167	2	14.7
GARY	*	55.8	59.4	37	164	3	13.7
BIGSKY		55.1	61.8	40	167	4	14.7
GOLDEN SPIKE	*	52.6	60.7	35	167	3	12.8
ELKHORN		50.2	59.3	45	170	4	14.8
NORSTAR		45.1	58.4	48	171	5	14.9

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, Pondera County.
Fertilizer: 60# 11-51-0 with the seed, + 45#N broadcast.
Previous crop: Fallow.
Date seeded: Sept. 9, 2002. Date harvested: Aug. 4, 2003.
Rainfall: From April 1 to harvest was 6.02 inches.
* = Hard white wheat. ** = Sawfly resistant variety.
1/ = Spring survival class: 5=best; 1=very low; based several location-years of observation.
Yield experimental mean: 62.49 ---- Error degrees of freedom: 96
F-test for var. = 2.11, C.V. 2 = 6.36, LSD (0.05) = 11.16

Table 3 **Dryland Winter Wheat** variety trial grown near the **Knees**, 2003. 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
ROCKY		65.0	60.7	38	2	10.6
MT 9989		64.4	58.1	37		10.8
JUDITH		64.2	57.9	37	3	10.6
MTR 9997		62.9	59.8	36		11.1
MT 9982		61.4	56.6	34		11.4
CDC FALCON		61.0	60.4	30	4	10.6
MT 00159		60.8	57.2	36		10.2
PAUL		59.8	55.7	34	4	11.6
BIGSKY		59.1	59.0	38	4	11.8
NUWEST	*	58.3	58.2	38	4	10.9
MTS 0031	**	57.9	60.0	38		11.6
MT 0097		57.8	58.8	35		11.1
PRYOR		57.7	57.8	35	3	10.7
PROMONTORY		57.2	59.9	35	2	10.7
JERRY		57.1	58.5	38	5	11.8
VANGUARD	**	56.6	60.5	38	2	11.5
MORGAN		55.9	57.8	35	5	10.9
NEELEY		55.8	56.8	37	3	10.7
NUSKY	*	55.7	57.9	38	4	10.6
TIBER		55.5	58.3	40	3	11.1
BIGHORN		55.3	59.1	31	3	9.9
MTI 01158		54.9	59.8	34		10.7
RAMPART	**	47.7	59.5	36	2	11.0
NORSTAR		46.6	57.7	46	5	11.7

Cooperator: Dan Picard.
Location: Thirty miles east of Brady, Chouteau County.
Fertilizer: 51-52-0 (N-P-K).
Rainfall: May 1, to harvest = 2.1 inches.
Previous crop: No-till chem-fallow.
Date seeded: Sept. 25, 2002. Date harvested: July 28, 2003.
Stored soil water at seeding: 7 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: 57.86 Error degrees of freedom: 46
F test for var. = 8.26,--- C.V. 2 = 2.70,--- LSD (0.05) = 4.44

Table 4 **Five-year summary** on dryland **Winter Wheat** varieties grown near the **Knees.** 1998 - 2000 - 2001 - 2002 - 2003. 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
MT 9982		49.1	59.7	29	14.0
ROCKY		48.5	53.6	29	13.4
JUDITH		47.0	58.6	31	13.9
MTR 9997		46.2	59.8	28	14.3
BIGSKY		44.7	59.3	30	14.3
MTS 0031	**	44.5	59.1	29	14.7
CDC FALCON		44.4	59.7	25	13.6
TIBER		44.1	59.8	31	14.1
VANGUARD	**	43.2	60.2	29	14.2
NUWEST	*	43.2	58.9	29	13.8
PAUL		43.6	57.8	27	14.1
PROMONTORY		42.8	59.9	29	13.2
NEELEY		42.2	58.1	29	13.4
MORGAN		41.9	58.3	29	13.5
BIGHORN		41.7	60.1	25	13.6
NUSKY	*	41.4	59.2	29	13.6
RAMPART	**	40.1	58.9	29	14.2
NORSTAR		37.7	58.5	34	13.9

Cooperator: Dan Picard.
Location: Thirty miles east of Brady. (Chouteau County)
* = Hard white wheat.
** = Sawfly resistant varieties.

2003 Spring Wheat & Durum 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. Luther Talbert, MSU Plant Science Dept.

Off-station spring wheat variety trials were grown in Teton County (Choteau), Toole County (Oilmont), Glacier County (Cut Bank), and Chouteau County (Knees). The 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, Oilmont and on station at Conrad included both spring wheat and durum. Conrad trials were grown on both dryland and irrigated conditions.

Results: Data for the trials at Conrad are presented in Tables 5-9, and include the 2003 data and five-year averages. Data for the off-station locations are presented in Tables 10-17, and include the 2003 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 18-24.

Moisture stress was prevalent by mid-season, resulting in test weights in the low to mid-50's. At Oilmont, where conditions were especially dry, test weights were in the 40's.

Averaged over several locations and years, field performance of the semi-dwarf sawfly-resistant variety 'Choteau' (MT9929) was excellent. Yield and test weight of 'Choteau' were among the highest; with yield equal to McNeal, Reeder and Outlook, and 10% higher than Fortuna and Ernest. Heading date for 'Choteau' was 2 days earlier than McNeal, 1 day earlier than Ernest, and 1 day later than Fortuna. Stem-solidness (sawfly resistance) rating for 'Choteau' was 22, compared to 20 for Fortuna, and 16 for Ernest. (Maximum rating = 25).

Among the durum varieties, Maier, Mountrail and Avonlea were the highest yielders. Maier averaged higher for test weight than Mountrail. Avonlea was two days earlier to head than Maier, Mountrail, and McNeal.

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.

Least Tolerant: Alex, Amidon, Borah, Border, Centennial, Ellar, Era, Erik, Express, Fergus, Fremont, Hiline, Kulm, Lew, Newana, Pondera, Pioneer 2375, Russ, Scholar, 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 Qaulity 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)

Abby (Canada): Stems not completely solid. Field performance not known.

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.

Choteau (MSU, 2004) MT9929: Semidwarf with good straw strength. Height = HiLine, 2" shorter than McNeal, 4" shorter than Ernest & Fortuna. Stems very solid with good sawfly resistance (more solid than Fortuna). Sawfly resistance comparisons (max rating = 25): Choteau =22, Fortuna = 20, Ernest = 16. Medium-early, 2 days later than Hank, 0.5 day later than Ernest & Fortuna, 2 days earlier than McNeal. Yield similar to McNeal on both dryland and irrigated. Dryland yield is 3 bu more than Ernest, and 5 bu more than Fortuna. Irrigated yield is 16 bu more than Ernest, and 19 bu more than Fortuna. Test wt = Ernest & Fortuna, and 0.5# higher than McNeal. Moderate resistance to Septoria, and good resistance to most stem rust races. Protein slightly higher than Fortuna & McNeal (0.5%), and slightly less than Ernest. Normal gluten strength and acceptable quality.

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.

Ernest (ND677) (ND, 1995): Bearded. Tall, weak straw. Sawfly resistance varies from medium to 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.

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.

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.

Hollow-Stem, Sawfly Susceptible Hard Red Spr Wheat Varieties

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.

Grandin (ND, 1989): Semidwarf, good lodging resistance. Maturity similar to HiLine. Moderately susceptible to leaf spot. Yields less than HiLine. Medium high protein. Good quality. Replaced Stoa in N. Dakota.

Gunner (Agripro): Standard height. For scab tolerance in eastern ND and MN. Late maturity. High TW & protein.

Hank (WPB): Shatter resistant line from 926/936 cross, and may replace WB-926. Height similar to 926, and 3" shorter than McNeal & Reeder. Early maturing, heading date 5 days earlier than McNeal, 2 days earlier than Reeder, 1 day later than 926. Very high 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# 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. Good quality.

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.

Knudson (AgriPro): Semidwarf, strong straw. Medium maturity, similar to Reeder. High test wt, med protein.

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

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.

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.

Norpro (AgriPro): Semidwarf, strong straw. Medium maturity. Medium protein.

Outlook (MT 9874; MSU, 2002): Russian Wheat Aphid resistant. Semidwarf, height equal to McNeal & Reeder. Maturity = McNeal. Yield similar to McNeal and Reeder. Test weight slightly lower than McNeal. Protein 0.2% lower than McNeal, and 0.5% lower than Reeder. Protein & quality acceptable.

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

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.

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.

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.

Westbred 936 (WPB): Bearded semidwarf for irrigated only. 936 is stiffer strawed than 926; 3 inches shorter than Newana and 5 inches shorter than McNeal. Maturity 3 days earlier than McNeal. Reportedly tolerant to Avenge herbicide; fairly good tolerance to FarGo. Does not have Hessian fly or dryland root rot resistance, thus 926 is preferred in those areas. More susceptible to dryland root rot than 926 and Fergus (although IMZ helps to control root rot). Moderate resistance to stem rust, resistant to stripe rust. Susceptible to leaf rust and Septoria. Shatter resistant. Possible replacement for 906 and 926. Superior to 906 and 926 as an irrigated variety. (Tested as ph986-61 in 1992). Has low test weight on dryland. Protein appears good, 1.5% higher than Newana and 0.4% higher than McNeal. Quality = 4.

Zeke (WPB, BZ987-331): Semidwarf, similar height as WB 926. Similar maturity and protein as Pristine, but lower yield and test wt. Protein 0.5 less than 926, and 0.5 higher than Newana.

Hard White Spring Wheat

For specialty market. Protein of hard white will probably need to be at least 14% to meet market standards for bread baking, but lower protein is required for noodle markets. Some contracts accept 11 to 14%. In order to be officially classified as Hard White by U.S. Grain Standards, the developer/owner of the variety must petition for classification. Many hard white varieties sprout more readily than hard reds, especially those developed from Australian germ plasm. The pure white trait is difficult to maintain, as pollen from red wheats may pollinate a white variety, causing a mixture of red kernels. It is very important to clean the combine, storage bins and other grain handling equipment prior to harvest to avoid mixing white wheat with other wheats. Seeding equipment and seedbed must also be free of red wheats. Seeding rate should be 10% higher than for red wheat to reduce late tillers and thereby reduce green kernels.

Argent (ND, 1998): Hard white. Semidwarf, lodging resistant. Early maturity. Fargo tolerant. High protein.

Blanca Grande (Gen Mills): Hard white. Medium high yield and high test wt in 2003.

Explorer (MTHW 9710). (MSU 2002). Hard white, bread-baking type. Semidwarf, 2 inches shorter than McNeal. Slightly solid-stem, but not sufficient for sawfly resistance. Early maturing, two days earlier than HiLine, 3-5 days earlier than McNeal. Yield is similar to HiLine, and 2 bu less than McNeal. Very susceptible to Septoria, thus not recommended for far eastern Montana. Good test weight. High protein, similar to HiLine & McNeal; and probably too high for noodles. Excellent bread baking quality.

Golden 86 (GP Seed & Research Inc, 1986): Used by a commercial milling and baking firm north of Three Forks, Montana. A high quality hard white for specialty markets.

Idaho 377S (ID, Pro-Mar, General Mills, 1997): Hard white. Grown under contract with General Mills. Agronomically similar to well-adapted hard red check varieties in Montana trials in 1977-1988. Taller than most irrigated varieties, and therefore is more prone to lodging. Susceptible to Avenge herbicide.

MTHW 9420 (MSU, 1999): Experimental for exclusive release. Agronomically similar to Hiline. Maturity equal to Hiline. Very susceptible to wheat streak mosaic virus. Quality excellent for bread market, but too high in protein for noodle market.

Plata (Gen Mills): Hard white. Medium yield & test wt in 2003.

Pristine (WPB): Hard white. Semidwarf. 3 days earlier than McNeal. Yield = McNeal. Prot 0.5% less than McNeal.

Durum

Durum is generally much more susceptible to wheat streak mv and Fusarium crown rot than spring wheat.

Durum quality scale: 4 = good; 3 = average; 2 = poor; 1 = very poor. Quality durum has strong gluten. Growers who plan to grow weak-gluten varieties need to have a marketing organization identified that will purchase those varieties. Cool-climate areas are traditionally the good quality durum areas, as durum kernels tend to get flinty in hot areas. However, current research is underway to determine if new higher quality varieties can do well enough in hot areas. Seeding rate for durum should be 30% higher than for spring wheat due to the larger durum kernel (fewer kernels per bushel). An additional seed-rate increase may be desirable to suppress late tillers and thereby decrease green kernels. Color score is important, and green kernels contribute to poor color and dockage. 23 to 29 seeds per square foot (approx 90 to 110 lbs per acre) has normally been a good seeding rate for durum.

Avonlea (Can): Medium tall, similar to Sceptre. Medium lodging. Early maturity, 3 days earlier than Sceptre, and 1 day earlier than Utopia. High yield and test weight. Good quality and protein.

Belzer (ND, 1997): Medium-tall, 4 inches taller than Laker, moderate suscept to lodging. Late maturity. Moderate scab resistance. Large kernels, low test weight, medium protein. Quality = 4.

Ben (ND, 1997): Medium height, medium strong straw. Medium maturity. Medium yield. Large kernel size, high protein. Quality = 4.

Command (ND): Semidwarf. High irrigated yield, medium dryland yield compared to other varieties. Severe leaf spots in 1999.

Cortez (WPB): Short stiff straw. Early maturity. Medium kernel size, high protein.

Dilse (ND): Medium height, late maturity. Medium to low yield. High protein, excellent quality.

Dressler (Agripro): Standard height, moderate suscept to lodging. Medium maturity. Good test weight and large kernel size. High protein and strong gluten. Quality = 4.

Kari (AgriPro): Medium height and maturity.

Kyle (Canada, 1984): Very tall weak straw, poor lodging resistance. Very late maturing. Medium high yield. Medium test weight, large kernel size. High protein. Strong gluten; quality = 4.

Laker, Westbred (WPB, 1985): Tall-semidwarf, midway between standard height and semidwarf. Better height choice for all around production, not as short as Lloyd and Cando. Stiff straw, medium lodging resistance. Medium maturity. Often had leaf-spot diseases while other entries did not. High yield. High test weight, medium kernel size. Protein medium. Strong gluten; quality = 3.

Lebsock (ND): Medium-short height, similar to Laker. Late maturing. Medium-high yield and protein. Qual = 4.

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.

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

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. Stong 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.

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.

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.

Table 5 **Advanced Yield Dryland Spring Wheat** variety trial grown north of **Conrad**, 2003. Montana Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	Head date	% protein
BZ 996472	66.2	61.2	32	180	15.1
MT 0252	65.2	57.2	34	181	16.9
MT 0248	64.5	57.0	34	182	17.3
MT 0202	63.2	62.5	35	180	16.6
BR 7030	61.3	57.6	33	182	15.1
MT 0013	60.1	56.7	31	180	16.9
MT 0261	58.9	57.0	37	181	17.4
MTHW 0202	57.5	58.8	32	179	16.3
MT 0249	57.3	56.5	34	181	17.7
MT 0265	56.7	53.8	35	180	18.0
BZ 998447	56.4	53.8	35	180	16.9
MT 0266	56.3	54.2	33	180	17.2
MTHW 0203	56.3	58.6	34	181	16.0
BLANCA GRANDE (h.white)	56.0	61.1	29	179	14.8
MT 0234	55.8	59.3	32	180	16.6
Reeder	55.1	56.3	34	180	17.1
MCNEAL	54.8	56.9	34	183	16.7
WESTBRED 926	54.7	55.2	33	180	17.8
CHOTEAU (MT 9929) *	54.7	55.7	33	181	17.4
MT 0244	54.3	54.8	33	181	17.0
MT 9955	53.2	57.4	31	182	17.0
MT 9918	53.2	55.7	38	181	17.6
MT 0228	52.0	54.2	34	182	16.7
MCNEAL LARGE SEED	52.0	56.0	35	183	17.2
MT 0247	52.0	58.0	35	183	17.6
KNUDSON	51.6	58.3	33	183	16.9
MT 0255	51.6	55.9	34	181	17.1
MTHW 9420 (h.white)	51.5	54.8	31	180	16.9
MT 0220	51.5	55.9	33	181	17.4
MT 0009	51.3	57.9	33	181	16.7
MT 0245	51.2	54.4	33	183	16.9
MT 0225	51.1	54.8	34	182	17.1
MT 0238	51.0	57.7	36	180	17.1

(Continued on next page)

(Advanced Yield Spring Wheat, continued)

NORPRO		49.9	54.5	30	181	17.2
MT 0260		49.6	55.2	34	182	17.2
MT 0147		49.6	59.1	34	181	18.0
HI-LINE		49.4	55.2	33	180	17.7
BZ 996434		49.3	56.0	33	181	18.0
OUTLOOK		48.7	54.7	32	183	17.5
MT 0253		48.7	55.7	35	183	17.4
EXPLORER (h.white)		48.7	56.7	31	179	17.6
MTHW 0204		48.7	51.6	32	182	17.4
FORTUNA	*	48.6	57.9	41	183	16.8
MT 0134		48.1	56.9	38	183	18.0
MTHW 0002		48.0	53.3	32	181	17.2
MT 0212		48.0	56.6	33	181	17.3
MT 0205		46.9	55.1	32	182	17.0
MT 0112		46.7	58.9	36	181	18.0
MT 0237		46.0	55.0	33	180	17.6
PLATA		45.8	55.7	28	180	16.2
MT 0103		45.6	54.0	35	184	17.9
MT 0148		45.2	57.9	33	182	17.3
HANK		45.1	52.4	33	180	18.3
Conan	*	44.6	54.8	30	181	17.7
SCHOLAR	*	44.3	56.7	40	184	18.1
MTHW 9901		44.1	56.4	37	182	18.0
MT 0118		43.6	56.8	36	180	18.4
MTHW 0201		43.0	55.7	32	180	17.2
SEEDEX SX1502B		41.3	50.4	32	185	17.7
NEWANA		39.8	54.0	31	185	17.3
AMIDON	*	39.7	54.5	40	182	18.2
SEEDEX SX1501B		36.7	50.2	27	186	16.9
ERNEST	*	35.5	55.9	39	183	18.7
THATCHER		34.1	52.6	43	185	18.5

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
Applied fertilizer: 51-52-0 (N-P-K) Previous crop: Fallow.
Date seeded: April 23, 2003. Date harvested: August 14, 2003.
Rainfall: From planting to maturity was 4.9 inches.
* = Sawfly resistant varieties. (Amidon, Conan, & Scholar have partial resistance)
Yield exp. mean: 50.65 ------ Error degrees of freedom: 126
F test for var: 1.53 ---- C.V. 2: 10.85 ---- LSD (0.05): 15.38

Table 6 **Advanced Yield Dryland Spring Wheat** variety trial grown north of **Conrad**, 2003. Montana Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

(Abbreviated list)

Variety		Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	Head date	% protein
BLANCA GRANDE (H.WHITE)		56.0	61.1	29	179	14.8
Reeder		55.1	56.3	34	180	17.1
MCNEAL		54.8	56.9	34	183	16.7
WESTBRED 926		54.7	55.2	33	180	17.8
CHOTEAU (MT 9929)	*	54.7	55.7	33	181	17.4
KNUDSON		51.6	58.3	33	183	16.9
MTHW 9420 (H.WHITE)		51.5	54.8	31	180	16.9
NORPRO		49.9	54.5	30	181	17.2
HI-LINE		49.4	55.2	33	180	17.7
OUTLOOK		48.7	54.7	32	183	17.5
EXPLORER (H.WHITE)		48.7	56.7	31	179	17.6
FORTUNA	*	48.6	57.9	41	183	16.8
PLATA		45.8	55.7	28	180	16.2
HANK		45.1	52.4	33	180	18.3
Conan	*	44.6	54.8	30	181	17.7
SCHOLAR	*	44.3	56.7	40	184	18.1
NEWANA		39.8	54.0	31	185	17.3
AMIDON	*	39.7	54.5	40	182	18.2
ERNEST	*	35.5	55.9	39	183	18.7
THATCHER		34.1	52.6	43	185	18.5

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
Applied fertilizer: 51-52-0 (N-P-K) Previous crop: Fallow.
Date seeded: April 23, 2003. Date harvested: August 14, 2003.
Rainfall: From planting to maturity was 4.9 inches.
* = Sawfly resistant varieties. (Amidon, Conan, & Scholar have partial resistance)
Yield exp. mean: 50.65 ------ Error degrees of freedom: 126
F test for var: 1.53 ----- C.V. 2: 10.85 ---- LSD (0.05): 15.38

Table 7 **Five-year summary** for dryland **Spring Wheat** varieties grown near **Conrad, MT.** 1999 - 2000 - 2001 - 2002 - 2003. 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
REEDER		46.3	60.6	29	179	14.4
CHOTEAU	*	43.7	59.9	28	180	15.1
MCNEAL		43.3	59.7	29	181	14.4
HANK		42.8	58.9	29	179	14.7
WESTBRED 926		42.0	59.6	28	178	15.2
OUTLOOK		41.6	58.9	29	181	14.6
NEWANA		41.4	60.3	27	182	14.4
MTHW9420	**	40.3	59.3	28	180	14.1
SCHOLAR	*	40.1	60.5	32	183	15.0
FORTUNA	*	39.9	60.3	34	181	14.8
HI-LINE		39.9	59.5	28	179	15.3
CONAN	*	39.8	60.1	28	180	15.0
EXPLORER	**	39.4	60.0	27	178	14.8
ERNEST	*	38.5	60.3	33	181	15.4
AMIDON	*	36.9	58.9	33	181	14.9

Cooperator: Western Triangle Agricultural Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
* = Sawfly resistant varieties. (Amidon, Scholar and Conan have partial resistance.)
** = Hard white wheat.

Table 8 **Irrigated Spring Wheat** variety trial grown north of **Conrad**, 2003. 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
WESTBRED 936		78.6	60.6	32	179	15.9
Reeder		78.0	61.6	35	181	15.9
WESTBRED 926		74.8	60.9	33	180	15.8
HANK		74.0	58.6	33	180	16.3
WESTBRED EXPRESS		73.8	61.1	29	180	15.9
HI-LINE		71.7	60.7	32	180	16.3
MT 9918		70.8	57.9	40	181	16.5
EXPLORER	**	70.7	61.4	30	179	16.2
MTHW 9420	**	70.7	61.0	29	179	15.2
SCHOLAR	*	70.2	60.2	41	184	16.6
Conan	*	68.7	60.0	32	182	16.2
NEWANA		68.4	59.6	30	184	15.1
MCNEAL		66.7	57.2	36	183	15.9
OUTLOOK		66.5	57.6	33	183	15.7
RAMBO	*	65.2	60.0	32	184	15.7
CHOTEAU (MT 9929)	*	64.0	59.1	31	181	17.0
ERNEST	*	63.3	61.1	41	181	16.9
FORTUNA	*	60.8	60.4	39	182	16.2
AMIDON	*	60.7	59.8	38	182	16.4
LEW	*	59.1	61.1	39	183	16.1

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 23, 2003.
Date harvested: Aug. 18, 2003.
Moisture rate: Rainfall from seeding to harvest was 4.9 inches, with two applications of sprinkler irrigation. (3.5" each)
* = Sawfly resistant varieties. (Amidon, Conan, Rambo and Scholar have partial resistance.)
** = Hard white wheat.
Yield experimental mean: 68.82
Error degrees of freedom: 38
F test for var: 1.63 ---- C.V. 2: 6.34 ---- LSD (0.05): 12.49

Table 9 **Five-year** summary for **Irrigated Spring Wheat** varieties grown north of **Conrad, MT.** 1999 - 2000 - 2001 - 2002 - 2003. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

		5 - year comparable average				
Variety		Yield bu/ac	Test wt lbs/bu	Plant hgt. inches	Head date @	% Protein
HANK		77.0	61.4	31	180	14.0
WESTBRED 936		74.1	62.2	29	179	13.9
REEDER		72.2	62.7	33	180	13.9
WESTBRED 926		71.9	61.9	29	180	13.7
MTHW9420	**	71.6	62.7	31	180	13.2
HI-LINE		69.8	62.9	30	179	14.0
OUTLOOK		68.9	60.5	32	182	14.0
SCHOLAR	*	68.7	62.4	37	183	14.7
RAMBO	*	68.7	62.1	30	183	13.1
NEWANA		68.7	61.8	30	182	12.8
WESTBRED EXPRESS		68.1	62.4	27	181	14.0
CHOTEAU	*	67.6	62.0	30	181	14.2
MCNEAL		67.5	61.5	33	182	13.9
CONAN	*	66.6	61.4	31	181	14.4
AMIDON	*	66.1	61.5	38	181	14.0
ERNEST	*	65.8	62.2	38	182	14.8
EXPLORER	**	65.7	62.1	29	180	14.2
LEW	*	62.3	63.3	38	183	13.9
FORTUNA	*	60.2	62.6	36	181	14.1

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles 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. (1999-01-02-2003)

Table 10 **Dryland Spring Wheat** variety trial grown near **Cut Bank**, 2003. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant Hgt. inches	% Protein
MCNEAL		38.8	54.3	32	14.8
OUTLOOK		38.0	55.0	32	13.7
CHOTEAU (MT 9929)	*	35.7	57.6	30	13.8
NEWANA		35.5	56.0	30	13.5
RAMBO	*	34.8	55.1	30	13.9
HI-LINE		34.4	53.6	29	15.3
FORTUNA	*	34.1	54.3	37	14.6
Reeder		33.1	57.2	32	14.2
LEW	*	31.9	54.9	37	14.7
HANK		31.7	54.1	30	14.8
EXPLORER	**	31.3	57.4	29	14.5
WESTBRED 926		30.2	53.9	28	15.4
Conan	*	29.8	56.1	28	15.0
WESTBRED 936		29.6	55.7	28	14.9
ERNEST	*	29.6	55.5	35	14.9
SCHOLAR	*	28.5	56.2	37	14.5
MT 9918		26.3	55.7	37	13.8
MTHW 9420	**	24.2	55.0	29	14.1
AMIDON	*	22.3	55.6	37	14.3
WESTBRED EXPRESS		16.4	55.5	26	14.1

Cooperator: Kevin Bradley.
Location: Fifteen miles north of Cut Bank. (Glacier County)
Fertilizer: 71-52-0 (N-P-K).
Previous crop: No-till chemical fallow.
Date seeded: April, 24, 2003.
Date harvested: Aug. 18, 2003.
* = Sawfly resistant varieties. (Amidon, Conan, Rambo, and Scholar have partial resistance.)
** = Hard white wheat.
Yield experimental mean: 30.80
Error degrees of freedom: 38.00
F test for var: 3.41
C.V. 2: 9.17
LSD (0.05): 8.09

Table 11 **Five-year summary** for dryland **Spring Wheat** varieties grown near **Cut Bank, MT.** 1999 - 2000 - 2001 - 2002 - 2003. Mont. Agr. Expt. Station, Western Triangle Ag.ResearchCenter,Conrad, MT.

		5 - year comparable average			
Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. @ inches	% Protein
MCNEAL		35.1	56.5	30	16.1
OUTLOOK		34.8	55.5	28	15.6
REEDER		32.7	58.4	29	15.9
RAMBO	*	31.3	57.8	27	15.3
SCHOLAR	*	31.3	57.6	31	16.0
HI-LINE		31.3	56.9	27	15.9
NEWANA		30.8	57.4	27	14.9
FORTUNA	*	30.5	57.8	32	15.9
LEW	*	30.5	57.3	32	15.6
WESTBRED 926		30.5	56.0	28	16.1
ERNEST	*	30.4	58.3	31	16.7
WESTBRED 936		30.1	56.9	26	16.0
CHOTEAU	*	29.6	58.5	26	16.1
AMIDON	*	29.6	57.1	33	15.7
EXPLORER	**	29.4	57.7	26	15.9
CONAN	*	29.1	58.4	26	15.7
HANK		27.2	55.4	27	16.0
MTHW9420	**	26.8	56.3	26	15.1
WESTBRED EXPRESS		25.1	57.1	25	15.3

Cooperator: Kevin Bradley.
Location: Fifteen miles north of Cut Bank. (Glacier County)
* = Sawfly resistant varieties. (Amidon, Rambo, Conan and Scholar have partial resistance.)
** = Hard white wheat.
@ = Plant heights based on 4 years average. (1999-00-01-03)

Table 12 **Dryland Spring Wheat** variety trial grown near **Oilmont**, 2003. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Protein
WESTBRED EXPRESS		23.6	47.2	27	18.4
HANK		22.7	46.5	28	20.4
WESTBRED 936		22.5	46.4	26	20.1
FORTUNA	*	22.4	48.5	35	18.7
Reeder		22.0	47.2	30	19.2
EXPLORER	**	21.8	47.4	29	19.7
OUTLOOK		20.8	44.8	30	19.5
ERNEST	*	20.7	50.9	32	20.1
WESTBRED 926		20.3	44.9	27	20.2
MTHW 9420	**	19.8	44.0	30	19.4
MT 9918		19.6	48.2	32	19.5
CHOTEAU (MT 9929)	*	19.5	50.7	28	18.9
MCNEAL		19.4	43.5	26	20.3
NEWANA		18.7	47.0	26	18.9
Conan	*	18.6	47.6	27	19.3
SCHOLAR	*	18.5	47.5	32	20.4
AMIDON	*	18.4	48.8	34	19.4
RAMBO	*	18.3	49.8	26	19.0
HI-LINE		17.7	44.9	26	20.3
LEW	*	16.3	48.3	35	20.9

Cooperator: Terry Alme.
Location: Eight miles east of Oilmont. (Toole County)
Fertilizer: 100# 11-52-0 (N-P-K).
Previous crop: Fallow.
Date seeded: April 22, 2003.
Date harvested: Aug. 5, 2003.
Stored soil moisture at planting: 5 inches.
* = Sawfly resistant varieties. (Amidon, Conan, Rambo, and Scholar have partial resistance.)
** = Hard white wheat.
Yield experimental mean: 20.07
Error degrees of freedom: 38.00
F test for var: 2.12
C.V. 2: 6.66
LSD (0.05): 3.83

Table 13 **Four-year summary** for dryland **Spring Wheat** varieties grown near **Oilmont, MT.** 1998 - 1999 - 2000 - 2003 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	% Protein
HANK		30.6	52.3	26	18.3
EXPLORER	**	30.2	52.1	27	17.7
REEDER		29.6	53.5	28	17.7
FORTUNA	*	28.6	53.9	31	16.7
MCNEAL		28.2	50.9	26	18.1
OUTLOOK		28.0	50.4	27	17.5
WESTBRED EXPRESS		27.1	52.7	24	16.8
CONAN	*	27.1	51.7	26	17.2
MTHW9420	**	26.6	50.9	26	17.5
NEWANA		26.5	53.3	26	17.2
SCHOLAR	*	26.4	52.5	28	18.1
CHOTEAU	*	26.3	57.1	26	16.9
WESTBRED 936		26.2	52.9	24	18.1
HI-LINE		26.1	52.1	25	18.1
RAMBO	*	26.0	54.4	25	17.2
AMIDON	*	25.7	53.7	30	17.4
LEW	*	25.3	53.1	31	17.9
ERNEST	*	25.2	54.9	28	18.3
WESTBRED 926		24.9	52.3	25	18.5

Cooperator: Terry Alme.
Location: Eight miles east of Cut Bank. (Toole County)
* = Sawfly resistant varieties. (Amidon, Rambo, Conan and Scholar have partial resistance.)
** = Hard white wheat.

Table 14 **Dryland Spring Wheat** variety trial grown near **Choteau**, 2003. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Protein
FORTUNA	*	39.8	55.4	39	17.6
HI-LINE		39.3	51.5	32	18.5
CHOTEAU (MT 9929)	*	39.3	53.6	29	18.3
MCNEAL		39.0	51.2	33	18.3
Conan	*	38.0	54.5	28	18.0
WESTBRED 936		37.3	53.1	30	18.3
Reeder		36.9	52.0	32	18.4
OUTLOOK		36.9	51.1	30	18.0
HANK		36.1	49.9	29	19.7
RAMBO	*	35.8	53.7	28	18.0
ERNEST	*	35.6	54.4	38	18.6
EXPLORER	**	35.5	52.7	30	17.8
WESTBRED 926		35.1	52.4	30	18.5
MT 9918		34.7	53.6	34	18.1
LEW	*	34.3	56.0	40	18.1
NEWANA		33.8	50.5	28	17.9
SCHOLAR	*	33.5	53.8	35	18.7
MTHW 9420	**	33.5	50.0	29	17.6
AMIDON	*	32.4	53.6	37	17.7
WESTBRED EXPRESS		31.9	52.8	26	17.2

Cooperator: Roy Inbody.
Location: Twelve miles northeast of Choteau (Teton County)
Fertilizer: 130-52-0 (N-P-K).
Previous crop: No-till chemical fallow.
Date seeded: April 22, 2003.
Date harvested: Aug. 13, 2003.
Rainfall from May 10 to harvest was 3.5 inches.
Stored soil moisture at planting: 7 inches.
* = Sawfly resistant varieties. (Amidon, Conan, Rambo, and Scholar have partial resistance.)
** = Hard white wheat.
Yield experimental mean: 35.95
Error degrees of freedom: 38.00
F test for var: 0.96
C.V. 2: 6.68
LSD (0.05): 6.87

Table 15 **Five-year** summary for **Dryland Spring Wheat** varieties grown near **Choteau.** (1998 - 1999 - 2000 - 2002 - 2003) Montana Agr. Expt. Sta., Western Triangle Ag. Res. Center, Conrad, MT.

		5 - year comparable average			
Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Protein
CHOTEAU	*	43.4	55.7	28	16.6
MCNEAL		42.4	55.2	29	17.1
FORTUNA	*	41.3	58.1	34	16.6
OUTLOOK		41.3	54.4	29	16.6
REEDER		40.6	56.2	31	17.2
EXPLORER	**	40.3	55.9	28	16.6
ERNEST	*	39.8	57.4	32	17.3
CONAN	*	39.6	56.8	28	16.8
HI-LINE		39.6	54.9	28	16.9
WESTBRED 936		39.5	55.1	27	17.7
RAMBO	*	39.4	56.4	26	16.3
HANK		38.9	52.5	26	18.3
SCHOLAR	*	38.4	56.4	33	17.2
MTHW9420	**	38.4	54.4	28	16.4
NEWANA		38.2	55.5	26	16.1
WESTBRED 926		37.6	55.1	27	17.4
LEW	*	36.8	57.1	34	16.5
WESTBRED EXPRESS		35.5	55.3	25	16.3
AMIDON	*	34.2	54.7	33	16.1

Cooperator: Roy Inbody.
Location: Twelve miles northeast of Choteau, MT. (Teton County)

Table 18 **Dryland Durum** variety trial grown near the **Knees**, 2003. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Protein
MONROE	36.9	55.6	41	17.8
LEBSOCK	33.9	57.4	37	17.4
MAIER	33.9	54.0	36	18.6
ABBEY	33.9	53.2	37	-
SCEPTRE	33.7	53.4	38	18.1
AC AVONLEA	33.3	55.0	38	17.9
RENVILLE	33.0	55.6	40	18.4
MEDORA	32.8	55.5	40	18.2
MOUNTRAIL	32.5	52.8	38	19.0
PLAZA	31.9	53.6	30	18.2
Munich	31.9	54.8	36	17.7
VIC	31.1	57.8	40	18.1
BEN	30.6	56.0	39	17.3
KYLE	29.8	55.3	40	18.0
MCNEAL (s.wheat)	28.7	50.2	34	16.4
LAKER	19.5	55.2	31	15.9

Cooperator: Dan Picard.
Location: Thirty miles east of Brady. (Chouteau, County)
Fertilizer: 51-52-00 (N-P-K)
Previous crop: No-till chem fallow.
Date seeded: April 22, 2003.
Date harvested: August 5, 2003.
Rainfall: From June 1 to harvest was 2.1 inches.
Stored soil moisture: 7 inches.
Yield experimental mean: 31.56
ERROR DEGREES OF FREEDOM: 28.00
F TEST FOR VAR: 9.63
C.V. 2: 3.96
LSD (0.05): 3.62

Table 19 **Four-year summary** on dryland **Durum** varieties grown near the **Knees.** 1999 - 2001 - 2002 - 2003 Mont. Agr. Expt. Sta., Western Tri. Ag. Research Center, Conrad, MT.

Variety	4 - year comparable average			
	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Protein
MOUNTRAIL	28.0	55.3	30	17.1
MAIER	27.4	55.7	30	17.6
MONROE	27.0	56.0	33	16.9
AC AVONLEA	26.6	56.4	31	17.3
MEDORA	26.4	56.8	32	17.6
LEBSOCK	25.8	57.6	30	16.4
KYLE	25.8	56.8	34	17.1
PLAZA	25.8	55.5	26	16.6
SCEPTRE	25.7	54.7	31	17.0
RENVILLE	24.9	56.3	33	17.2
BEN	24.7	56.4	32	17.3
MUNICH	24.0	55.1	29	17.3
MCNEAL (wheat)	23.7	52.5	29	16.1

Cooperator: Dan Picard.
Location: Thirty miles east of Brady. (Chouteau County)

Table 20 **Dryland Durum** variety trial grown near **Oilmont**, 2003. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches
MCNEAL	(s.wheat)	19.0	46.8	27
ABBEY		18.3	49.2	31
MAIER		18.3	52.5	30
MONROE		17.9	52.6	32
LEBSOCK		17.8	52.3	35
RENVILLE		16.7	51.9	30
VIC		16.4	54.3	32
Munich		15.0	51.7	26
MEDORA		15.6	51.0	32
MOUNTRAIL		15.5	50.9	31
SCEPTRE		15.4	51.1	30
BEN		15.4	53.4	31
AC AVONLEA		15.2	50.4	31
PLAZA		14.5	54.3	25
KYLE		13.8	52.6	30
LAKER		13.6	49.2	25

Cooperator: Terry Alme.
Location: Eight miles east of Oilmont. (Toole, County)
Fertilizer: 11-52-00 (N-P-K)
Previous crop: Fallow.
Date seeded: April 22, 2003.
Date harvested: August 5, 2003.
Stored soil moisture at seeding was 5 inches.
Yield experimental mean: 16.07
Error degrees of freedom: 28.00
F test for var: 3.30
C.V. 2: 5.54
LSD (0.05): 2.58

Table 21 **Dryland Durum** variety trial grown north of **Conrad**, 2003. 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
MAIER	46.0	58.1	36	183	17.9
MCNEAL (s.wheat)	44.1	54.0	34	183	17.6
AC AVONLEA	42.6	56.4	38	181	20.2
WPB YU 894-75	42.2	55.8	32	180	17.2
UTOPIA	41.4	52.3	29	180	17.3
WPB YU 894-163	41.1	55.8	30	180	16.9
AZ P. B. D00AL-2	39.5	54.6	30	181	17.8
MOUNTRAIL	39.2	55.6	38	183	17.9
PLAZA	39.1	55.2	30	184	18.4
Munich	38.3	56.5	33	181	18.2
PIERCE	37.8	57.4	38	183	18.5
BEN	35.6	57.9	39	183	18.4
GEN. MILLS AP 1526	35.3	56.6	35	182	18.3
LAKER	34.8	55.9	32	183	16.9
MONROE	34.5	55.5	38	179	18.7
LEBSOCK	33.6	56.5	37	182	18.5
KYLE	33.1	55.1	41	186	18.7
DILSE	31.6	56.3	36	184	19.7
RENVILLE	31.3	55.2	39	183	19.9
VIC	30.6	56.6	40	182	18.3

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
Fertilizer: 51-52-0 (N-P-K)
Previous crop: Fallow
Date seeded: April 23, 2003.
Date harvested: August 14, 2003.
Rainfall: From planting to maturity was 4.91 inches.
Yield experimental mean: 37.58
Error degrees of freedom: 38
F test for var.: 1.48
C.V. 2: 9.78
LSD (0.05): 10.52

Table 22 **Five-year summary** for **Dryland Durum** varieties grown north of **Conrad, MT.** 1999 - 2000 - 2001 - 2002 - 2003. 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	43.1	60.0	32	180	14.1
MAIER	42.0	60.7	30	182	13.4
WPB YU 894-75	41.5	59.5	28	179	13.3
MCNEAL (wheat)	41.1	58.3	30	182	13.3
UTOPIA	40.0	57.7	25	179	13.3
MOUNTRAIL	39.8	58.9	31	182	13.0
PLAZA	39.7	59.5	27	182	12.8
MUNICH	38.9	59.4	29	181	13.5
KYLE	38.7	59.8	36	184	14.0
LAKER	38.4	60.2	29	182	12.7
LEBSOCK	37.3	60.6	30	182	13.3
MONROE	35.1	59.4	32	178	13.8
BEN	34.7	60.4	33	182	13.6
RENVILLE	33.9	59.1	33	182	13.9
VIC	33.4	60.0	33	181	13.5

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

Table 23 **Irrigated Durum** variety trial grown north of Conrad in 2003. 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
AZ P. B. D00AL-2	88.9	61.9	31	180	13.9
UTOPIA	85.8	57.7	32	181	15.1
MOUNTRAIL	83.8	59.9	40	184	13.8
WPB YU 894-75	82.1	61.8	37	179	15.2
GEN. MILLS AP 1526	80.9	61.3	37	183	15.4
PIERCE	80.4	61.4	41	184	14.0
WPB YU 894-163	79.5	59.2	34	180	15.7
MAIER	79.2	61.8	36	183	15.6
MCNEAL	77.2	58.3	36	184	14.9
DILSE	76.9	61.5	40	184	15.2
AC AVONLEA	76.6	61.2	38	181	15.8
LAKER	75.2	60.7	32	183	14.9
Munich	73.9	60.1	37	183	16.2
BEN	73.3	62.5	38	183	15.5
LEBSOCK	72.8	60.5	38	183	16.0
RENVILLE	70.2	61.0	44	183	16.0
PLAZA	65.8	59.0	33	183	16.2
VIC	64.5	60.8	43	182	16.5
MONROE	63.3	62.7	38	180	16.6
KYLE	57.0	59.3	42	185	16.4

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 23, 2003.
Date harvested: Aug. 18, 2003.
Moisture Data: Rainfall from seeding to harvest was 4.91 inches, with two applications of sprinkler irrigation. (3.5" each)
Yield experimental mean: 75.35
Error degrees of freedom: 38.00
F test for var.: 1.66
C.V. 2: 8.30
LSD (0.05) : 17.90

Table 24 **Five-year summary** for **Irrigated Durum** varieties grown north of **Conrad, MT.** 1999 - 2000 - 2001 - 2002 - 2003. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

	5 - year comparable average				
Variety	Yield bu/ac	Test wt lbs/bu	Plant hgt. inches	Head date @	% Protein
UTOPIA	76.0	61.5	27	180	12.5
MOUNTRAIL	75.7	62.3	35	182	12.0
LAKER	75.6	62.7	30	182	11.8
WPB YU 894-75	75.3	63.3	31	179	12.6
PLAZA	72.5	62.8	30	182	12.2
AVONLEA	72.4	62.7	35	180	13.0
MUNICH	72.1	62.2	33	181	12.9
MCNEAL (wheat)	71.4	61.6	33	182	12.9
MAIER	70.1	63.1	33	180	12.8
LEBSOCK	67.0	62.7	33	181	13.1
BEN	62.8	63.2	36	182	12.8
KYLE	61.0	62.0	40	184	13.3
RENVILLE	59.2	62.3	36	181	12.7
VIC	58.7	62.6	37	182	13.0
MONROE	58.6	62.6	35	179	13.1

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
@ = Head dates based on 4 years average. (1999-2001-2002-2003)

2003 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
Pat Hensleigh, MSU Plant Science Dept.

Off-station barley variety trials were grown in Teton County (Choteau), Toole County (Oilmont), Glacier County (Cut Bank), and Chouteau County (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.

Results: Data for the trials at Conrad are presented in Tables 25-32, and include the 2003 data and five-year averages. Data for the off-station locations are presented in Tables 33-40, and include the 2003 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.

Moisture stress was prevalent by mid-season, resulting in below-average test weights except for Haxby and Conlon.

Averaged over several locations and years, dryland field performance of Haxby (2-row feed) was excellent, with yield and test weight being the highest of all varieties. On irrigated, Baronesse had a slight yield advantage over Haxby. MT960228 (2-row feed) showed good field performance, especially in the higher moisture environments. The line is currently under evaluation in feeding trials for potential high nutritional value.

Yield and test weight of Conlon (2-row malt) were substantially higher than for Harrington. Conlon was 4 days earlier to head than Harrington, which may have contributed to its high relative yield performance under the moisture-stress conditions encountered in most of these trials.

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.

Baronnesse (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 Piroline 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.

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.

Calgary (Ariz Plt Br): 2-row feed for irrigated conditions. Stiff straw 2" shorter than Baronesse, stiffer than Baronesse, Haxby & Gallatin. Head date = Baronesse. Irrigated yield greater than Baronesse. Test wt = Baronesse.

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.

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.

Copeland (Canada): 2-row malt.

Crystal (78AB6871) (ID): 2-row malt (AMBA for Idaho & Montana). 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 malt. Height similar to Stander, stronger straw than other 6-row malt types. Improved yield over Morex, Robust and Foster. Plump higher than Morex.

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.

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

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.

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.

Hays (MSU, 2004): MT981060. Hooded 2-row. Shorter than Haybet and more resistant to lodging. Higher grain yield than Haybet (similar to Harrington). Test wt = Habet, and 2# less than Harrington. Higher forage yield than Haybet and Westford (8%).

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.

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

Legacy (Busch Ag 2978; 6B932978): 6-row malt. 2 to 4 inches taller than Harrington. Higher yield than Morex and Robust, 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.

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.

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.

Metcalfe (Canada): 2-row malt. Possible replacement for Harrington.

MT 960228 (MSU, 2005): 2-row feed. (Stark/Baron cross). Height 1" taller than Baronesse, 1" shorter than Haxby. Heading date similar to Harrington, and 1-2 days later than Haxby. Yield similar to Baronesse, and slightly higher than Haxby. Test wt = Baronesse, and 2# less than Haxby.

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

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 hulless. 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.

Tradition (Busch Ag): 6-row malt. Higher yield than Legacy.

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. H 3860224 (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 25 **Dryland Intrastate Barley** variety trial grown north of **Conrad**, 2003. 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
MT 970116	106.3	51.5	37	80	6	180	15.5
MT 910189	105.3	48.5	36	60	14	179	15.8
MT 981212	102.8	51.4	33	80	6	179	15.6
MT 970026	100.7	51.0	36	64	12	182	15.5
MT 981091	97.7	49.7	32	59	13	179	15.7
MT 000153	97.3	50.0	32	64	14	180	15.3
MT 970229	96.4	51.1	32	69	9	181	16.6
Baronesse	93.9	48.1	30	70	11	183	16.1
MT 000130	93.7	49.9	34	68	10	180	15.6
MT 010177	91.5	48.6	32	46	17	180	16.1
MT 010155	91.3	50.9	35	82	6	181	15.9
MT 000047	90.3	47.3	34	42	24	180	17.3
MT 010093	89.3	45.1	33	39	19	184	16.9
MT 010160	89.1	48.8	34	61	14	182	15.8
Haxby	89.1	50.7	35	35	24	180	16.0
MT 000092	88.8	47.8	36	62	16	182	14.9
MT 000239	88.2	45.8	37	43	23	184	17.4
Valier	87.3	48.3	32	25	30	183	17.5
Hays	87.0	42.5	37	16	42	184	16.0
MT 000156	86.6	48.5	32	60	14	179	16.6
Harrington	85.8	46.5	36	54	18	183	16.3
MT 010198	85.9	48.9	36	65	13	179	16.3
Merit	85.8	45.1	34	72	10	183	15.7
MT 000045	85.6	47.5	34	65	16	181	16.7
MT 981210	85.0	49.0	33	60	14	182	17.1
MT 981030	85.0	48.4	33	29	27	184	16.6
Legacy	84.8	47.1	37	51	20	179	15.1
MT 010212	84.0	44.2	37	26	39	184	17.0
Tradition	83.8	45.8	33	23	33	180	16.2
MT 000180	83.7	48.5	32	49	22	182	15.8
MT 960228	83.6	47.5	36	45	25	183	16.2
MT 000063	83.5	48.0	35	40	31	183	17.4
MT 010097	83.4	45.7	34	49	16	181	15.6

(Continued on next page)

(Dryland Intrastate Barley, continued)

MT 981006	83.3	46.4	35	30	25	181	17.9
MT 000125	83.2	48.0	33	57	18	182	15.7
Conlon	82.9	49.8	34	89	9	177	15.9
MT 981238	82.1	47.7	34	40	30	179	17.6
MT 010095	81.3	46.7	33	42	24	182	16.5
Gallatin	81.1	46.3	34	25	33	180	16.5
MT 970148	80.9	44.9	30	58	15	180	15.3
MT 010191	80.2	46.5	34	43	30	185	17.7
MT 990106	80.1	47.6	34	56	13	183	18.0
MT 010158	79.3	46.6	32	24	30	182	17.3
MT 010001	79.2	47.0	33	48	20	180	16.8
MT 010061	77.4	46.6	33	29	30	182	17.9
MT 010081	77.0	45.8	34	18	43	181	18.3
MT 000138	76.5	48.1	37	42	24	180	17.7
MT 970155	75.8	45.3	34	57	16	182	17.0
MT 010133	75.8	45.8	33	9	52	184	17.2
MT 960101	75.3	46.6	29	16	41	183	16.7
Garnet	72.9	45.7	32	49	17	183	17.4
MT 010080	72.3	48.1	33	45	16	180	17.7
MT 010219	71.6	46.6	33	42	16	181	16.4
MT 960099	71.0	46.1	31	9	52	184	17.4
Xena	70.0	45.8	33	9	44	182	15.6
MT 010156	69.8	45.3	31	27	32	179	18.1
B99AL621	69.4	45.0	29	18	45	182	17.2
Haybet	69.2	42.8	39	15	41	181	16.9
MT 010205	68.8	44.0	31	15	37	185	18.3
MT 010213	68.5	46.0	30	29	32	181	19.0
MT 981004	68.2	43.9	33	9	42	181	17.4
MT 010162	66.3	42.8	29	29	38	184	17.8
MT 010183	66.2	44.8	33	35	35	182	18.8
MT 000040	65.3	44.9	35	12	47	181	18.5

Cooperator: Western Triangle Ag. Research Center. Location: Ten miles north of Conrad, MT. (Pondera County)
Applied fertilizer: 51-52-0 (N-P-K)
Previous crop: Fallow.
Date seeded: April 23, 2003. Date harvested: Aug. 6, 2003
Rainfall: From planting to harvest was 4.8 inches.
Yield experimental mean: 82.72 Error degrees of freedom: 126
F test for var.: 1.70, --- C.V. 2: 9.12, --- LSD (0.05): 21.12

Table 26 **Dryland Intrastate Barley** variety trial grown north of **Conrad**, 2003. 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
Baronesse	93.9	48.1	30	70	11	183	16.1
Haxby	89.1	50.7	35	35	24	180	16.0
Valier	87.3	48.3	32	25	30	183	17.5
Hays	87.0	42.5	37	16	42	184	16.0
Harrington	85.8	46.5	36	54	18	183	16.3
Merit	85.8	45.1	34	72	10	183	15.7
Legacy	84.8	47.1	37	51	20	179	15.1
Tradition	83.8	45.8	33	23	33	180	16.2
MT 960228	83.6	47.5	36	45	25	183	16.2
Conlon	82.9	49.8	34	89	9	177	15.9
Gallatin	81.1	46.3	34	25	33	180	16.5
Garnet	72.9	45.7	32	49	17	183	17.4
Xena	70.0	45.8	33	9	44	182	15.6
B99AL621	69.4	45.0	29	18	45	182	17.2
Haybet	69.2	42.8	39	15	41	181	16.9

Cooperator: Western Triangle Ag. Research Center. Location: Ten miles north of Conrad, MT. (Pondera County)
Applied fertilizer: 51-52-0 (N-P-K)
Previous crop: Fallow.
Date seeded: April 23, 2003. Date harvested: Aug. 6, 2003
Rainfall: From planting to harvest was 4.8 inches.
Yield experimental mean: 82.72 Error degrees of freedom: 126
F test for var.: 1.70, --- C.V. 2: 9.12, --- LSD (0.05): 21.12

Table 27 **Five-year** summary for **Dryland Barley** varieties grown north of **Conrad**, MT. 1999 - 2000 - 2001 2002 - 2003. 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
BARONESSE	72.5	50.1	25	74	8	182	13.7
MT 960228 Eslick	71.5	50.5	27	68	12	182	13.8
VALIER	69.1	51.9	28	62	14	182	14.6
HAXBY	68.1	53.1	28	69	9	181	13.6
HARRINGTON	66.2	49.5	27	73	9	182	13.9
MT 960099	65.5	49.9	25	48	23	183	14.0
XENA	62.7	50.0	27	68	13	182	14.0
GALLATIN	62.7	49.5	28	61	15	181	14.1
MERIT	62.3	47.6	27	74	8	182	14.0
GARNET	58.9	49.2	27	75	8	183	14.4
CONLON	58.8	50.9	26	84	6	177	13.7
LEGACY	56.9	47.3	31	60	13	180	13.9

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
* = Head dates based on 4 years. (1999-2001-2002-2003)

Table 28 **Irrigated Intrastate Barley** variety trial grown north of **Conrad**, 2003. 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 010093	145.0	52.6	35	95	1	184	12.9
MT 981091	141.2	54.2	33	94	3	180	13.6
MT 960228	140.0	53.6	33	91	3	183	11.4
MT 981006	139.6	53.4	33	94	3	181	12.8
MT 000153	136.0	53.6	33	97	1	180	13.8
MT 000040	132.9	54.2	35	90	4	181	14.3
Merit	131.4	53.1	36	99	1	182	13.5
MT 960101	131.1	53.0	32	92	2	183	12.5
MT 010081	131.0	54.1	33	96	2	181	13.6
MT 000180	130.8	52.5	38	96	1	181	13.1
MT 010133	130.5	55.5	37	98	1	183	10.7
MT 000125	129.7	54.0	36	98	1	182	13.4
MT 010095	129.3	54.0	37	95	2	182	13.1
MT 010219	127.6	53.5	38	98	1	182	12.6
MT 010155	127.3	53.8	36	96	1	180	12.5
MT 010097	127.2	52.7	33	97	1	181	12.1
Tradition	126.8	52.0	33	94	1	179	12.1
MT 010212	126.8	51.5	37	90	3	181	13.8
MT 010156	126.5	53.1	31	95	1	181	14.2
MT 000239	125.9	52.8	39	96	1	185	13.2
Baronesse	125.7	52.2	34	94	2	182	12.4
MT 010198	125.6	54.4	37	97	1	179	13.6
Xena	125.6	53.3	38	94	3	181	12.4
B99AL-621	124.3	51.7	30	94	2	182	12.6
MT 970229	124.1	55.2	32	99	1	181	12.4
MT 000047	123.9	53.6	29	95	1	180	13.9
MT 010158	123.5	53.8	28	96	1	181	13.8
Valier	123.5	53.9	39	93	1	183	13.2
Haxby	123.4	54.5	30	96	1	181	13.1
Gallatin	123.0	54.7	37	94	2	179	12.1

(Continued on next page)

(**Irrigated Intrastate Barley, continued**)

MT 010191	122.6	51.8	35	93	2	184	12.6
MT 010213	121.8	53.7	27	97	1	181	13.1
MT 000063	121.2	54.6	29	96	1	181	13.3
Conlon	120.8	55.0	33	99	1	175	13.2
MT 981004	120.7	52.4	29	90	2	181	14.1
MT 000156	120.6	52.9	29	96	1	179	13.5
MT 910189	120.6	53.9	33	96	2	180	12.9
MT 010160	120.6	52.8	33	96	1	181	13.8
MT 000130	120.0	54.1	34	98	1	180	13.2
MT 970148	119.9	52.6	27	98	1	179	12.3
MT 970116	119.6	54.1	34	97	1	180	13.8
Calgary	119.3	52.1	31	95	1	181	12.7
MT 990106	118.8	55.0	31	96	1	182	13.5
MT 981210	118.2	53.5	35	98	1	182	12.7
Harrington	117.9	51.6	30	95	1	182	12.4
MT 010080	117.7	52.7	32	90	3	180	14.0
MT 000138	115.6	54.2	34	98	1	179	15.6
MT 960099	115.2	51.7	28	88	2	183	12.9
MT 010162	114.9	52.5	29	94	1	182	12.6
MT 000092	114.8	52.5	34	96	1	181	11.0
Garnet	114.7	53.3	35	97	1	183	13.8
Legacy	114.7	50.4	36	83	5	180	12.2
MT 010001	114.6	52.9	31	88	2	179	14.0
MT 981238	114.6	54.4	35	94	2	180	13.9
MT 981212	114.4	54.3	30	98	1	179	13.9
MT 970026	113.9	54.4	32	92	2	181	13.0
MT 970155	113.5	53.4	30	96	1	183	13.5
MT 010061	112.2	53.7	32	97	1	181	12.7
MT 010205	111.7	52.2	30	98	1	184	13.7
MT 010183	111.4	53.6	29	98	1	182	13.3
MT 981030	109.5	53.1	31	70	7	183	13.8
MT 000045	104.3	52.9	30	94	1	181	13.6
Hays	96.9	48.4	38	72	10	182	12.9
Haybet	88.0	49.4	41	56	11	181	12.8

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 23, 2003. Date harvested: Aug. 12, 2003.
Moisture Data: Rainfall from planting to harvest was 4.1" with two applications of sprinkler irrigation. (approx. 3.5" each)
Yield exp. mean = 121.78, Error degrees of freedom = 126
F test for var. = 1.72 --- C.V. 2 = 6.03 --- LSD (0.05) = 20.55

Table 29 **Irrigated Intrastate Barley** variety trial grown north of **Conrad**, 2003. 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 960228 Eslick	140.0	53.6	33	91	3	183	11.4
Merit	131.4	53.1	36	99	1	182	13.5
Tradition	126.8	52.0	33	94	1	179	12.1
Baronesse	125.7	52.2	34	94	2	182	12.4
Xena	125.6	53.3	38	94	3	181	12.4
B99AL-621	124.3	51.7	30	94	2	182	12.6
Valier	123.5	53.9	39	93	1	183	13.2
Haxby	123.4	54.5	30	96	1	181	13.1
Gallatin	123.0	54.7	37	94	2	179	12.1
Conlon	120.8	55.0	33	99	1	175	13.2
Calgary	119.3	52.1	31	95	1	181	12.7
Harrington	117.9	51.6	30	95	1	182	12.4
Garnet	114.7	53.3	35	97	1	183	13.8
Legacy	114.7	50.4	36	83	5	180	12.2
Hays	96.9	48.4	38	72	10	182	12.9
Haybet	88.0	49.4	41	56	11	181	12.8

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 23, 2003. Date harvested: Aug. 12, 2003.
Moisture Data: Rainfall from planting to harvest was 4.0" with two applications of sprinkler irrigation. (approx. 3.5" each)
Yield exp. mean = 121.78, Error degrees of freedom = 126
F test for var. = 1.72 --- C.V. 2 = 6.03 --- LSD (0.05) = 20.55

Table 30 **Five-year summary** for **Irrigated Barley** varieties grown north of **Conrad, MT.** 1999 - 2000 - 2001 2002 - 2003. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

	5-year comparable average						
Variety	Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	% Plump	% thin	Head date *	% Protein
MT 960228	118.4	53.5	30	93	2	182	10.6
MT 960099	115.9	52.3	27	87	4	182	11.3
BARONESSE	113.7	52.9	30	95	1	182	11.0
CALGARY	110.7	52.8	27	95	1	181	11.8
HAXBY	108.0	54.2	31	93	2	181	11.5
MERIT	106.1	50.3	31	96	1	182	11.7
VALIER	105.8	53.4	32	94	1	182	11.8
CONLON	105.5	53.1	29	96	1	178	12.1
GALLATIN	104.8	53.3	33	92	3	179	11.1
HARRINGTON	101.0	51.5	30	94	2	182	11.2
GARNET	98.8	52.5	32	97	1	182	11.7
LEGACY	93.4	49.4	33	83	5	180	12.2

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
* = Head date based on four years only. (1999-01-02-2003)

Table 31 **Irrigated Malt Barley** variety trial grown north of **Conrad**, 2003. 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
MT 981091	123.6	54.1	27	96	1	180	13.4
Lacey	122.5	52.4	31	94	1	176	12.5
Stratus	120.0	52.2	24	93	2	183	12.6
Kendall	118.4	52.9	26	96	2	182	13.5
MT 970116	115.8	54.6	31	97	1	180	13.3
MT 960101	115.0	52.8	25	92	3	183	12.3
MT 981238	114.6	54.3	31	97	1	180	13.9
Metcalfe	113.2	52.6	30	94	2	181	13.3
Foster	112.8	50.7	32	97	1	176	12.1
Baronesse	110.5	53.8	25	97	1	180	13.0
Excel	110.0	50.0	32	85	5	178	12.5
Gallatin	108.8	55.0	29	95	1	179	12.7
Coors 37	105.9	53.6	25	94	2	183	13.5
MT 981210	104.5	53.8	32	98	1	182	13.9
Drummond	103.7	51.1	33	93	2	178	12.8
Robust	103.1	51.2	33	86	3	177	12.9
Legacy	102.8	49.2	33	76	7	179	12.7
BA 1202	97.9	51.3	26	91	2	181	13.6
Conlon	97.1	55.5	29	99	1	174	13.5
Stander	95.7	51.0	35	88	3	180	12.7
Garnet	94.8	52.8	31	96	1	183	12.8
Merit	92.5	49.4	30	83	6	185	13.6
Morex	91.0	50.1	35	88	3	178	13.0
Harrington	89.3	52.1	30	91	2	182	12.9

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
Fertilizer: 51-52-00 (N-P-K)
Previous crop: Fallow. Date seeded: April 23, 2003. Date harvested: Aug. 12, 2003 Moisture Data: Rainfall from planting to harvest was 4.71" with two applications of sprinkler irrigation. (approx. 3.5" each) Yield exp. mean = 106.81 Error degrees of freedom = 46.00 F test for var. = 2.56 --- C.V. 2 = 5.98 --- LSD (0.05) = 18.17

Table 32 **Four-year summary** for **Irrigated Malt Barley** varieties grown north of **Conrad, MT.** 2000 - 2001 - 2002 - 2003. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety	4-year comparable average						
	Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	% Plump	% thin	Head date *	% Protein
BARONESSE	104.2	53.4	27.3	94	2	181	11.6
STRATUS	101.4	51.4	26.9	92	2	183	12.0
METCALFE	100.2	51.9	29.6	92	2	181	12.2
KENDALL	98.7	52.3	28.8	94	2	183	12.1
BUSCH AG. 1202	94.2	51.2	27.8	95	1	181	12.1
GALLATIN	93.8	53.7	31.3	93	2	180	11.6
MERIT	93.1	49.8	29.0	82	4	184	11.7
FOSTER	92.3	49.7	31.0	92	2	178	11.8
EXCEL	91.1	49.7	31.5	86	3	180	11.4
COORS 37	89.6	52.3	24.5	93	3	182	11.9
LEGACY	88.9	49.2	32.3	83	5	181	11.5
HARRINGTON	88.7	50.8	29.3	90	3	182	11.8
DRUMMOND	87.3	50.2	33.0	90	2	180	12.0
GARNETT	87.2	52.2	30.6	94	1	182	12.0
CONLON	86.6	53.0	28.2	92	2	177	11.9
ROBUST	80.9	50.1	33.5	84	4	179	11.8
STANDER	78.2	50.6	31.3	91	3	181	12.1
MOREX	66.7	49.6	32.5	81	5	179	12.5

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
* = Head date based on three years only. (2001 - 2002 - 2003)

Table 33 **Dryland Barley** variety trial grown north of **Cut Bank**, 2003. 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
Conlon	67.9	50.3	34	89	3	13.9
MT 960099	59.5	46.9	32	14	47	14.1
Hays	58.3	43.3	30	18	45	14.1
MT 970155	58.0	46.9	30	30	23	13.6
Haxby	57.3	48.2	33	8	43	13.8
MT 970116	55.7	48.3	35	39	25	13.8
MT 970229	55.1	49.2	31	53	14	14.5
MT 970148	54.8	44.2	31	31	25	13.9
WPB Xena	51.0	45.2	32	13	46	16.1
Valier	50.8	46.1	34	8	54	15.4
Gallatin	49.8	44.3	30	23	43	15.1
MT 960228	47.7	44.0	31	12	52	15.2
Baronesse	47.6	42.1	30	7	58	15.9
Harrington	46.4	44.0	31	20	40	15.8
MT 960101	46.1	43.7	29	14	53	15.1
Haybet	44.0	39.7	33	2	87	15.5

Cooperator: Kevin Bradley.
Location: Fifteen miles north of Cut Bank, MT. (Glacier Co.)
Applied fertilizer: 71-52-0 (N-P-K)
Date seeded: April 24, 2003.
Date harvested: August 18, 2003.
Previous crop: No-till chem fallow (wheat stubble)
Yield experimental mean: 53.12
Error degrees of freedom: 30
F test for var: 2.11
C.V. 2: 8.19
LSD (0.05): 12.56

Table 34 **Five-year** summary for **Dryland Barley** varieties grown near **Cut Bank, MT.** 1999 - 2000 - 2001 - 2002 - 2003. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety	5 - year comparable average					
	Yield bu/ac	Test wt. lbs/bu.	Plant hgt.* inches	% Plump	% thin	% Protein
XENA	52.7	50.5	29	61	15	14.7
CONLON	52.4	52.0	31	69	13	14.5
HAXBY	49.7	52.4	30	52	18	14.7
MT 960228	47.5	50.2	28	50	22	15.0
MT 960099	49.6	50.7	27	37	28	14.9
GALLATIN	48.4	50.0	30	54	19	15.6
BARONESSE	48.1	49.3	27	48	23	15.7
VALIER	46.9	50.4	29	37	28	16.2
HARRINGTON	44.7	49.4	27	46	22	16.2

Cooperator: Kevin Bradley.
Location: Fifteen miles north of Cut Bank. (Glacier County)
* = Plant heights based on 4 years average. (1999-00-01-2003)

Table 35 **Dryland Barley** variety trial grown east of **Oilmont** 2003. 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
MT 970229	46.2	45.9	26	9	50	19.4
Baronesse	44.5	43.5	24	4	66	18.6
MT 970116	43.5	45.6	28	13	49	18.2
MT 970155	42.7	43.5	25	5	57	18.7
Haxby	42.4	43.1	26	14	41	18.4
MT 960228	40.4	43.1	23	3	70	18.2
Valier	38.8	45.4	26	3	66	19.3
Conlon	37.0	47.2	26	68	9	16.7
Haybet	34.0	39.7	26	2	77	17.9
Metcalf	33.9	43.2	26	-	-	-
Gallatin	33.3	43.9	26	7	59	18.7
Hays	32.0	40.9	23	6	55	17.3
WPB Xena	31.7	49.0	26	11	47	17.5
Harrington	28.8	43.4	26	22	34	18.0
MT 960101	28.4	41.8	23	4	69	19.2
MT 960099	27.9	43.6	23	6	64	18.3
MT 970148	27.4	43.6	23	22	32	17.5

Cooperator: Terry Alme.
Location: Eight miles east of Oilmont, MT. (Toole County)
Fertilizer: 100# 11-52-0 with the seed.
Previous crop: Fallow.
Date seeded: April 22, 2003.
Date harvested: August 5, 2003.
Stored soil misture at seeding was 5 inches.
Yield experimental mean: 36.19
Error degrees of freedom: 30
F test for var.: 10.94
C.V. 2: 5.47
LSD (0.05): 5.72

Table 36 **Four-year** summary for **Dryland Barley** varieties grown near **Oilmont.** (1998 - 1999 - 2000 - 2003) 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
HAXBY	55.4	48.3	26	45	27	15.5
MT 960228	52.4	45.3	25	20	43	15.8
BARONESSE	48.0	46.7	22	28	41	16.9
XENA	46.8	48.4	26	33	31	15.6
CONLON	46.1	50.4	24	44	19	15.0
GALLATIN	44.1	46.6	25	29	40	16.4
VALIER	43.9	47.8	24	14	46	17.1
MT 960099	42.9	47.3	23	10	50	16.5
HARRINGTON	40.8	46.2	24	37	28	16.5

Cooperator: Terry Alme.
Location: Eight miles east of Oilmont, MT. (Toole County)

Table 37 **Dryland Barley** variety trial grown northeast of **Choteau**, 2003. 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
MT 970229	76.2	47.2	32	38	20	16.9
MT 970116	74.7	48.1	36	41	22	16.9
Conlon	74.0	48.9	30	77	8	15.3
Haxby	72.6	50.0	32	16	32	16.5
MT 960099	71.9	43.8	27	6	67	17.0
MT 970148	71.5	44.5	30	34	23	15.8
MT 960228	67.1	45.0	31	42	9	16.4
MT 970155	65.8	45.9	32	26	21	17.4
Gallatin	65.6	45.8	32	16	35	17.5
Hays	65.4	39.2	31	8	52	16.9
MT 960101	65.3	43.2	30	6	61	17.7
WPB Xena	64.4	44.0	30	18	35	18.1
Valier	64.2	45.2	32	5	58	17.8
Harrington	64.0	42.3	32	12	41	17.4
Baronesse	62.0	43.2	29	6	50	17.7
Haybet	61.3	40.6	34	2	68	18.3

Cooperator: Roy Inbody.
Location: Twelve miles northeast of Choteau, MT.(Teton, County)
Applied fertilizer: 130-52-0 (N-P-K)
Previous crop: No-till chem fallow.
Date seeded: April 22, 2003.
Date harvested: Aug. 6, 2003.
Rainfall: From May 10 to harvest was 3.5 inches.
Yield experimental mean: 67.88
Error degrees of freedom: 30
F test for var.: 6.63
C.V. 2: 2.75
LSD (0.05): 5.39

Table 38 **Five-year** summary for **Dryland Barley** varieties grown near **Choteau.** (1998 - 1999 - 2000 - 2001 - 2003) Montana Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety	5 - year comparable average					
	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Plump	% thin	% Protein
HAXBY	68.6	51.6	34	16	41	17.1
CONLON	64.6	48.7	31	38	37	17.1
MT 960228	61.0	47.0	33	24	38	17.1
XENA	59.5	47.1	31	28	37	16.8
MT 960099	58.8	46.0	28	5	70	18.6
BARONESSE	58.4	48.1	30	31	31	18.4
VALIER	56.3	48.0	32	8	62	18.2
GALLATIN	54.9	47.3	31	15	47	18.1
HARRINGTON	48.3	45.2	32	19	45	18.1

Cooperator: Roy Inbody.
Location: Twelve miles northeast of Choteau, MT. (Teton County)

Table 39 **Dryland Barley** variety trial grown east of the **Knees**, 2003. 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
MT 970116	69.8	47.5	38	44	19	15.0
MT 970148	69.4	44.2	31	29	24	14.6
Conlon	67.7	51.9	33	90	2	14.3
Gallatin	67.1	46.1	34	20	31	15.6
Haxby	66.7	50.4	32	23	24	14.5
WPB Xena	64.5	43.2	32	18	38	16.5
Baronesse	63.3	44.5	32	5	58	16.5
Hays	63.3	42.1	33	15	41	15.0
MT 970229	63.2	43.3	31	50	12	14.7
MT 960228	62.8	44.9	32	15	30	15.0
Haybet	62.7	41.6	36	2	67	15.9
Valier	62.0	44.2	32	4	55	16.3
MT 960099	61.9	44.0	28	8	56	15.4
MT 970155	60.7	44.0	31	13	36	16.5
Harrington	60.5	41.7	32	17	38	16.7
MT 960101	54.9	41.8	30	2	76	16.5

Cooperator: Dan Picard.
Location: Thirty miles east of Brady, MT. (Chouteau, County)
Applied fertilizer: 51-52-0 (N-P-K)
Previous crop: No-till chem fallow (wheat stubble).
Date seeded: April 22, 2003.
Date harvested: July 28, 2003.
Stored soil moisture at seeding: 7 inches.
Rainfall: From June 1 to harvest was 2.1 inches.
Yield experimental mean: 63.78
Error degrees of freedom: 30
F test for var.: 3.04
C.V. 2: 3.38
LSD (0.05): 6.22

Table 40 **Five-year** summary for **Dryland Barley** varieties grown near the **Knees**. (1999 - 2000 - 2001 - 2002 - 2003) Montana Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety	5 - year comparable average					
	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Plump	% thin	% Protein
BARONESSE	52.9	46.9	25	33	33	17.1
HAXBY	52.1	51.4	27	43	24	15.5
MT 960228	50.9	47.4	26	33	28	15.7
XENA	50.9	46.7	28	41	26	15.7
MT 960099	49.9	46.9	24	23	46	16.6
GALLATIN	49.5	47.4	28	35	31	16.2
VALIER	46.6	47.7	27	30	37	17.1
CONLON	47.4	48.3	26	47	19	15.7
HARRINGTON	44.7	45.7	26	39	28	16.8

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

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

Year: 2003.

Location: Western Triangle Research Center, Conrad, MT.

Personnel: Gregory D. Kushnak, Research Center, Conrad; Luther Talbert and Pat Hensleigh, 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 2002, fallow in 2001, and barley in 2000. 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 50 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 2003, along with 5-year averages, are presented in Tables 41 and 42 for spring wheat, and Tables 43 and 44 for barley.

Averaged over five years, Outlook, Reeder, Conan and Ernest ranked high for recrop yield performance. Choteau and Fortuna ranked slightly lower, but were among the highest performers for both yield and test weight in the very dry conditions of 2003. Choteau, Outlook, and Reeder also had good performance on fallow conditions.

Among the barley varieties, Haxby and Valier had the highest recrop performance for both yield and test weight. Similarly, Haxby and Valier had good performance in fallow conditions.

Levels of disease were minimal for no-till in 2003, 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 41 **Dryland Recrop No-till Spring Wheat** variety trial grown north of **Conrad,** 2003. 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
WESTBRED 936		38.0	55.3	30	179	13.2
OUTLOOK		37.1	52.9	32	184	13.2
RAMBO	*	35.7	53.3	30	182	12.8
FORTUNA	*	35.2	56.4	38	180	14.0
LEW	*	34.7	51.6	37	183	13.4
CHOTEAU (MT 9929)	*	34.6	56.7	30	183	13.5
ERNEST	*	34.0	56.1	36	181	13.7
WESTBRED 926		33.1	52.1	28	179	14.1
Conan	*	32.7	54.1	30	182	14.2
NEWANA		32.1	50.8	29	182	13.2
MTHW 9420	**	31.7	54.1	29	181	13.4
Reeder		31.5	53.6	30	181	14.2
MT 9918		31.2	56.2	34	180	13.6
HANK		31.2	52.1	30	180	14.3
HI-LINE		31.0	56.1	30	180	14.4
EXPLORER	**	30.7	54.2	30	181	14.2
SCHOLAR	*	30.5	55.5	35	183	13.8
AMIDON	*	29.8	52.1	36	181	13.0
WESTBRED EXPRESS		29.5	54.8	28	181	13.8
MCNEAL		28.8	54.0	33	181	14.1

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.
Date seeded: April 24, 2003, into no-till standing stubble.
Date harvested: August 6, 2003.
Rainfall: From planting to harvest was 4.78 inches.
* = Sawfly resistant varieties. (Amidon, Conan, Rambo and Scholar have partial resistance.)
** = Hard white wheat.
Yield experimental mean: 32.64
Error degrees of freedom: 38
F test for var: 1.03 ---- C.V. 2: 7.76 ---- LSD (0.05): 7.25

Table 42 **Five-year summary** for **No-till Recrop Spring Wheat** varieties grown near **Conrad, MT.** 1999 - 2000 - 2001 - 2002 - 2003. Mont. Agr. Expt. Station, Western Triangle Agr. Research Center, Conrad, MT.

		5 - year comparable average				
Variety		Yield bu/ac	Test wt lbs/bu	Plant hgt. inches	Head date @	% Protein
OUTLOOK		31.9	56.5	27	182	14.4
WESTBRED 936		30.8	58.7	25	181	15.0
REEDER		30.4	58.5	27	182	14.9
WESTBRED 926		30.4	57.8	26	182	15.2
CONAN	*	29.8	58.4	26	180	14.8
ERNEST		29.6	59.2	30	179	14.7
NEWANA		29.6	57.2	25	182	13.7
RAMBO	*	29.5	57.7	26	182	14.0
LEW	*	29.2	55.0	29	182	14.0
HI-LINE		29.0	58.9	26	179	15.2
CHOTEAU	*	28.7	58.4	25	181	15.0
FORTUNA	*	28.5	58.7	31	180	14.4
HANK		28.4	56.4	26	183	15.3
EXPLORER	**	28.2	58.7	26	181	15.0
MTHW9420	**	28.2	57.6	25	181	14.0
SCHOLAR	*	28.1	58.0	31	179	15.0
MCNEAL		27.9	56.8	28	180	14.4
WESTBRED EXPRESS		26.5	58.3	24	182	14.7
AMIDON	*	26.5	55.6	31	180	14.0

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. (1999-01-02-03)

Table 43 **Dryland Recrop No-till Barley** variety trial grown north of **Conrad**, 2003. Mont. Agr. Expt. Station, Westerm Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test wt. lb/bu	Plant hgt. inches	% Plump	% Thin	Head Date	% Protein
MT 960099	58.5	47.6	25	38	28	185	10.9
MT 970229	58.5	49.4	28	61	9	184	11.4
Haxby	58.4	51.1	26	25	32	182	11.4
Valier	55.6	49.1	28	36	25	185	12.0
MT 970116	54.7	49.1	31	44	22	182	11.9
WPB Xena	54.1	46.9	28	54	15	184	11.7
Conlon	51.3	46.0	28	67	13	180	11.3
Hays	50.7	43.5	27	19	38	186	12.6
MT 970148	48.7	44.3	26	30	30	182	11.9
MT 960228	48.4	46.6	28	14	44	186	13.2
Baronesse	47.8	44.9	26	13	48	184	13.1
MT 960101	47.5	46.1	27	24	31	186	12.9
MT 970155	46.5	46.6	27	36	22	185	12.9
Gallatin	45.0	44.4	28	22	37	182	12.7
Harrington	43.4	44.5	27	30	31	184	13.2
Haybet	37.3	43.5	31	4	65	180	12.8

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
Applied fertilizer: 61-52-0 (N-P-K)
Previous crop: Barley.
Method of seeding: Double-disc drill into standing stubble.
Date seeded: April 22, 2003.
Date harvested: Aug. 4, 2003.
Rainfall: From planting to harvest was 4.8 inches.
Yield experimental mean: 50.40
Error degrees of freedom: 30
F test for var.: 7.30
C.V. 2: 4.41
LSD (0.05): 6.41

Table 44 **Five-year** summary for **Recrop Dryland No-Till Barley** varieties grown north of **Conrad, MT.** 1999 - 2000 - 2001 - 2002 - 2003. Mont. Agr. Expt. Station, Western Triangle Agr. Res. Center, Conrad, MT.

	5 - year comparable average						
Variety	Yield bu/ac	Tst wt lbs/bu	Plant hgt. inches	% Plump	% thin	Head date *	% Protein
MT 960099	51.0	48.9	22	38	34	183	14.1
HAXBY	50.7	51.8	24	56	23	181	13.8
XENA	49.8	49.1	25	57	20	183	13.5
VALIER	48.9	50.8	24	53	24	184	14.6
MT 960228	48.5	48.9	25	46	28	183	14.2
BARONESSE	48.5	48.7	24	50	25	183	14.3
GALLATIN	46.9	47.9	25	50	29	182	14.2
HARRINGTON	45.0	47.9	24	55	24	184	14.6
CONLON	44.9	47.8	24	54	21	181	13.9

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
* = Head dates based on 4 years average. (1999-2001-2002-2003)

Title: Effect of planting date, planting rate, and hybrid on canola.

Year: 2003.

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

Personnel: Grant Jackson and John Miller, Western Triangle Ag. Research Center, Conrad, MT
Chengci Chen, Central Ag. Research Center, Mocassin, MT.

Objectives: To study the response of canola to planting date and rate.

Procedures: Two herbicide tolerant canola hybrids (357 RR and 223 RR) were planted on three dates, April 25, May 13, and June 3, with planting rates of 1, 3, 6, and 9 seeds/ft^2. Plots were planted into barley stubble, no-till with a six row, 12" row spaced plot drill. Plots were fertilized, while planting, with 145-30-30-20. Phosphorus fertilized was seed placed and all fertilizer materials were broadcast. Fertilizers used were urea, ammonium phosphate, KCl, and ammonium sulfate. Plots were swathed with a Swift Machine, small plot swather and threshed with a Hege small plot combine.

Results:

Results are shown in Table 45. Canola yields were greatly affected this year because of the lack of significant precipation during July and high air temperatures during flowering and pod fill. Planting rate and date results are consistent with current canola production guidelines.

Table 45. Effect of hybrid, planting date, and planting rate on the yield of canola. Western Triangle Ag. Research Center, Conrad, MT. 2003.

Hybrid and Planting Rate seeds/ft^2	Planting Date	
	April 25 (lbs/acre)	May 13 (lbs/acre)
223 1	207	61
223 3	303	115
223 6	492	265
223 9	635	376
357 1	130	66
357 3	228	109
357 6	381	265
357 9	476	361
Mean	**356**	**202**
P-value for planting date	0.0000	
Planting Rate Summary		
1	168	63
3	265	112
6	437	265
9	555	369
P-value for planting rate	0.0000	
P-value, linear contrast	0.0000	
P-value, date x rate interaction	0.5392	
Hybrid Summary		
223	409	303
357	303	200
P-value	0.0114	
P-value, date x hybrid interaction	0.0188	
Statistical Summary		
Overall Mean	279	
P-value, date x rate x hybrid interaction	0.9235	
CV (%)	29.8	

For soil test results see page 69.

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

Year: 2003

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

Personnel: Grant Jackson and John Miller, Western Triangle Ag. Research Center.
Perry Miller, Land Resources and Environmental Science Dept.

Objectives: 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 barley stubble, no-till 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 – Yuma) – 3 and 6 pls/ft^2 and desi chickpea (cultivars- Amit and Myles) and dry pea (cultivar-Espace) – 4 and 8 pls/ft^2. 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 46 and Figures 1 - 4. Chickpea data were affected by early and differential infection of *Ascochyta* that gradually disappeared due to the hot and dry weather that dominated the region for about 10 weeds starting about June 20. Also pea yields were reduced by extensive shatter. Generally both pea and chickpea responded to high irrigation levels this year. However this year chickpea had higher yields than pea probably due to the excessive shattering of pea. Experiment will be repeated one more year.

Soil Test Summary

Depth	K	Olsen P	EC	OM	pH
	ppm		mmhos/cm	%	
0 - 6"	234	10	0.96	2.1	7.9

Depth (ft)	NO_3-N	SO_4-S
	(lbs/a)	
0 – 1	10	124
1 – 2	4	345
2 – 3	4	632
3 – 4	6	652

Table 46. Effect of irrigation, planting rate, and cultivar on seed yield and 1000 seed weight of chickpea and pea. The experiment was located at Western Triangle Ag. Research Center, Conrad, MT. 2003.

Variety[1]	Planting Rate[2]	Water Level	Seed yield (lb/a)	1000 Seed Weight (gm)
Amit	Dryland	High	3446.6	244.5
Amit	Irrigated	Medium	3419.8	259.4
Amit	Irrigated	High	3372.0	232.8
Myles	Irrigated	Medium	3112.9	185.0
Amit	Dryland	Medium	3062.4	252.1
Espace	Dryland	High	2866.8	246.9
Myles	Dryland	High	2752.3	179.6
Myles	Irrigated	High	2642.8	176.9
Myles	Dryland	Medium	2582.2	192.5
Amit	Irrigated	Low	2474.3	264.5
Yuma	Irrigated	High	2429.9	406.0
Espace	Irrigated	Medium	2118.6	238.3
Yuma	Dryland	High	2115.6	404.1
Espace	Irrigated	High	2049.0	243.3
Yuma	Irrigated	Medium	2016.3	410.3
Espace	Dryland	Low	1981.8	204.3
Amit	Irrigated	Dryland	1941.4	254.0
Yuma	Dryland	Medium	1891.0	390.8
Yuma	Dryland	Dryland	1714.4	426.1
Amit	Dryland	Dryland	1672.7	274.5
Myles	Dryland	Low	1563.0	186.3
Espace	Dryland	Dryland	1521.2	179.8
Espace	Irrigated	Dryland	1504.4	176.1
Espace	Irrigated	Low	1488.7	184.8
Espace	Dryland	Medium	1487.3	236.6
Amit	Dryland	Low	1483.5	270.3
Myles	Irrigated	Low	1368.4	186.1
Myles	Irrigated	Dryland	1279.7	180.4
Yuma	Irrigated	Low	1224.8	362.5
Yuma	Irrigated	Dryland	1190.8	402.6
Yuma	Dryland	Low	1087.2	451.8
Myles	Dryland	Dryland	999.0	177.9

[1] Chickpea: Desi = Amit and Myles; Kabuli = Yuma. Dry pea = Espace

[2] Seeding Rate: Desi and Dry Pea = 8 pls/ft^2 for irrigated; 4 pls/ft^2 for dryland. Kabuli = 6 pls/ft^2 for irrigated; 3 pls/ft^2 for dryland.

Summary Statistics

Experimental Means	2063.5	264.2
Error Mean Square	827.1	28.2
Interaction P-value	0.8337	0.3105
C.V.: (s/mean)*100	40.1	10.7
LSD (0.05)	NS	NS

Variety Summary

Variety	Seed yield (lb/a)	1000 Seed Weight
Espace	1888.7	214.8
Myles	2037.5	183.1
Amit	2636.9	255.8
Yuma	1728.8	405.3
P-value	0.0005	0.0000
LSD	431.7	14.5

Planting Rate Summary

Planting Rate[1]	Seed yield (lb/a)	1000 Seed Weight
Irrigated	2096.2	260.1
Dryland	2029.2	268.4
P-value	0.5550	0.0767
LSD	NS	NS

[1]Planting Rate: Desi and Dry Pea = 8 pls/ft^2 for irrigated; 4 pls/ft^2 for dryland.
Kabuli = 6 pls/ft^2 for irrigated; 3 pls/ft^2 for dryland.

Water Level Summary

	Seed yield (lb/a)	1000 Seed Weight
Dryland	1476.5	261.5
Low	1573.9	257.1
Medium	2441.9	270.6
High	2709.4	266.8
P-value	0.0000	0.3457
LSD	431.7	NS

Precipitation and Applied Water

Water Level	Total Irrigation Water (inches)	Total Precipitation (inches)	Total Water (inches)
Low	2.3	9.6	11.9
Medium	7.4	9.6	17.0
High	8.7	10.4	19.1
Dryland Pea	0.6	9.4	10.0
Dryland Chickpea	0.6	9.5	10.1

Notes:
Seeding Date: 5/14/03 Threshed: 8/4/03[4]; 8/26/03[5]; 9/3/03[6], 9/18/03[7]
Previous Crop: Barley stubble
Herbicide: Sprayed with Spartan® at 4oz/a on 4/7/03, and with Poast® at 1.5 pt/a on 6/12/03.
Fertilizer: 6 lbs N/a, 30 lbs/a P_2O_5 as mono-ammonium phosphate and 30 lbs/a KCl.
[4] Direct cut pea in dryland band.
[5] Direct cut chickpea in dryland band and low irrigation rate pea.
[6] Direct cut medium and low irrigation rates and high irrigation rate pea.
[7] Direct cut high irrigation rate chickpea.

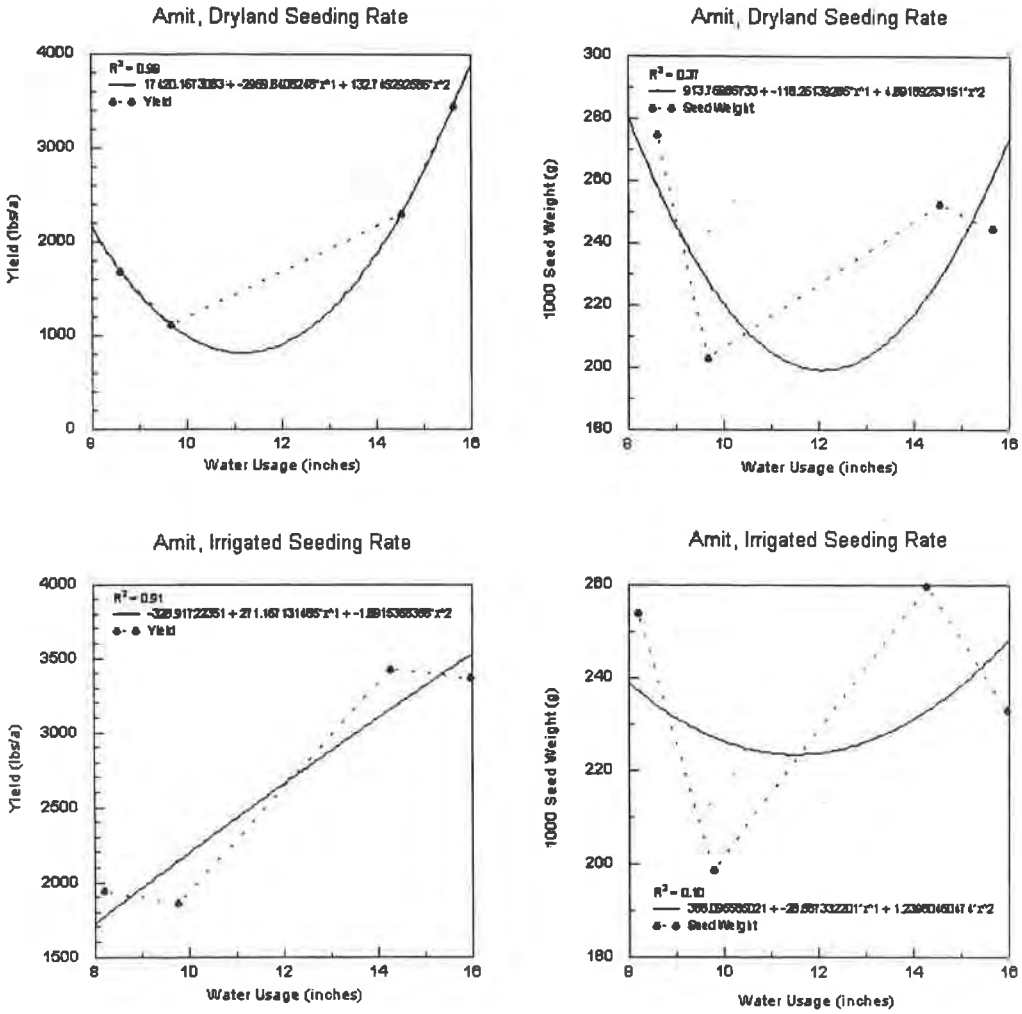

Figure 1. Effect of water use and planting rate on seed yield and weight of Amit Chickpea.

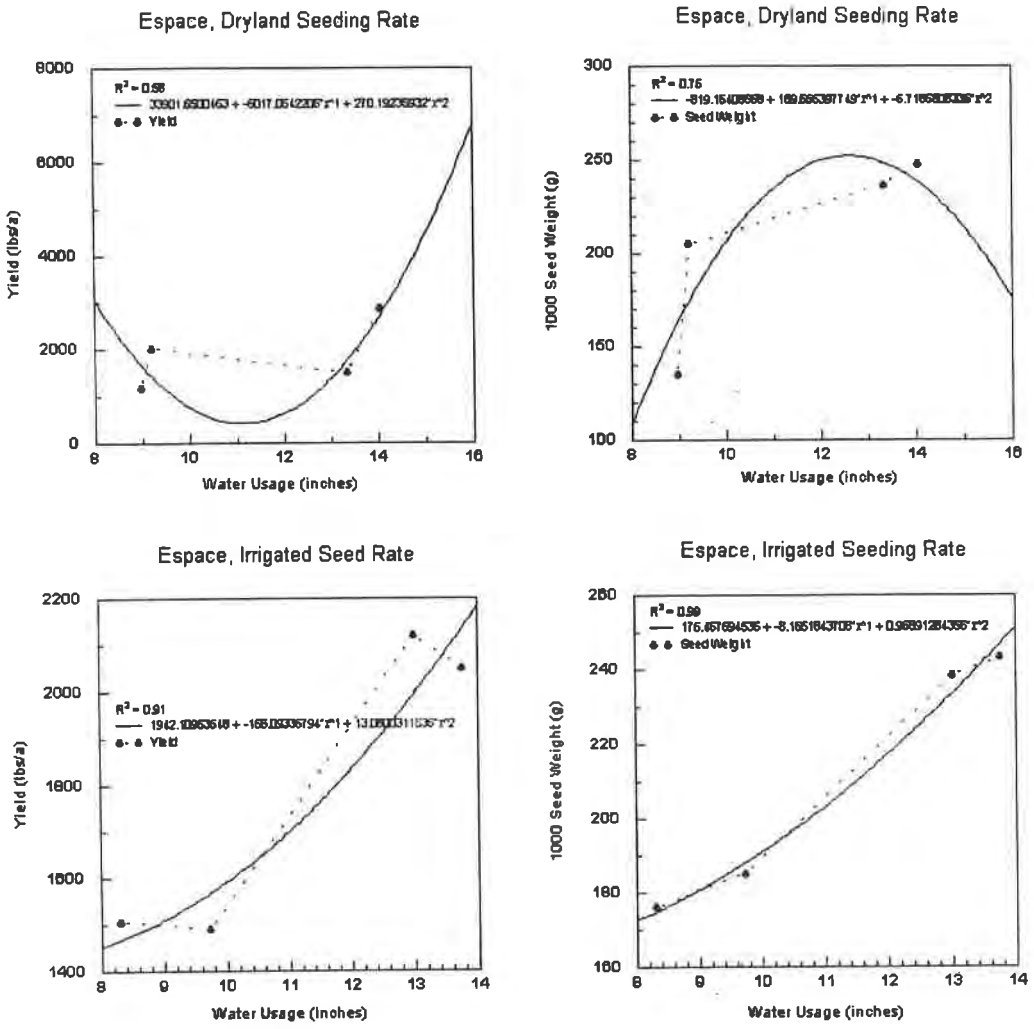

Figure 2. Effect of Water Use and Planting Rate on the seed yield and weight of Espace Pea.

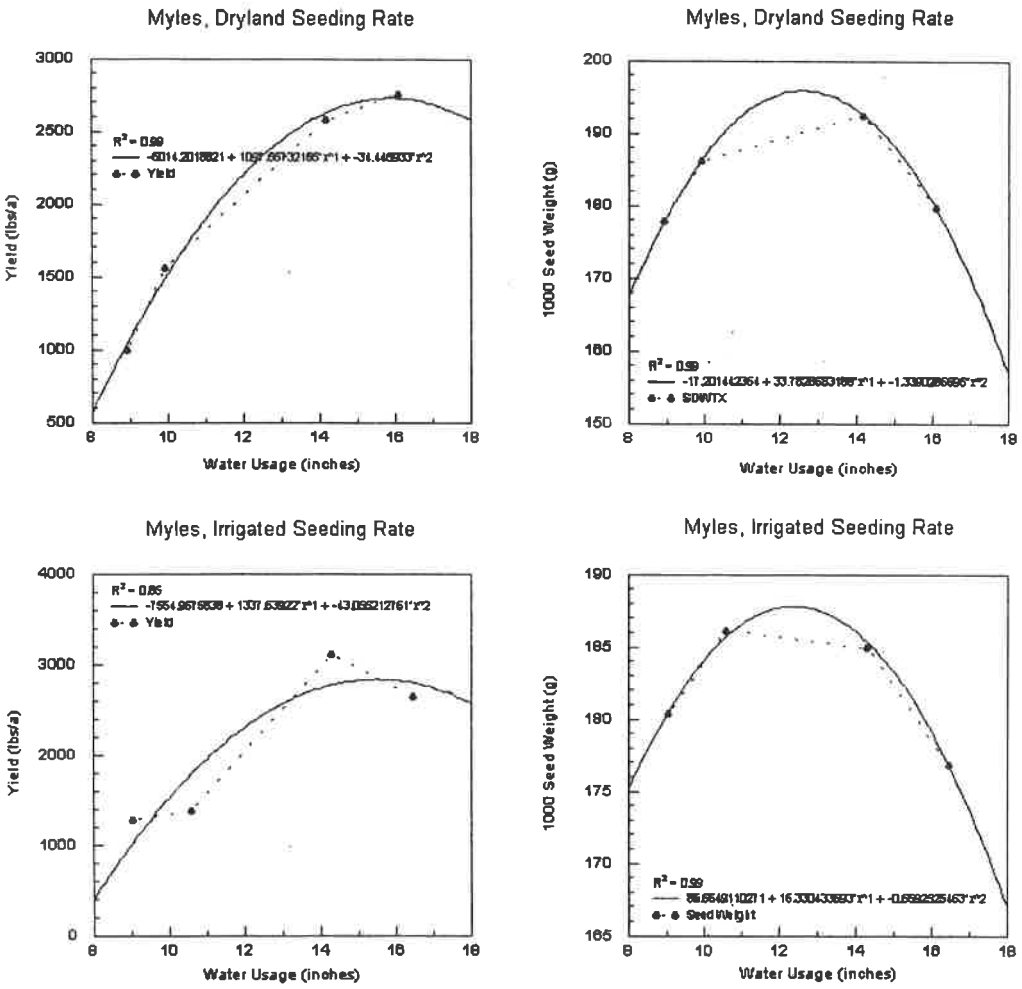

Figure 3. Effect of Water Use and Planting rate on seed yield and weight of Myles Chickpea.

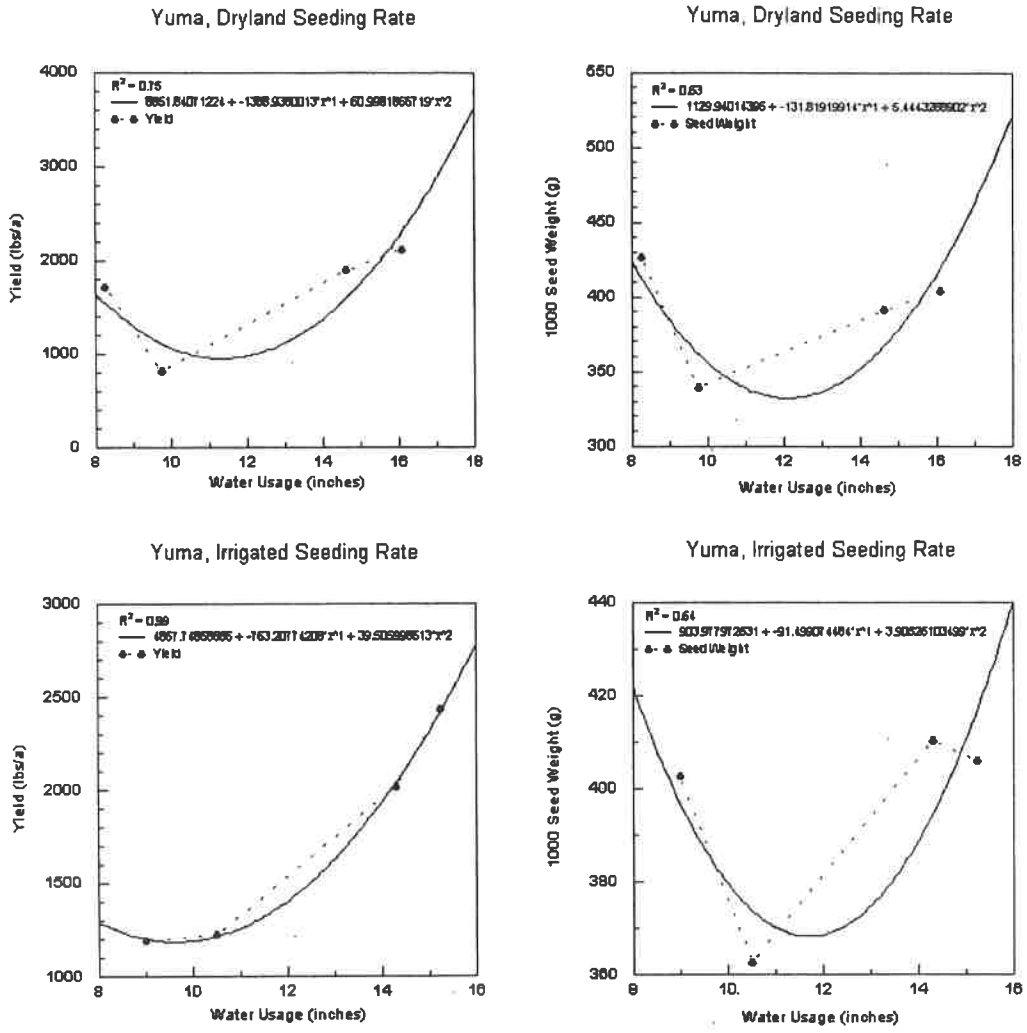

Figure 4. Effect of Water Use and Planting Rate on seed yield and weight of Yuma Chickpea.

Title: Dryland Chickpea Variety Performance Trial.

Year: 2003.

Location: Western Triangle Agricultural Research Center, Conrad, MT 59425.

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

Objectives: To evaluate chickpea varieties under dryland-fallow conditions.

Procedures: Plots were planted into fallow with a six-row plot drill using 12" row spacing. Seeding rate was about five seeds/ft^2. Granular innoculum and P fertilizer (60 lbs 11-52-0) were placed with the seed. Twenty five lbs of K as KCl was broadcast while planting. Plot size was six by 25 feet with four replications. Plots were direct cut with a Hege plot combine. Yield data reflect a moisture content of about 9%.

Results: Seed yield and1000 seed weight are summarized in Table 47. No evidence of *ascochyta* was noted this year.

Table 47. Dryland chickpea performance nursery trial located at Western Triangle Agricultural Research Center, Conrad, MT. 2003.

Variety	Seed Yield (lbs /a)	1000 Seed Wt. (g)	Flowering Date
Anna	2327 a	213 d	June 26
Amit	2171 ab	268 c	June 30
Myles	2027 bc	198.8 d	June 26
Sierra	1955 cd	516.6 a	July 2
Yuma	1802 d	411.6 b	June 30
Dwelley	1616 e	532.6 a	July 2

Summary Statistics

Experimental Means	1983	356.8	
Error Mean Square	12933	135.46	
P-Value	0.0000	0.0000	
C.V. 1: (s/mean)*100	5.7	3.3	
LSD (0.05)	171	17.5	

Notes:
Planted: April 28 Harvested: 8/25/03 then Dwelley and Sierra on 9/3/03.
Previous Crop: Fallow Growing Season ppt.: 3.9"
Herbicide: Sprayed with Spartan on 4/1/03 at 4 oz/a and with Roundup Ultra Max at 2 qt/a on 5/12/03.

See Soil Test Summary in the Sunflower and Flax Section

Title: Phosphorous Fertilizer for chickpea, lentil, and pea.

Year: 2003.

Location: Cut Bank, MT, David Broberg farm.

Personnel:

Grant Jackson and John Miller, Western Triangle Ag. Research Center, Conrad, MT 59425.
Chengci Chen, Central Ag. Research Center, Mocassin, MT.

Objectives: Investigate phosphorus (P) fertilizer response in pea, lentil, and chickpea in central and north central Montana low P soils.

Procedures: Three varieties of chickpea, lentil, and pea, planted in a factorial arrangement with 0, 15, 30, and 45 lbs P_2O_5/acre, were grown on land previously in spring wheat, no-till. Phosphorus fertilizer source was triple super phosphate (0-45-0), and 30 lbs KCl was applied while planting on the entire experiment. Plots were planted with a no-till nursery planter, six rows wide with a 12" row space. Plot size was six by 25'. Spartan herbicide was applied preplant on the chickpea and pea area while Prowl herbicide was incorporated with a harrow on the lentil area. Grassy weeds in the plot area were treated with Poast. Chickpea and lentil were harvested by direct cut while the pea was swathed before threshing. Pea swathes were held in place and protected from the wind by netting staked over the windrows.

Results: Results are shown in Table 48. A noticeable P response was noted in June, but drought conditions during July and August (no significant precipitation was measured) prevented the response from being measured. All seed yields were disappointing, average yields for chickpea, lentil and pea were 661, 770, and 1042 lbs/acre, respectively.

Soil Test Summary

Depth	K	Olsen P	EC	OM	pH
	---------- ppm ----------		mmhos/cm	%	
0 – 1 foot	510	6	0.76	2.4	7.9

Table 48. Effect of phosphorus fertilizer on Chickpea, Lentil, and Pea. Western Triangle Ag. Research Center, Conrad, MT. 2003

Chickpea		Lentil		Pea	
Treatment Variety (P rate)	Seed Yield	Treatment Variety (P rate)	Seed Yield	Treatment Variety (P rate)	Seed Yield
lbs P_2O_5/acre or lbs/acre					
Myles (0)	747	Brewer (0)	816	Integra (0)	1044
Myles (15)	747	Brewer (15)	711	Integra (15)	1111
Myles (30)	792	Brewer (30)	787	Integra (30)	1209
Myles (45)	683	Brewer (45)	732	Integra (45)	1137
Chico (0)	719	Richlea (0)	736	Majoret (0)	954
Chico (15)	679	Richlea (15)	796	Majoret (15)	1151
Chico (30)	775	Richlea (30)	728	Majoret (30)	1059
Chico (45)	675	Richlea (45)	781	Majoret (45)	1050
Yuma (0)	507	Vantage (0)	769	Mozart (0)	869
Yuma (15)	561	Vantage (15)	838	Mozart (15)	1051
Yuma (30)	514	Vantage (30)	747	Mozart (30)	936
Yuma (45)	536	Vantage (45)	804	Mozart (45)	969
Phosphorus Summary					
0	658	0	772	0	956
15	662	15	782	15	1091
30	693	30	754	30	1068
45	632	45	773	45	1051
P-value	0.4003	P-value	0.893	P-value	0.3857
LSD (0.05)	NS	LSD (0.05)	NS	LSD (0.05)	NS
Variety Summary					
Myles	742	Brewer	761	Integra	1126
Chico	712	Richlea	760	Majoret	1047
Yuma	530	Vantage	790	Mozart	967
P-value	0.0000	P-value	0.578	P-value	0.1002
LSD (0.05)	63	LSD (0.05)	NS	LSD (0.05)	NS
Statistical Summary					
Mean	661	Mean	770	Mean	1042
Interaction	NS	Interaction	NS	Interaction	NS
CV (%)	13.2	CV (%)	11.8	CV (%)	20.5

Notes:
Seeding Date: 4/22/03 Swathing Date: 7/24/03
Thrashing Date: Pea and Lentil: 7/31/03 and 8/14/03 for Chickpea
Growing Season ppt: 3.80
Previous Crop: Chemical Fallow

Title: Effect of crop rotation and phosphorus (P) fertilization on no-till, irrigated malting barley, durum wheat, and pea.

Year: 2003

Location: Western Triangle Ag. Research Center, Conrad, MT 59425

Personnel: Grant Jackson and John Miller, Western Triangle Ag. Research Center
Bill Grey, Dept. of Plant Sciences and Plant Pathology, MSU-Bozeman
Andrew W. Lenssen, Dept. of Entomology, MSU-Bozeman

Objectives:

1. Compare irrigated malt barley and durum wheat production in rotation with field pea.

2. Compare nitrogen and phosphorus dynamics of irrigated malt barley and durum wheat in rotation with pea inoculated with *Rhizobium leguminosarum* (N-Prove®), and *Rhizobium leguminosarum* plus *Penicillium bilaii* (TagTeam®).

Procedures:

Initial rotations were established in the spring of 2000 on burned barley stubble. The following rotations and P fertilizer treatments were established:
(1) continuous malt barley, with 0, 10, 20, and 30 lbs P_2O_5/a;
(2) continuous durum wheat, with 0, 10, 20, and 30 lbs P_2O_5/a;
(3) field pea inoculated with *Rhizobium leguminosarum* (N-Prove®) and 0, 10, 20, and 30 lbs P_2O_5, followed by #1 and #2;
(4) field pea inoculated with *Rhizobium leguminosarum* and *Penicillium balaii* TagTeam®) with P rates as in #3, followed by #1 and #2;
(5) #1, followed by #2, followed by #3;
(6) #1, followed by #2, followed by #4;
(7) #2, followed by #3, followed by #1;
(8) #2, followed by #4, followed by #1.

Plot size is 12 by 30 feet.

Results: Year 2003 was the fourth year of this study, so we are not yet able to compare production and quality of durum and barley in the various rotation treatments. However, comparisons can be made for phosphorus fertilization level within each crop. Malt barley and durum wheat yields and quality were not influenced by phosphorus fertilization levels (Tables 49 and 50). In general pea yield was improved with phosphorus fertilization (Table 51); however, yield of the Rhizobium + Penicillium inoculation treatment was significantly less than the Rhizobium only treatment.

Future Plans: We plan on continuing this trial for at least 6-9 years.

Table 49. Effect of P, *Rhizobium leguminosarum* (N-Prove®), and *Rhizobium leguminosarum* plus *Penicillium bilaii* (TagTeam®) on irrigated Espace pea seed yield. Experiment located at Western Triangle Ag. Research Center. Conrad, MT. 2003.

Crop Rotation	Phosphorus Rate (lbs P_2O_5/a)	Seed Yield (lbs/a)	Test Wt. (g)
3	30	1990.0	62.9
3	10	1821.3	63.1
4	30	1759	62.7
3	20	1692.0	63.5
4	10	1595.8	63.8
4	0	1595.8	63.2
3	0	1584.0	63.3
4	20	1142.0	63.6

Summary Statistics

Experimental Means		1627.7	63.3
Error Mean Square		311.2	0.64
Interaction P-value		0.3342	0.6130
C. V. 1:(s/mean)*100		19.1	1.01
LSD (0.05)		NS	NS

Pea Summary

3		1768.9	63.2
4		1495.3	63.3
P-value		0.0160	0.7301
LSD (0.05)		237.0	NS

Phosphorus Summary

	0	1540.1	63.2
	10	1628.9	63.5
	20	1417.0	63.5
	30	1874.9	62.8
	P-value	0.0539	0.1478
	LSD (0.05)	NS	NS

Zero Phosphorus, Inoculated Pea Summary

3		1584.5	63.3
4		1595.8	63.2
Experimental Means		1590.1	63.2
Error Mean Square		282.0	0.76
P-value		0.9586	0.7655
C. V. 1:(s/mean)*100		17.7	1.20
LSD (0.05)		NS	NS

Table 50. Effect of P, *Rhizobium leguminosarum* (N-Prove®), and *Rhizobium leguminosarum* plus *Penicillium bilaii* (TagTeam®) on irrigated Merit malt barley seed yield, test weight, and quality. Experiment located at Western Triangle Ag. Research Center. Conrad, MT. 2003.

Crop Rotation	P rate (lbs P_2O_5/a)	Yield (bu/a)	Test Wt. (lbs/bu)	Plump (%)	Thin (%)
6	30	75.9	50.0	91.4	2.0
5	10	69.3	49.5	90.4	2.2
5	30	69.0	50.7	91.2	1.9
5	20	66.6	49.7	91.7	1.8
6	10	65.7	49.9	88.8	2.9
5	0	64.2	54.0	88.5	3.2
6	20	64.2	49.6	90.5	2.2
1	30	57.0	49.6	90.7	2.2
6	0	55.8	49.4	90.5	2.5
1	10	55.1	49.3	90.3	1.9
1	0	49.6	49.1	88.3	2.8
1	20	46.5	49.7	90.6	2.2

Summary Statistics

Experimental Means	61.6	50.0	90.2	2.3
Error Mean Square	11.7	3.1	3.3	0.91
Interaction P-value	0.8473	0.6299	0.9194	0.6263
C. V. 1:(s/mean)*100	18.9	6.2	3.6	39.8
LSD (0.05)	NS	NS	NS	NS

Barley Summary

5		67.3	51.0	90.4	2.3
6		65.4	49.7	90.3	2.4
1		52.1	49.4	90.0	2.3
P-value		0.0014	0.3486	0.9243	0.8691
LSD (0.05)		8.4	NS	NS	NS

Phosphorus Summary

	0	56.5	50.8	89.1	2.8
	10	63.4	49.6	89.8	2.3
	20	59.1	49.7	91.0	2.0
	30	67.3	50.1	91.1	2.0
	P-value	0.1363	0.7597	0.4020	0.1499
	LSD (0.05)	NS	NS	NS	NS

Table 51. Effect of P, *Rhizobium leguminosarum* (N-Prove®), and *Rhizobium leguminosarum* plus *Penicillium bilaii* (TagTeam®) on irrigated Utopia durum seed yield, test weight and quality. Experiment located at Western Triangle Ag. Research Center. Conrad, MT. 2003.

Crop Rotation	P rate (lbs P_2O_5/a)	Yield (bu/a)	Test Wt. (lbs/bu)
7	20	58.0	61.5
2	20	57.9	61.9
7	10	55.4	61.5
8	20	55.3	61.5
8	10	53.4	61.3
2	30	51.1	61.9
7	30	49.7	60.4
8	30	47.6	59.5
8	0	44.1	61.6
2	0	40.6	61.4
7	0	40.6	61.2
2	10	39.8	62.1

Summary Statistics

Experimental Means		50.6	61.3
Error Mean Square		10.9	1.4
Interaction P-value		0.5077	0.6808
C. V. 1:(s/mean)*100		21.5	2.3
LSD (0.05)		NS	NS

Durum Summary

7		54.4	61.2
8		50.1	61.0
2		47.3	61.9
P-value		0.1919	0.1766
LSD (0.05)		NS	NS

Phosphorus Summary

	0	46.4	61.4
	10	49.5	61.7
	20	57.1	61.6
	30	49.5	60.6
	P-value	0.1205	0.2226
	LSD (0.05)	NS	NS

Title: Evaluation of Sunflower and Flax as potential feed stock for biofuels or lubricants.

Year: 2003

Locations: Western Triangle Ag. Research Center
Knees area east of Brady (Picard farm)
Choteau area (Inbody farm)
Cut Bank area (Bradley farm)
Sunburst area (Karst farm)
Joplin area (Moog farm)

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

Objectives: To determine the seed yield and seed oil quality of flax and sunflower in north central Montana. To evaluate sunflower planting rates for optimum seed and oil yield.

Procedures:

Twenty NuSun sunflower lines and three flax lines were planted at six locations with a six-row, 12-inch spaced planter. Plot size was 6 by 25 feet. All locations were planted no-till into previously fallowed land or following barley, recrop. Plot areas were fertilized with 30 lbs/acre of 11-52-0 applied with the seed and 30 lbs/acre of 0-0-60 applied broadcast while planting. At the recrop site, Sunburst, 70 lbs of nitrogen as urea was applied broadcast while planting. Plant population for the sunflower trial was 25,000 seeds/acre, and the planting rate for flax was 30 lbs/acre. In addition, a sunflower population study was planted at three locations with planting rates varying from 14,000 to 32,000 seeds/acre in 2000 seed increments. Seed yield, oil content, and fatty acid profile will be determined for each flax and sunflower line as well as the population study. Weeds were controlled (with labeled rates) in sunflower with Spartan and Poast herbicides and in flax with Bronate and Poast.

Results:

Seed yields of sunflower and flax are shown in Tables 52, 54, 55, and 56. Overall both oil seeds averaged about the same, 800 lbs/acre. The sunflower location at WTARC was lost due to black birds. Cl 308 and MG 7350 seemed to have the most stable ranking. The sunflower (Table 53) population study was inconclusive probably due to the drought conditions and poor hybrid selection for the study.

Table 52. Sunflower hybrid evaluation trials: Seed yield and plant height. Western Triangle Ag. Research Center, Conrad. 2003.

	Location (Cooperator)					
	WTARC	Inbody	Picard	Moog	Karst	Bradley
Hybrid	Plt Ht, in.	Seed Yield in lbs/acre - Rank				
Cl 308	48	745-4	964-3	988-3	1447-3	773-7
Cl 322	54	541-15	793-8	635-17	1226-15	628-14
Cl 340	50	539-17	741-15	692-14	965-20	600-18
Cl 345	57	838-2	770-10	**1048-1**	1437-4	715-8
Cl 385	54	642-12	763-11	859-6	1365-8	624-15
IT 536	47	502-19	727-16	729-11	1301-11	697-9
IT 541	55	559-14	659-18	595-18	998-19	489-20
IT 552	62	586-13	884-4	972-4	1328-10	656-11
IT550	52	681-8	756-13	805-10	1384-5	610-16
KS 2015	48	540-16	806-7	518-20	1378-6	634-13
KS 8330	47	653-11	651-20	520-19	**1561-1**	542-19
MG 7240	54	838-3	843-6	841-8	1248-13	810-3
MG 7350	52	709-6	**999-1**	995-2	1494-2	831-2
MG 8242	52	667-9	859-5	820-9	1141-18	778-6
MG 8377	54	693-7	973-2	939-5	1293-12	802-4
MG 8N327	50	717-5	758-12	853-7	1169-17	**863-1**
PN 63M80	49	**881-1**	749-14	719-13	1246-14	656-12
PN 63M02	51	659-10	657-19	677-15	1370-7	785-5
DK 30-33	53	532-18	780-9	723-12	1345-9	692-10
DK 33-33	51	499-20	696-17	640-16	1203-16	607-17
Summary Statistics						
Mean	52	651	791	778	1295	690
P-value	0.0000	0.0215	0.0000	0.0001	0.068	0.0000
LSD (0.05)	5	224	132	237	NS	143
CV (%)	7.3	20.8	11.7	21.5	18.1	14.7

Soil Test Summary for Sunflower and Flax Trials

Location	Depth	Olsen-P	K	EC	OM	pH
		--------ppm-------		Mmhos/cm	%	
WTARC	O – 6 inches	29.0	363	0.96	2.0	7.5
Inbody	O – 6 inches	11.0	518	1.24	1.6	7.9
Picard	O – 6 inches	16.0	350	0.72	2.0	6.0
Moog	O – 6 inches	9.0	233	0.84	1.2	7.9
Karst	O – 6 inches	26.0	393	0.88	1.7	7.4
Bradley	O – 6 inches	9.0	437	0.88	2.9	7.9

Nitrate Nitrogen

	Location (Cooperator)					
	WTARC	Inbody	Picard	Moog	Karst	Bradley
Depth (ft)	NO_3-N (lbs/a)					
0 – 1	50	38	54	39	9	21
1 – 2	23	24	25	13	4	9
2 - 3	16	26	32	21	4	4
3 –4	11	28	40	20	4	4
4 - 5	7	20	24	12	4	4

Sulfate Sulphur

	Location (Cooperator)					
	WTARC	Inbody	Picard	Moog	Karst	Bradley
Depth (ft)	SO_4-S (lbs/a)					
0 – 1	111	154	81	88	66	51
1 – 2	113	98	58	85	328	59
2 - 3	360	394	92	507	449	88
3 –4	669	786	359	845	662	244
4 - 5	740	906	638	866	585	384

Title: Effect of nitrogen and sulfur on winter and spring wheat.

Year: 2003.

Locations: (1) Southwest of Conrad, MT on the Greg Kellogg farm
(2) East of Brady, MT (Knees) on the Dan Picard farm
(3) East of Sunburst, MT on the Herb Karst farm

Personnel:

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

Objectives:

To determine wheat yield and protein response to nitrogen (N) fertilization and N soil tests and sulfur (S) fertilizer and S soil tests.

Procedures:

Nitrogen fertilizer treatments of 0, 30, 60 and 90 lbs (0, 50, 100, and 150 lbs on spring wheat) N/acre were applied in combination with sulfur fertilizer rates of 0, 10, 20, and 30 lbs S/acre. All fertilizer materials were applied while planting, and all plots received the P and KCl fertilizers. Nitrogen as urea (46-0-0) and potash (30 lbs KCl/acre as 0-0-60) fertilizers were broadcast, P (60 lbs/acre of monoammonium phosphate was placed with the seed, and S as ammonium thiosulfate (12-0-0-26) was dribbled on the surface approximately two inches from the seed row. Both plot areas were planted into chemical-fallow (spring wheat-recrop into barley stubble) using a six-row, double disk plot drill with 12 inch row spacing. Planting rate was 20 seeds/ft^2. Plot size was 6 by 25 feet with four replications. Plots were harvested with a Hege plot combine.

Results:

Grain yield, grain protein content, test weight, and seed S content are shown in Tables 57, 58, and 59. The Kellogg location (Table 57) did not respond to N or S fertilizer; however, the results were highly variable as the result of the drought conditions and shallow soils. The Picard location (Table 58) responded to both N and S fertilizers. This is the first, documented winter wheat yield and protein response to S in the Western Triangle area. The N and S grain yield and protein responses were very dramatic and classic, text book responses to two added nutrients without interaction. The S response was probably due to previous year's dry conditions and the subsequent lack of sulfate dissolution from the mineral gypsum which is prevalent in Western Triangle soils. In the spring wheat experiment (Table 59), all responses (yield, protein, test weight, and grain S content) were due to N. Interestingly, S content of the grain was not increased by S fertilization.

Table 57. Effect of N and S on winter wheat yield and quality. Experiment located Southwest of Conrad, MT., Western Triangle Ag. Research Center, Conrad, MT. 2003.

Fertilizer N-S (lbs/ac)	Grain Yield (bu/ac)	Grain Protein %	Test Weight (lb/bu)	Seed Sulfur (%)
0-0	31.7	14.5	58.6	0.174
0-10	31.4	14.6	58.2	0.174
0-20	34.1	12.9	59.4	0.163
0-30	35.5	14.8	58.3	0.182
30-0	32.9	12.9	59.3	0.160
30-10	31.1	11.6	60.0	0.149
30-20	30.9	12.6	59.3	0.160
30-30	30.3	13.5	58.7	0.167
60-0	29.3	15.6	57.1	0.191
60-10	32.7	14.3	58.1	0.177
60-20	31.0	14.3	57.9	0.174
60-30	30.0	14.1	58.5	0.168
90-0	31.7	13.7	58.2	0.164
90-10	31.1	14.7	57.9	0.183
90-20	34.4	14.2	59.2	0.181
90-30	32.9	15.2	58.0	0.181

Summary Statistics

Experimental Means	31.9	14.0	58.5	0.172
Interaction P-value	0.478	0.775	0.763	0.428
C.V. 1: (s/mean)*100	10.5	13.3	2.5	10.9

Nitrogen Summary

0	33.2	14.2	58.6	0.173
30	31.3	12.7	59.3	0.159
60	30.7	14.6	57.9	0.178
90	32.5	14.4	58.3	0.177
P-value	0.175	0.022	0.062	0.026
Linear Contrast	0.519	0.212	0.178	0.156
Quadratic Contrast	0.036	0.135	0.715	0.143
LSD (0.05)	NS	NS	NS	0.013

Sulfur Summary

0	31.4	14.2	58.3	0.172
10	31.6	13.8	58.5	0.171
20	32.6	13.5	59.0	0.170
30	32.2	14.4	58.4	0.174
P-value	0.738	0.553	0.586	0.896
Linear Contrast	0.383	0.894	0.681	0.804
Quadratic Contrast	0.722	0.187	0.270	0.494
LSD (0.05)	NS	NS	NS	NS

Soil Test Summary

Depth	K	Olsen P	EC	OM	pH
	---------- ppm ----------		mmhos/cm	%	
0 - 6"	298	13.0	0.24	3.06	8.0

Depth	NO_3-N	SO_4-S
(ft)	----------(lbs/a)----------	
0 - 1	22.1	45.2
1 - 2	21.8	29.5

Notes:
Variety: Rampart
Seeding Date: 9/12/02
Harvest Date: 7/29/03
Growing Season ppt: 1.50"
Planting Rate: 20 seeds/ft^2
Previous Crop: Chemical Fallow
Herbicide: None.

Table 58. Effect of N and S on winter wheat yield and quality. Experiment located East of Brady (Knees community), MT. Western Triangle Ag. Research Center, Conrad, MT. 2003.

Fertilizer Rate N-S	Grain Yield	Protein Content	Test Weight	Sulfur Content
(lbs/ac)	(bu/ac)	%	(lb/bu)	(%)
0-0	40	13.6	58.5	0.170
30-0	42.2	13.8	58.2	0.168
60-0	44.3	14.4	58.1	0.176
90-0	45.2	14.5	57.6	0.178
0-10	46.6	13.9	59.0	0.167
30-10	48.4	14.3	58.6	0.170
60-10	49.4	15.1	58.3	0.180
90-10	49.5	15.0	58.5	1.178
0-20	48.8	14.3	58.4	0.169
30-20	48.9	14.2	58.7	0.173
60-20	51.7	15.3	58.2	0.178
90-20	53.1	15.5	58.6	0.197
0-30	49.4	14.7	58.2	0.179
30-30	50.0	15.5	58.1	0.198
60-30	52.7	15.8	57.9	0.192
90-30	52.1	16.7	57.4	0.201

Summary Statistics

Experimental Means	48.2	14.8	58.3	0.180
Interaction P-value	0.983	0.869	0.983	0.636
C.V. 1: (s/mean)*100	6.1	5.2	1.2	7.3

Nitrogen Summary

0	46.2	14.1	58.6	0.171
30	47.3	14.4	58.4	0.177
60	49.5	15.1	58.1	0.181
90	50.0	15.4	58.0	0.188
P-value	0.002	0.000	0.063	0.005
Linear Contrast	0.000	0.000	0.008	0.000
Quadratic Contrast	0.641	0.963	0.714	0.842
LSD (0.05)	2.1	0.5	NS	0.009

Sulfur Summary

0	42.9	14.1	58.1	0.173
10	48.4	14.6	58.6	0.174
20	50.6	14.8	58.5	0.179
30	51.0	15.7	58.0	0.193
P-Value	0.000	0.000	0.034	0.000
Linear Contrast	0.000	0.000	0.646	0.000
Quadratic Contrast	0.000	.0358	0.004	0.064
LSD (0.05)	2.1	0.5	0.5	0.009

Soil Test Summary

Depth	K	Olsen P	EC	OM	pH
	---------- ppm ----------		mmhos/cm	%	
0 - 6"	456	20.8	0.25	1.85	8.0

Depth	NO_3-N	SO_4-S
(ft)	----------(lbs/a)----------	
0 – 1	32.1	178.6
1 - 2	18.8	120.4
2 - 3	38.4	2719.5
3 - 4	32.2	6635.0
4 - 5	13.5	8530.6

Notes:
Variety:Rampart
Seeding Date: 9/13/02 Harvest Date: 7/29/03
Growing Season ppt: 0.82" Planting Rate: 20 seeds/ft^2
Previous Crop: Winter Wheat Chemical fallow
Herbicide: None
The rain gauge was not put out until most of the June moisture was past.

Table 59. Effect of N and S on spring wheat yield and quality. Experiment located East of Sunburst, MT., Western Triangle Ag. Research Center, Conrad, MT. 2003.

Fertilizer N-S (lbs/ac)	Grain Yield (bu/ac)	Grain Protein %	Test Weight (lb/bu)	Seed Sulfur (%)
0-0	24.3	10.8	58.3	0.157
0-10	24.4	10.9	58.0	0.157
0-20	22.7	10.9	58.2	0.163
0-30	22.2	10.6	58.6	0.161
50-0	34.4	12.8	57.3	0.177
50-10	35.0	12.7	57.4	0.177
50-20	30.4	13.0	56.5	0.180
50-30	32.2	12.2	58.1	0.175
100-0	33.5	16.0	55.2	0.206
100-10	39.2	15.0	56.1	0.197
100-20	41.3	14.7	56.9	0.203
100-30	36.5	15.2	56.2	0.210
150-0	34.0	17.3	54.6	0.230
150-10	38.6	16.5	55.5	0.224
150-20	35.6	16.8	55.0	0.229
150-30	35.0	17.0	54.5	0.230

Summary Statistics

Experimental Means	32.5	13.9	56.7	0.192
Interaction P-value	0.613	0.885	0.678	0.999
C.V. 1: (s/mean)*100	16.5	7.7	2.4	8.6

Nitrogen Summary

0	23.4	10.8	58.3	0.160
50	33.3	12.7	57.3	0.177
100	37.7	15.2	56.1	0.204
150	35.8	16.9	54.9	0.228
P-value	0.000	0.000	0.000	0.000
Linear Contrast	0.000	0.000	0.000	0.000
Quadratic Contrast	0.000	0.743	0.708	0.424
LSD (0.05)	3.8	0.8	1.0	0.012

Sulfur Summary

0	31.6	14.2	56.3	0.192
10	34.3	13.7	56.8	0.189
20	32.3	13.9	56.6	0.194
30	32.0	13.8	56.9	0.194
P-value	0.491	0.565	0.744	0.811
Linear Contrast	0.880	0.291	0.361	0.600
Quadratic Contrast	0.263	0.483	0.777	0.649
LSD (0.05)	NS	NS	NS	NS

Soil Test Summary

Depth	K	Olsen P	EC	OM	pH
	---------- ppm ----------		mmhos/cm	%	
0 - 6"	393	26	0.88	1.7	7.4

Depth	NO_3-N	SO_4-S
(ft)	----------(lbs/a)----------	
0 – 1	9	66
1 – 2	4	328
2 – 3	4	449
3 – 4	4	662
4 - 5	4	585

Notes:
Variety: McNeal
Seeding Date: 4/23/03 Harvest Date: 8/11/03
Growing Season ppt: 2.7" Planting Rate: 20 seeds/ft^2
Previous Crop: Chemical Fallow
Herbicide: Applied Bronate at 1½ pt/a and Discover at 4 oz/a on 5/29/03.

Table 51. Effect of P, *Rhizobium leguminosarum* (N-Prove®), and *Rhizobium leguminosarum* plus *Penicillium bilaii* (TagTeam®) on irrigated Utopia durum seed yield, test weight and quality. Experiment located at Western Triangle Ag. Research Center. Conrad, MT. 2003.

Crop Rotation	P rate (lbs P_2O_5/a)	Yield (bu/a)	Test Wt. (lbs/bu)
7	20	58.0	61.5
2	20	57.9	61.9
7	10	55.4	61.5
8	20	55.3	61.5
8	10	53.4	61.3
2	30	51.1	61.9
7	30	49.7	60.4
8	30	47.6	59.5
8	0	44.1	61.6
2	0	40.6	61.4
7	0	40.6	61.2
2	10	39.8	62.1

Summary Statistics

Experimental Means		50.6	61.3
Error Mean Square		10.9	1.4
Interaction P-value		0.5077	0.6808
C. V. 1:(s/mean)*100		21.5	2.3
LSD (0.05)		NS	NS

Durum Summary

7		54.4	61.2
8		50.1	61.0
2		47.3	61.9
P-value		0.1919	0.1766
LSD (0.05)		NS	NS

Phosphorus Summary

	0	46.4	61.4
	10	49.5	61.7
	20	57.1	61.6
	30	49.5	60.6
	P-value	0.1205	0.2226
	LSD (0.05)	NS	NS

Title: Evaluation of Sunflower and Flax as potential feed stock for biofuels or lubricants.

Year: 2003

Locations: Western Triangle Ag. Research Center
Knees area east of Brady (Picard farm)
Choteau area (Inbody farm)
Cut Bank area (Bradley farm)
Sunburst area (Karst farm)
Joplin area (Moog farm)

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

Objectives: To determine the seed yield and seed oil quality of flax and sunflower in north central Montana. To evaluate sunflower planting rates for optimum seed and oil yield.

Procedures:

Twenty NuSun sunflower lines and three flax lines were planted at six locations with a six-row, 12-inch spaced planter. Plot size was 6 by 25 feet. All locations were planted no-till into previously fallowed land or following barley, recrop. Plot areas were fertilized with 30 lbs/acre of 11-52-0 applied with the seed and 30 lbs/acre of 0-0-60 applied broadcast while planting. At the recrop site, Sunburst, 70 lbs of nitrogen as urea was applied broadcast while planting. Plant population for the sunflower trial was 25,000 seeds/acre, and the planting rate for flax was 30 lbs/acre. In addition, a sunflower population study was planted at three locations with planting rates varying from 14,000 to 32,000 seeds/acre in 2000 seed increments. Seed yield, oil content, and fatty acid profile will be determined for each flax and sunflower line as well as the population study. Weeds were controlled (with labeled rates) in sunflower with Spartan and Poast herbicides and in flax with Bronate and Poast.

Results:

Seed yields of sunflower and flax are shown in Tables 52, 54, 55, and 56. Overall both oil seeds averaged about the same, 800 lbs/acre. The sunflower location at WTARC was lost due to black birds. Cl 308 and MG 7350 seemed to have the most stable ranking. The sunflower (Table 53) population study was inconclusive probably due to the drought conditions and poor hybrid selection for the study.

Table 52. Sunflower hybrid evaluation trials: Seed yield and plant height. Western Triangle Ag. Research Center, Conrad. 2003.

	Location (Cooperator)					
	WTARC	Inbody	Picard	Moog	Karst	Bradley
Hybrid	Plt Ht, in.	Seed Yield in lbs/acre - Rank				
Cl 308	48	745-4	964-3	988-3	1447-3	773-7
Cl 322	54	541-15	793-8	635-17	1226-15	628-14
Cl 340	50	539-17	741-15	692-14	965-20	600-18
Cl 345	57	838-2	770-10	**1048-1**	1437-4	715-8
Cl 385	54	642-12	763-11	859-6	1365-8	624-15
IT 536	47	502-19	727-16	729-11	1301-11	697-9
IT 541	55	559-14	659-18	595-18	998-19	489-20
IT 552	62	586-13	884-4	972-4	1328-10	656-11
IT550	52	681-8	756-13	805-10	1384-5	610-16
KS 2015	48	540-16	806-7	518-20	1378-6	634-13
KS 8330	47	653-11	651-20	520-19	**1561-1**	542-19
MG 7240	54	838-3	843-6	841-8	1248-13	810-3
MG 7350	52	709-6	**999-1**	995-2	1494-2	831-2
MG 8242	52	667-9	859-5	820-9	1141-18	778-6
MG 8377	54	693-7	973-2	939-5	1293-12	802-4
MG 8N327	50	717-5	758-12	853-7	1169-17	**863-1**
PN 63M80	49	**881-1**	749-14	719-13	1246-14	656-12
PN 63M02	51	659-10	657-19	677-15	1370-7	785-5
DK 30-33	53	532-18	780-9	723-12	1345-9	692-10
DK 33-33	51	499-20	696-17	640-16	1203-16	607-17
Summary Statistics						
Mean	52	651	791	778	1295	690
P-value	0.0000	0.0215	0.0000	0.0001	0.068	0.0000
LSD (0.05)	5	224	132	237	NS	143
CV (%)	7.3	20.8	11.7	21.5	18.1	14.7

Soil Test Summary for Sunflower and Flax Trials

Location	Depth	Olsen-P	K	EC	OM	pH
		--------ppm-------		Mmhos/cm	%	
WTARC	O – 6 inches	29.0	363	0.96	2.0	7.5
Inbody	O – 6 inches	11.0	518	1.24	1.6	7.9
Picard	O – 6 inches	16.0	350	0.72	2.0	6.0
Moog	O – 6 inches	9.0	233	0.84	1.2	7.9
Karst	O – 6 inches	26.0	393	0.88	1.7	7.4
Bradley	O – 6 inches	9.0	437	0.88	2.9	7.9

Nitrate Nitrogen

	Location (Cooperator)					
	WTARC	Inbody	Picard	Moog	Karst	Bradley
Depth (ft)	NO_3-N (lbs/a)					
0 – 1	50	38	54	39	9	21
1 – 2	23	24	25	13	4	9
2 - 3	16	26	32	21	4	4
3 –4	11	28	40	20	4	4
4 - 5	7	20	24	12	4	4

Sulfate Sulphur

	Location (Cooperator)					
	WTARC	Inbody	Picard	Moog	Karst	Bradley
Depth (ft)	SO_4-S (lbs/a)					
0 – 1	111	154	81	88	66	51
1 – 2	113	98	58	85	328	59
2 - 3	360	394	92	507	449	88
3 –4	669	786	359	845	662	244
4 - 5	740	906	638	866	585	384

Title: Effect of nitrogen and sulfur on winter and spring wheat.

Year: 2003.

Locations: (1) Southwest of Conrad, MT on the Greg Kellogg farm
(2) East of Brady, MT (Knees) on the Dan Picard farm
(3) East of Sunburst, MT on the Herb Karst farm

Personnel:

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

Objectives:

To determine wheat yield and protein response to nitrogen (N) fertilization and N soil tests and sulfur (S) fertilizer and S soil tests.

Procedures:

Nitrogen fertilizer treatments of 0, 30, 60 and 90 lbs (0, 50, 100, and 150 lbs on spring wheat) N/acre were applied in combination with sulfur fertilizer rates of 0, 10, 20, and 30 lbs S/acre. All fertilizer materials were applied while planting, and all plots received the P and KCl fertilizers. Nitrogen as urea (46-0-0) and potash (30 lbs KCl/acre as 0-0-60) fertilizers were broadcast, P (60 lbs/acre of monoammonium phosphate was placed with the seed, and S as ammonium thiosulfate (12-0-0-26) was dribbled on the surface approximately two inches from the seed row. Both plot areas were planted into chemical-fallow (spring wheat-recrop into barley stubble) using a six-row, double disk plot drill with 12 inch row spacing. Planting rate was 20 seeds/ft^2. Plot size was 6 by 25 feet with four replications. Plots were harvested with a Hege plot combine.

Results:

Grain yield, grain protein content, test weight, and seed S content are shown in Tables 57, 58, and 59. The Kellogg location (Table 57) did not respond to N or S fertilizer; however, the results were highly variable as the result of the drought conditions and shallow soils. The Picard location (Table 58) responded to both N and S fertilizers. This is the first, documented winter wheat yield and protein response to S in the Western Triangle area. The N and S grain yield and protein responses were very dramatic and classic, text book responses to two added nutrients without interaction. The S response was probably due to previous year's dry conditions and the subsequent lack of sulfate dissolution from the mineral gypsum which is prevalent in Western Triangle soils. In the spring wheat experiment (Table 59), all responses (yield, protein, test weight, and grain S content) were due to N. Interestingly, S content of the grain was not increased by S fertilization.

Table 57. Effect of N and S on winter wheat yield and quality. Experiment located Southwest of Conrad, MT., Western Triangle Ag. Research Center, Conrad, MT. 2003.

Fertilizer N-S (lbs/ac)	Grain Yield (bu/ac)	Grain Protein %	Test Weight (lb/bu)	Seed Sulfur (%)
0-0	31.7	14.5	58.6	0.174
0-10	31.4	14.6	58.2	0.174
0-20	34.1	12.9	59.4	0.163
0-30	35.5	14.8	58.3	0.182
30-0	32.9	12.9	59.3	0.160
30-10	31.1	11.6	60.0	0.149
30-20	30.9	12.6	59.3	0.160
30-30	30.3	13.5	58.7	0.167
60-0	29.3	15.6	57.1	0.191
60-10	32.7	14.3	58.1	0.177
60-20	31.0	14.3	57.9	0.174
60-30	30.0	14.1	58.5	0.168
90-0	31.7	13.7	58.2	0.164
90-10	31.1	14.7	57.9	0.183
90-20	34.4	14.2	59.2	0.181
90-30	32.9	15.2	58.0	0.181

Summary Statistics

Experimental Means	31.9	14.0	58.5	0.172
Interaction P-value	0.478	0.775	0.763	0.428
C.V. 1: (s/mean)*100	10.5	13.3	2.5	10.9

Nitrogen Summary

0	33.2	14.2	58.6	0.173
30	31.3	12.7	59.3	0.159
60	30.7	14.6	57.9	0.178
90	32.5	14.4	58.3	0.177
P-value	0.175	0.022	0.062	0.026
Linear Contrast	0.519	0.212	0.178	0.156
Quadratic Contrast	0.036	0.135	0.715	0.143
LSD (0.05)	NS	NS	NS	0.013

Sulfur Summary

0	31.4	14.2	58.3	0.172
10	31.6	13.8	58.5	0.171
20	32.6	13.5	59.0	0.170
30	32.2	14.4	58.4	0.174
P-value	0.738	0.553	0.586	0.896
Linear Contrast	0.383	0.894	0.681	0.804
Quadratic Contrast	0.722	0.187	0.270	0.494
LSD (0.05)	NS	NS	NS	NS

Soil Test Summary

Depth	K	Olsen P	EC	OM	pH
	---------- ppm ----------		mmhos/cm	%	
0 - 6"	298	13.0	0.24	3.06	8.0

Depth	NO_3-N	SO_4-S
(ft)	----------(lbs/a)----------	
0 - 1	22.1	45.2
1 - 2	21.8	29.5

Notes:
Variety: Rampart
Seeding Date: 9/12/02
Harvest Date: 7/29/03
Growing Season ppt: 1.50"
Planting Rate: 20 seeds/ft^2
Previous Crop: Chemical Fallow
Herbicide: None.

Table 58. Effect of N and S on winter wheat yield and quality. Experiment located East of Brady (Knees community), MT. Western Triangle Ag. Research Center, Conrad, MT. 2003.

Fertilizer Rate N-S	Grain Yield	Protein Content	Test Weight	Sulfur Content
(lbs/ac)	(bu/ac)	%	(lb/bu)	(%)
0-0	40	13.6	58.5	0.170
30-0	42.2	13.8	58.2	0.168
60-0	44.3	14.4	58.1	0.176
90-0	45.2	14.5	57.6	0.178
0-10	46.6	13.9	59.0	0.167
30-10	48.4	14.3	58.6	0.170
60-10	49.4	15.1	58.3	0.180
90-10	49.5	15.0	58.5	1.178
0-20	48.8	14.3	58.4	0.169
30-20	48.9	14.2	58.7	0.173
60-20	51.7	15.3	58.2	0.178
90-20	53.1	15.5	58.6	0.197
0-30	49.4	14.7	58.2	0.179
30-30	50.0	15.5	58.1	0.198
60-30	52.7	15.8	57.9	0.192
90-30	52.1	16.7	57.4	0.201

Summary Statistics

Experimental Means	48.2	14.8	58.3	0.180
Interaction P-value	0.983	0.869	0.983	0.636
C.V. 1: (s/mean)*100	6.1	5.2	1.2	7.3

Nitrogen Summary

0	46.2	14.1	58.6	0.171
30	47.3	14.4	58.4	0.177
60	49.5	15.1	58.1	0.181
90	50.0	15.4	58.0	0.188
P-value	0.002	0.000	0.063	0.005
Linear Contrast	0.000	0.000	0.008	0.000
Quadratic Contrast	0.641	0.963	0.714	0.842
LSD (0.05)	2.1	0.5	NS	0.009

Sulfur Summary

0	42.9	14.1	58.1	0.173
10	48.4	14.6	58.6	0.174
20	50.6	14.8	58.5	0.179
30	51.0	15.7	58.0	0.193
P-Value	0.000	0.000	0.034	0.000
Linear Contrast	0.000	0.000	0.646	0.000
Quadratic Contrast	0.000	.0358	0.004	0.064
LSD (0.05)	2.1	0.5	0.5	0.009

Soil Test Summary

Depth	K	Olsen P	EC	OM	pH
	---------- ppm ----------		mmhos/cm	%	
0 - 6"	456	20.8	0.25	1.85	8.0

Depth	NO_3-N	SO_4-S
(ft)	----------(lbs/a)----------	
0 – 1	32.1	178.6
1 - 2	18.8	120.4
2 - 3	38.4	2719.5
3 - 4	32.2	6635.0
4 - 5	13.5	8530.6

Notes:
Variety:Rampart
Seeding Date: 9/13/02 Harvest Date: 7/29/03
Growing Season ppt: 0.82" Planting Rate: 20 seeds/ft^2
Previous Crop: Winter Wheat Chemical fallow
Herbicide: None
The rain gauge was not put out until most of the June moisture was past.

Table 59. Effect of N and S on spring wheat yield and quality. Experiment located East of Sunburst, MT., Western Triangle Ag. Research Center, Conrad, MT. 2003.

Fertilizer N-S (lbs/ac)	Grain Yield (bu/ac)	Grain Protein %	Test Weight (lb/bu)	Seed Sulfur (%)
0-0	24.3	10.8	58.3	0.157
0-10	24.4	10.9	58.0	0.157
0-20	22.7	10.9	58.2	0.163
0-30	22.2	10.6	58.6	0.161
50-0	34.4	12.8	57.3	0.177
50-10	35.0	12.7	57.4	0.177
50-20	30.4	13.0	56.5	0.180
50-30	32.2	12.2	58.1	0.175
100-0	33.5	16.0	55.2	0.206
100-10	39.2	15.0	56.1	0.197
100-20	41.3	14.7	56.9	0.203
100-30	36.5	15.2	56.2	0.210
150-0	34.0	17.3	54.6	0.230
150-10	38.6	16.5	55.5	0.224
150-20	35.6	16.8	55.0	0.229
150-30	35.0	17.0	54.5	0.230

Summary Statistics

Experimental Means	32.5	13.9	56.7	0.192
Interaction P-value	0.613	0.885	0.678	0.999
C.V. 1: (s/mean)*100	16.5	7.7	2.4	8.6

Nitrogen Summary

0	23.4	10.8	58.3	0.160
50	33.3	12.7	57.3	0.177
100	37.7	15.2	56.1	0.204
150	35.8	16.9	54.9	0.228
P-value	0.000	0.000	0.000	0.000
Linear Contrast	0.000	0.000	0.000	0.000
Quadratic Contrast	0.000	0.743	0.708	0.424
LSD (0.05)	3.8	0.8	1.0	0.012

Sulfur Summary

0	31.6	14.2	56.3	0.192
10	34.3	13.7	56.8	0.189
20	32.3	13.9	56.6	0.194
30	32.0	13.8	56.9	0.194
P-value	0.491	0.565	0.744	0.811
Linear Contrast	0.880	0.291	0.361	0.600
Quadratic Contrast	0.263	0.483	0.777	0.649
LSD (0.05)	NS	NS	NS	NS

Soil Test Summary

Depth	K	Olsen P	EC	OM	pH
	---------- ppm ----------		mmhos/cm	%	
0 - 6"	393	26	0.88	1.7	7.4

Depth	NO_3-N	SO_4-S
(ft)	----------(lbs/a)----------	
0 – 1	9	66
1 – 2	4	328
2 – 3	4	449
3 – 4	4	662
4 - 5	4	585

Notes:
Variety: McNeal
Seeding Date: 4/23/03 Harvest Date: 8/11/03
Growing Season ppt: 2.7" Planting Rate: 20 seeds/ft^2
Previous Crop: Chemical Fallow
Herbicide: Applied Bronate at 1½ pt/a and Discover at 4 oz/a on 5/29/03.