

The 17th

ANNUAL REPORT

of the

WESTERN TRIANGLE AGRICULTURAL RESEARCH CENTER

Montana Agricultural Experiment Station

Conrad, Montana

1994

Submitted by

Dr. Gregory D. Kushnak, Superintendent & Crop Scientist

and

Dr. Grant D. Jackson, Soil Scientist

MSU-MAES Research Report



TABLE OF CONTENTS

	<u>Page</u>
Weather Summary	1-2
Research Results	
Winter Wheat Variety Investigations	3
Comments on winter wheat varieties	4-8
Conrad Intrastate, Table 1	9
Conrad (IS) abbreviated, Table 2	11
Conrad, 5-year summary, Table 3	13
Chester, Table 4	14
Chester, 5-year summary, Table 5	15
Dutton, Table 6	16
Dutton, 5-year summary, Table 7	17
Spring Wheat & Durum Variety Investigations	18a
Comments on varieties	18-24
Conrad dryland wheat (AY), Table 8	25
Conrad dryland (AY abbreviated), Table 9	27
Conrad dryland, 5-year summary, Table 10	28
Conrad irrigated wheat, Table 11	29
Conrad irrigated, 5-year summary, Table 12	30
Cut Bank wheat, Table 13	31
Cut Bank, 5-year summary, Table 14	32
Oilmont wheat, Table 15	33
Oilmont, 5-year summary, Table 16	34
Choteau wheat, Table 17	35
Choteau, 5-year summary, Table 18	36
Dryland Durum, Conrad, Table 19	37
Dryland Durum, 5-year summary, Table 20	38
Irrigated Durum, Conrad, Table 21	39
Irrigated Durum, 5-year summary, Table 22	40
Emmer, Table 23	41
Barley Variety Investigations	42
Comments on barley varieties	42-45
Conrad dryland intrastate, Table 24	46
Conrad dryland (IS abbreviated), Table 25	48
Conrad dryland, 5-year summary, Table 26	49
Conrad irrigated intrastate, Table 27	50
Conrad irrigated (IS abbreviated), Table 28	52
Conrad irrigated, 5-year summary, Table 29	53
Cut Bank, Table 30	54
Cut Bank, 5-year summary, Table 31	55
Oilmont, Table 32	56
Oilmont, 5-year summary, Table 33	57
Choteau, Table 34	58
Choteau, 5-year summary, Table 35	59

(continued)

No-till recrop grain Varieties	60
Spring wheat, Table 36	61
Spring wheat, 5-year summary, Table 37	62
Barley, Table 38	63
Barley, 5-year summary, Table 39	64
Recrop residue management & Tilt for disease management	
Barley, Table 40	65
Wheat, Table 41	66
Canola Varieties, Table 42	67
Soils Research Report	
Canola, rapeseed, and peas as enhancers of soil nutrient availability and crop productivity in cereal rotations	68
Tables 43 through 45	70
Effect of N, P, K, and Cl on spring wheat	73
Tables 46 through 58	75
Figures 1 through 7	87
Plant diagnosis for protein management in spring wheat	89
Table 59	91
Figures 8 through 18	92
Canola response to N, P, and S Fertilizers	95
Table 60	96
Figure 19	94

Climatic summary for the 1994 calendar year at the Western Triangle Research Center,
 Conrad, MT.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total or average
Precipitation (inches)													
Current Year	0.21	0.41	0.26	1.62	1.57	1.72	0.22	0.28	0.05	1.01	0.11	0.02	7.48
Average	0.24	0.25	0.58	0.96	1.86	2.40	1.57	1.73	1.51	0.56	0.30	0.16	12.12
Mean Temperature (°F)													
Current Year	23.0	12.1	39.3	43.5	55.7	60.0	68.5	68.1	61.4	44.3	29.4	29.1	44.5
Average	24.1	21.4	35.6	44.6	54.1	61.0	65.3	65.1	57.6	45.8	31.5	19.1	43.8

Last killing frost in Spring

1994----- May 1 (22°)
 Average----- May 14

First killing frost in Fall

1994----- Oct 3 (32°)
 Average----- Sept 20

Frost free period (days)

1994----- 155
 Average----- 129

Maximum summer temperature----- 96° (Jul 22)

Minimum winter temperature----- -35° (Feb 9)

Summary of climatic data by month for the 1993-94 crop year (September thru August) at the Western Triangle Agricultural Research Center, Conrad, MT.

	Sep 1993	Oct 1993	Nov 1993	Dec 1993	Jan 1994	Feb 1994	Mar 1994	Apr 1994	May 1994	June 1994	July 1994	Aug 1994	Total or Average
Precipitation (inches)													
Current year	1.09	0.25	0.46	0.24	0.21	0.41	0.26	1.62	1.57	1.72	0.22	0.28	8.33
Average	1.67	0.51	0.32	0.18	0.24	0.25	0.58	0.96	1.86	2.40	1.57	1.73	12.27
Mean Temperature (°F)													
Current year	55.0	46.5	27.0	30.0	23.0	12.1	39.3	43.5	55.7	60.0	68.5	68.1	44.1
Average	57.1	46.0	31.8	17.8	24.0	21.4	35.6	44.6	54.1	61.0	65.3	65.1	43.7

Last killing frost in Spring

1994-----May 1 (22°)
Average-----May 14

First killing frost in Fall

1994-----Oct. 3 (32°)
Average-----Sept. 20

Frost free period (days)

1994-----155
Average-----129

Maximum summer temperature----- 96° (Jul 22)

Minimum winter temperature----- -35° (Feb. 6, 1994)

Title: 1994 WESTERN TRIANGLE WINTER WHEAT VARIETY TESTS

Personnel: Greg Kushnak, Ron Thaut, and Larry Christiaens -
Agricultural Research Center, Conrad, MT; and Dr. Phil
Bruckner, MSU, Bozeman.

Winter wheat variety trials were grown near Conrad, Chester, Dutton, and the Knees during 1994. The Knees location was not harvested due to stand losses from wind damage, but the plots were evaluated for sawfly damage. Sawfly cutting was moderately severe at Dutton and the Knees except for the two experimental sawfly resistant lines MTS92042 and MTSF2238, which had very little damage. These two lines ranked medium for yield in areas without sawfly damage. At Dutton, however, they ranked high, indicating the yield losses suffered among the susceptible varieties were due to sawfly. Although sawfly cutting was severe at Dutton, harvest was accomplished before the stems lodged. This demonstrated the effect of larval feeding on the disruption of nutrient flow in stem tissue.

Wheat streak was minimal at the three harvested locations, and stored soil moisture was abundant. Summer rainfall was very limited, with the Conrad site receiving the most with 5.23 inches.

Data for the 1994 trials are presented in Tables 1 - 7, and include five-year averages. Varieties not included in the five-year summaries do not have enough test years to be certain of their adaptation to this area, and caution should be used when considering these for production. 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. Other observations concerning the varieties are presented in the following pages.

WINTER WHEAT VARIETY NOTES

Abilene (AgriPro NA 362-5) - Ranked low, Conrad 1988, low winter-hardiness(2). Adapted north of Ks/Okla borders and Texas panhandle. Short semidwarf. Susceptible to Hessian fly.

Agassiz(ND) - Recommended for District 6 only to replace Froid (Eastern Montana). High winterhardiness (4-5). Tall very weak straw, lodges bad. Low yield; shatter resistance and protein fairly good, better than Norstar. Medium late maturity.

Arapaho (Nebr)-Medium height with long coleptile and moderate straw strength. Winterhardiness fairly good?? Heterozygous (mixed) resistance to Great Plains strain of Hessian fly, moderate tolerance to Cephalosporium stripe. Medium yield, low test weight, early heading. Medium winter survival.

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

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

Bighorn(Rohm & Haas, Inc. Hybritech Intl, Inc.) - Winterhardiness less than Cheyenne, and may be risky. (might be considered a 2). Short straw. Medium early maturity. Protein is medium.

Centurk-(Nebraska). High yield, low protein. Medium winterhardiness, less than Redwin and Tiber. Very susceptible to yellow berry expression under low Nitrogen conditions. Early maturity, which sometimes allows escape from sawfly. Medium stiff straw.

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

Chisolm -(Oklahoma). Winterhardiness equal or less than Cimmaron.

Cimmaron -(Oklahoma). Winterhardiness adequate for Kansas, Nebraska, and Colorado. Semidwarf, red head, awnless (awnletted). Hard to thresh due to very stiff straw.

Cree(MSU)-Shatter resistant version of Cheyenne. Identical to Cheyenne in other respects except has red head and brown chaff. Medium to high yield. Winterhardiness medium (3). Tall straw. High protein. Medium maturity and highly vulnerable to sawfly.

Dawn (S.Dak.)-Medium short height, good lodging resistance. Early maturity. Fair winterhardiness, greater than Hawk. Quality is fair.

Eklund (private var.- eastern Mta grower)-Beardless. Medium short height and maturity. High winterhardiness (4 or5). Medium shatter resistance.

Froid - Drop from recommended list. Low yield and tall weak straw. High winterhardiness (5).

Hawk - (AgriPro) Winterhardness moderate to poor, probably less than Centurk; sometimes yields high, but not consistently. Early maturity & good lodging resistance. Adapted to Southern Great Plains.

Hill-81 (Oregon)- Soft White. Compared to other soft-white wheats, winterhardness is good, but still may be risky for Triangle area. Good straw strength.

Judith (MT 8039)(MSU)- Yields fair to good - sometimes equal to Rocky, and Tiber. Low vernalization requirement. Stripe and stem rust resistant. Protein is equal to Tiber, greater than Centurk, and less than Redwin. Heading slightly later than Rocky, but earlier than Tiber. However, it had more sawfly damage than Rocky & Tiber at the Knees plot in 1991. Medium short straw; winterhardness higher than Rocky and Cheyenne, and equal to Redwin. Medium shatter resistance.

Three problems:

- 1) Test weight is sometimes low, and may be a problem.
- 2) Broken stems at crown and white heads at Conrad in 1986.
- 3) Straw less stiff than Neeley, Tiber and Redwin; but stiffer than Rocky and Centurk. Has some red heads and tall and beardless heads.

Jules (Colorado)- Semidwarf with better straw strength & yield than Lamar, but lower test weight. High yield in 1994. Winterhardness appears poor.

Karl (Kansas)- Early maturing, low yield, poor winterhardness.

Kestrel (Sask., Can)- Winterhardy and high yielding in Canada (hardiness similar to Norstar with higher yield). Shorter straw, better lodging resistance, and three days earlier than Norstar (similar maturity as Redwin). Test weight and protein less than for Norstar (low). Probably will not tolerate drought stress very well. Leaf spots at Conrad 1992.

Lamar(Colorado)-Medium height with long coleoptile. Adapted to severe low moisture conditions of Colorado. Heterogeneous reaction to Great Plains biotype of Hessian fly. Very early heading, medium yield, high test weight, weak straw, very poor winterhardness. Shattered in 1993.

Manning(Utah)-Medium short. Adapted to deep snow areas, resistant to dwarf bunt and moderately tolerant to snow mold. Good straw strength, poor winterhardness.

Meridian(Idaho)- Developed for irrigated conditions in Idaho. Yields rank from low to very high depending on year. Medium test weight, very late maturity (several days later than Neeley). Good straw strength, poor winterhardness. Needs long, moist growing season.

MT 7811 - Hard white winter wheat for specialty markets (Market still under development). Medium high yield. Currently (1992) has a small percentage of red kernels, and attempts are underway to purify it for possible release.

Minter-Medium height and maturity. High winterhardness (4-5). Good shatter resistance. Low yield.

Mounty - (Wally Johnson's) Stiffer straw than Neeley, and yield claimed to be equal to or better than Neeley, according to Johnson?? Not tested by MSU.

Continued

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

Norstar(Canada) - Maximum Winterhardiness (5). Lower protein than Roughrider (medium). Very tall straw, poor lodging resistance. Low yield. Late maturity. Medium shatter resistance? (head shattering occurred at Conrad in 1980).

Norwin(MSU)-Winalta winterhardiness (4-5 high). Protein medium to low. Pseudomonas bacterial leaf blight bad. Licensed in Canada. Short semidwarf straw, but not a tripledwarf. Too short for dryland. Medium yield. Good shatter resistance. Medium maturity.

Promontory (Utah)- Excellent dwarf smut resistance. Yield and test weight higher than Manning. Medium height, strong straw, good lodging resistance. Winterhardiness probably poor. Red head.

Quantum 542 (Hybritech- Seed Intl. Inc.) - An F₁ hybrid; needs new seed each year. Planting F₂ (second generation) seed may result in yield reduction and development of ergot due to sterility in a small percentage of florets (ms ratio less than 3:1). F₁ vs F₂ tests in 1992 indicated a 12% yield reduction from planting 2nd generation seed. High yield; protein as good as Rocky; early maturity like Rocky. Recommended in 1991 for districts 2,3,4, & 5 (but not for dwarf smut areas). Medium short height, lodging resistance equal to Rocky. Winterhardiness is fairly good but less than Winalta. Bearded.

Quantum 555 - An F₁ hybrid (see Q 542). According to Hybritech, adapted to Montana, 2 days later than Centurk. Semidwarf. Excellent straw strength. Good winterhardiness. Irrigated. Awnletted.

Ram(NAPB) - Winterhardiness less than Centurk. Tall semidwarf with good straw strength. Early maturity (similar to the Centurk-type wheats). Adapted to Southern Great Plains. Susceptible to Hessian fly. Low winterhardiness, medium-low test weight.

Rawhide(Nebraska)-not tested. For Southern Plains.

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

Readymade (W188)(Lethbr. Canada) - Selection out of Redwin by Agr Canada at Lethbridge. Slightly lower protein, and larger kernels than Redwin. Winterhardiness and yield similar to Redwin. Head color same as Redwin; but stems are yellow, whereas Redwin stems are mixture of red and yellow. Redwin has a mix of small spring wheat-like seeds with large seeds. Readymade is all large seed that grade properly under the Canadian system. Had similar leaf spot problems as Redwin at Conrad 1992. Same maturity as Redwin.

Rio Blanco (NAPB)-not tested. For Southern Plains.

Continued

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

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

Seward (ND 8002) - (Centurk/Froid/Norstar). Winterhardiness of Winalta (4), outyields Winalta by 20% at Sidney, but not at Conrad. Medium height and is shorter and stiffer than Winalta (about like Rocky). Protein 3/4% less than Norstar. Good lodging resistance. Low protein & poor quality. Medium shatter resistance. Low yield.

Siouxland (S.Dak) - Sticky dough problems, and could damage our market image. Winterhardiness not adequate for Triangle area of Montana.

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

Thunderbird(AgriPro) - Winterhardiness may be low, less than Centurk. Short straw with good lodging resistance, long coleoptile. Early maturity.

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

Tomahawk (Agripro) - No data, but probably similar to Rocky in most agronomic traits.

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

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

Weston -(Idaho) Dwarf smut resistant, but less than Blizzard. Tall straw, lodges. Winter killed at Moccasin in 1989, winterhardiness poor. Moderate snowmold tolerance. Low to medium yield.

Winalta - High protein, tall weak straw, high winterhardiness (4). Medium yields. Good shatter resistance. Redwin and Tiber offer improvements.

Winoka-Similar to Winalta, but slightly earlier to mature.

Wings -(Private variety) Winterhardness less than Centurk. Sister to Vona, but a little more winterhardness. Early maturity.

Winridge(MSU) - Medium to high yield. Medium height with stiff straw. Medium late maturity, and therefore highly vulnerable to sawfly. Low test weight and protein. Winterhardness (2) medium, better than Centurk but less than Cheyenne. Good shatter resistance. For dwarf smut areas.

Vista (Nebr)- Early heading semidwarf with resistance to Hessian fly. Medium yield in 1994. Winterhardness uncertain, but good survival in 1994.

Yuma (Colorado) - Early maturing semidwarf, long coleoptile. Winterhardness probably poor.

Table 1

Dryland Winter Wheat variety trial grown north of Conrad, 1994. 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
MT 8918	71.5	58.5	33	171		
XNH 1643	71.4	60.3	33	170		
XNH 1609	70.3	61.7	33	165		
QUANTUM 542	70.1	61.6	35	169	3	
XNH 1727	68.8	60.1	32	171		
NORWIN	68.6	61.0	27	172		
MERIDIAN	65.8	57.4	32	172		
XNH 1654	65.6	61.7	31	164		
JULES	65.4	59.7	33	169		
MANNING	65.2	59.3	31	169		
XNH 1712	64.3	61.9	31	164		
S86-736	62.1	58.7	36	172		
BLIZZARD	62.0	58.9	37	176	2-3	
YUMA	61.6	61.7	30	160		
PROMONTORY	61.2	61.0	31	164		
IDHW0355	61.2	59.3	36	172		
MT 7811 *	60.7	59.5	33	170		
VISTA	59.4	60.9	29	163		
WPB BZ9W89-8	58.9	60.3	29	163		
CENTURK	58.2	61.7	32	161	2	
NEELEY	57.8	58.9	35	171	3	
MT 8949	57.5	60.7	35	172		
TIBER	56.8	60.7	36	171	3	
WINRIDGE	56.5	56.9	38	173	2	
KESTREL	56.2	57.6	33	172	5	
AC READYMADE	55.7	59.0	37	176	3	
ARAPAHO	55.4	59.4	34	166	3	
WPB WI88-275	54.1	59.8	30	158		
LAMAR	53.4	61.9	31	165		
MT 91051	53.3	56.2	39	171		

(Continued on next page)

(Conrad Winter Wheat continued)

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Head date	Spring survival class /1	% Protein
ROCKY		53.1	62.3	32	166	2	
REDWIN		52.2	60.3	33	172	3	
MT 8713		52.1	59.8	28	171		
VONA		52.0	61.7	28	157		
MTS92042	**	51.8	61.1	32	171		
MT 88046		51.0	60.7	33	165		
MT 8719		50.9	60.7	32	171		
MT 91432		50.7	59.1	30	170		
WINALTA		49.1	61.7	40	171	4	
MTSF2238	**	48.2	61.9	34	166		
AGASSIZ		47.5	58.3	39	172	4	
KARL 92		47.2	60.7	29	160		
MTS92055		46.4	59.5	34	170		
WESTON		43.5	59.6	33	172	2	
NORSTAR		43.4	59.5	39	176	5	
MTS92057		43.3	59.5	35	170		
JUDITH		43.1	56.7	32	171	3	
ROUGH RIDER		41.6	60.3	35	172		
WPB BZ9W89-14		36.8	60.0	27	160		

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, Pondera County.
 Fertilizer: 100# 11-51-0 with the seed, + 35# N broadcast.
 Previous crop: Fallow.
 Date seeded: Sept. 28, 1993.
 Date harvested: Aug. 11, 1994.
 Rainfall: From April 1 to harvest was 5.23 inches.
 1/ = Spring survival class: 5=best; 1=very low; based
 several location-years of observatio
 Yield experimental mean: 56.17
 Error degrees of freedom: 96.00
 F test for var. = 4.10, c.v. 2 = 7.60, LSD (0.05) = 11.99
 * = Hard white wheat.
 ** = Sawfly resistant variety.

Table 2: Dryland Winter Wheat variety trial grown north of Conrad, 1994. 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/
QUANTUM 542	70.1	61.6	35	169	3
NORWIN	68.6	61.0	27	172	
MERIDIAN	65.8	57.4	32	172	
JULES	65.4	59.7	33	169	
MANNING	65.2	59.3	31	169	
BLIZZARD	62.0	58.9	37	176	2-3
YUMA	61.6	61.7	30	160	
PROMONTORY	61.2	61.0	31	164	
MT 7811 *	60.7	59.5	33	170	
VISTA	59.4	60.9	29	163	
CENTURK	58.2	61.7	32	161	2
NEELEY	57.8	58.9	35	171	3
TIBER	56.8	60.7	36	171	3
WINRIDGE	56.5	56.9	38	173	2
KESTREL	56.2	57.6	33	172	5
AC READYMADE	55.7	59.0	37	176	3
ARAPAHO	55.4	59.4	34	166	3
LAMAR	53.4	61.9	31	165	
ROCKY	53.1	62.3	32	166	2
REDWIN	52.2	60.3	33	172	3
VONA	52.0	61.7	28	157	
MTS92042 **	51.8	61.1	32	171	
MT 8719	50.9	60.7	32	171	
WINALTA	49.1	61.7	40	171	4
MTSF2238 **	48.2	61.9	34	166	
AGASSIZ	47.5	58.3	39	172	4
KARL 92	47.2	60.7	29	160	
WESTON	43.5	59.6	33	172	
NORSTAR	43.4	59.5	39	176	

(continued on next page)

(Conrad Winter Wheat continued)

Variety	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Head date	Spring survival class /1
JUDITH	43.1	56.7	32	171	3
ROUGH RIDER	41.6	60.3	35	172	

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, Pondera County.
Fertilizer: 100# 11-51-0 with the seed, + 35# N broadcast.
Previous crop: Fallow.
Date seeded: Sept. 28, 1993.
Date harvested: Aug. 11, 1994.
Rainfall: From April 1 to harvest was 5.23 inches.
1/ = Spring survival class: 5=best; 1=very low; based
several location-years of observation.
Yield experimental mean: 56.17
Error degrees of freedom: 96.00
F test for var. = 4.10, c.v. 2 = 7.60, LSD (0.05) = 11.99
* = Hard white wheat.
** = Sawfly resistant variety.

Table 3. **Five-year summary for Winter Wheat varieties grown near Conrad, MT. 1988 - 1989 - 1990 - 1993 - 1994. 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 1/
QUANTUM 542	63.2	62.2	35.6	166	11.6
NEELEY	60.8	61.2	32.4	171	11.7
BLIZZARD	60.2	61.5	34.4	173	12.3
MT 7811	60.0	61.3	32.8	169	12.1
TIBER	58.7	62.5	34.4	169	11.2
ROCKY	58.6	63.4	32.2	166	11.2
WINRIDGE	58.4	60.0	34.8	171	10.2
MT 8713	56.3	62.4	27.4	168	11.9
JUDITH	56.1	60.6	32.4	167	10.5
CENTURK	55.6	62.7	32.8	165	11.7
MT 8719	54.3	62.5	30.0	170	12.6
WESTON	54.1	60.4	34.9	168	11.5
REDWIN	53.3	61.2	33.0	169	12.0
WINALTA	52.1	63.1	36.8	168	12.8
AGASSIZ	51.6	61.7	38.4	170	11.8
NORSTAR	51.5	61.8	40.4	174	11.6
ROUGH RIDER	47.5	62.1	34.8	168	12.6

Cooperator: Conrad Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 1/ = Proteins based on four years of data. (1988-89-90-93-94)

Table 4. Dryland Winter Wheat variety trial grown near Chester, 1994. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Spring survival class 1/	% protein
ROCKY		49.1	59.3	30	2	13.7
HAWK		48.2	61.7	23	2-3	15-3
ARAPAHOE		46.9	59.7	27	3	14.8
MT 7811	*	46.4	57.2	30		15.1
QUANTUM 542		46.1	58.0	29	3	14.5
CENTURK		46.1	58.1	31	2	14.2
NEELEY		45.9	56.2	27	3	14.6
ARCHER		45.9	57.0	26		14.2
MANNING		45.7	56.9	29	2	14.8
MT 8713		43.1	59.2	25		15.2
MTS92042	**	42.2	58.1	30		15.3
S86-736		41.6	54.7	31		14.3
WINRIDGE		41.4	56.3	29	2	14.4
AC READYMADE		41.4	59.0	31	3	15.9
BIGHORN		41.3	57.6	27	3	14.7
MTSF2238	**	40.9	58.3	27		16.1
TIBER		40.4	58.7	30	3	16.5
MT 8719		39.7	60.1	26		15.8
KESTREL		39.6	55.0	30	5	14.8
REDWIN		39.2	58.6	30	3	16.0
JUDITH		38.3	55.1	27	3	15.0
WESTON		37.4	58.8	31	2	15.3
NORSTAR		36.0	57.8	33	5	15.1
AGASSIZ		35.3	57.8	35	4	15.4

Cooperator: Mike Violet.

Location: Ten miles southwest of Chester, Liberty County.

Fertilizer: 100# 11-51-0 with the seed, + 45 units AA-N.

Previous crop: Fallow.

Date seeded: Sept. 27, 1993.

Date harvested: Aug. 1, 1994.

Rainfall: From May 3 to harvest was 2.9 inches.

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

Yield experimental mean = 42.42

Error degrees of freedom = 46.00

F test for var. = 3.59.

c.v. 2 = 4.83.

LSD (0.05) = 5.83

* = Hard white wheat.

** = Sawfly resistant variety.

Table 5. **Five-year summary for Winter Wheat varieties grown southwest of Chester, MT. 1988 - 1989 - 1990 - 1993 - 1994. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.**

Variety	5 - year comparable average				
	Years grown	Yield bu\ac	Test wt. lbs\bu.	Plant hgt. inches	% Protein
NEELEY	5	50.4	57.5	28.4	14.0
QUANTUM 542	3	50.0	57.9	30.6	13.3
KESTREL	2	48.9	57.3	29.7	12.5
ROCKY	5	47.3	58.9	29.6	14.0
MT 7811	3	47.1	57.8	29.4	13.3
ARAPAHOE	2	47.0	58.7	27.8	14.7
ARCHER	3	46.9	60.3	27.0	13.6
TIBER	5	46.8	58.6	29.8	14.2
JUDITH	5	46.8	58.4	29.4	14.1
CENTURK	5	46.2	58.1	29.0	13.8
AC READYMADE	2	46.1	59.2	30.1	15.1
WINRIDGE	5	45.7	56.7	29.2	13.3
BIGHORN	2	45.4	58.8	26.8	14.3
REDWIN	5	44.6	59.5	29.0	15.2
MANNING	2	44.2	57.7	27.8	14.1
HAWK	3	43.9	60.0	24.3	14.8
NORSTAR	5	42.8	59.8	33.2	13.7
WESTON	2	42.6	59.7	31.1	15.1
AGASSIZ	3	40.1	58.4	34.0	15.2

Cooperator: Mike Violet.

Location: Ten miles southwest of Chester, MT. (Liberty Co.)

Table 6. Dryland Winter Wheat variety trial grown near Dutton, 1994. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Spring survival class 1/	% protein
ARCHER		53.0	56.8	33		12.74
MTSF2238	**	50.5	59.1	33		12.16
MTS92042	**	49.7	59.3	33		12.82
ARAPAHOE		47.6	58.7	33	3	13.69
ROCKY		46.6	59.3	36	2	12.12
AC READYMADE		46.1	59.5	37	3	13.22
HAWK		45.9	61.9	27	2-3	12.57
TIBER		45.5	60.0	36	3	13.89
REDWIN		45.2	59.7	37	3	12.85
CENTURK		44.4	58.8	35	2	12.74
QUANTUM	542	43.4	59.0	34	3	12.00
MANNING		43.2	56.8	34	2	12.54
MT 8719		42.8	58.8	34		13.12
BIGHORN		42.6	58.3	31	3	11.48
S86-736		41.7	56.9	35		11.88
WINRIDGE		40.1	56.8	36	2	12.86
NEELEY		39.7	58.3	36	3	11.58
WESTON		38.5	57.9	36	2	13.75
MT 8713		37.7	59.3	30		11.87
KESTREL		35.9	56.2	37	5	12.04
AGASSIZ		35.7	57.9	40	4	13.64
JUDITH		35.2	55.2	35	3	12.37
MT 7811	*	33.5	56.8	35		13.27
NORSTAR		33.4	59.3	37	5	14.13

Cooperator: Darrell Goodmundson.

Location: Three miles east of Dutton, Teton County.

Fertilizer: 100# 11-51-0 with the seed, + 90# AA-N.

Previous crop: Fallow.

Date seeded: Sept. 27, 1993.

Date harvested: Aug. 1, 1994.

Rainfall: From May 3 to harvest was 2.8 inches.

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

Yield experimental mean = 42.41

Error degrees of freedom = 46.00

F test for var. = 5.63

c.v. 2 = 5.39

LSD (0.05) = 6.50

* = Hard white wheat.

** = Sawfly resistant variety.

Table 7. **Five-year summary for Winter Wheat varieties grown east of Dutton, MT. 1988 - 1989 - 1990 - 1993 - 1994. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.**

Variety	5 - year comparable average				
	Years grown	Yield bu\ac	Test wt. lbs\bu.	Plant hgt. inches	% Protein
ARAPAHOE	2	57.7	59.7	29.5	12.7
NEELEY	5	56.5	60.3	32.8	11.9
ARCHER	3	56.3	59.0	31.9	11.6
REDWIN	5	55.5	60.0	34.4	12.4
BIGHORN	2	55.5	60.2	29.5	11.1
ROCKY	5	54.8	61.0	33.4	11.3
MANNING	2	54.2	58.8	32.4	10.8
TIBER	5	51.6	60.4	34.2	11.8
QUANTUM 542	4	54.1	59.7	33.7	11.2
AC READYMADE	2	53.4	60.6	36.2	12.1
JUDITH	5	52.1	59.0	33.2	12.0
HAWK	2	50.4	61.8	25.2	11.0
CENTURK	5	49.2	60.6	32.0	11.7
NORSTAR	5	48.5	60.8	38.2	12.6
WINRIDGE	5	47.9	59.1	34.6	11.0
KESTREL	2	46.3	59.0	35.2	10.2
AGASSIZ	2	43.8	59.7	38.1	12.7
WESTON	2	44.5	60.2	34.7	12.9
MT 7811	2	43.9	59.5	33.3	11.8

Cooperator: Darrell Goodmundson.

Location: Three miles east of Dutton, MT.

(Teton County)

Title: Spring wheat variety investigations.

Year: 1994

Location: Western Triangle Research Center, Conrad, MT.

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

Spring wheat and durum varieties were grown on dryland and irrigated at Conrad, and dryland spring wheat variety trials were grown near Cut Bank, Oilmont, and Choteau. Data for the wheat trials are presented in Tables 8-18, and durum in Tables 19-22. 1994 data and five-year averages are included. (Emphasis should be placed more on the five-year averages when predicting which varieties are best suited for a given area. The 1994 tables reflect performance under the conditions of only one year, and therefore should not be relied on too heavily).

Growing season rainfall was approximately 60 to 70 percent of normal, but abundant stored soil moisture at planting time maintained plant growth long enough to produce fairly good yields. Test weights were low at Conrad, Oilmont and Choteau, as soil moisture was eventually depleted. Disease was not detected at any of the sites.

Severe infestation of sawfly occurred at Choteau, but lodging had not progressed appreciably by the time the plot was harvested. Sawfly infestation also occurred at Conrad, but parasitism resulted in nearly 100 percent sawfly larval mortality. Although many of the varieties tested are classified as being sawfly resistant (indicated by an * in the data tables), the level of resistance has not been fully determined on some of the newer varieties. Resistance levels may range from 50 to 90 percent.

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

SPRING WHEAT VARIETY NOTES

Far-Go herbicide tolerance:

Most Tolerant: Fortuna, NK 751, Rambo, Success, Bronze Chief, Kodiak, Len, Oslo, Butte, Marshall, Glenman, Stoa, Grandin, Cutless, McNeil, Gus, Penewawa, Owens, Olaf.

Intermediate: WP 906R, McKay, Klasic.

Least Tolerant: Borah, Newana, Lew, Pondera, Fremont, Alex, Amidon, Era, Erik, Ellar, Hiline.

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. Incorporate Far-Go 1.5" deep (run tillage equipment 3" or less). 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. If the soil is light and has little organic matter, injury to the spring wheat is more likely.

1) Semidwarf Sawfly resistant varieties:

Border (WPB)- Early maturity (4 days earlier than Fortuna). Semidwarf. Medium yield and protein. Solid stem in some years, sawfly resistance about like Rambo.

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

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

Rambo, Westbred (WPB)-Sawfly resistance-partial (36% less solid than Fortuna). Short stiff straw, but medium lodging resistance. Bearded semidwarf. Threshes easily, high yield, similar to Glenman. Medium-low protein similar to Glenman, but 1% lower than Lew and 2% lower than Fortuna. May have more tolerance to septoria than Fortuna, but is still susceptible. Test weight high.

2) Standard Height Sawfly resistant Varieties:

Amidon (ND 606)-Standard height, bearded. Partial solid stem (30% less solid than Fortuna), lodges worse than Fortuna. Weak broken stems. Same maturity as Lew, but slightly higher yield. Slightly later to mature than Pondera. Yield and test weight is medium to high. High protein like Fortuna. Does well in dry areas. Moderately susceptible to septoria. Sawfly resistance not sufficient for severely infested areas. Has shown good tolerance to wheat streak mv (3 on scale of 1-3).

CONTINUED

Eatonia (Ag Canada Sask; Agripro) - 3% higher yield than Leader. Maturity, test weight, & height similar to Leader. Larger kernels, greater stem solidness, & better resistance to common root rot than Leader. Straw strength slightly less than Leader.

Fortuna(ND)-Beardless, high protein and test weight, early maturing; medium to low yield. Apparently tolerant to Fargo. Very susceptible to septoria. Somewhat susceptible to shattering. Very good sawfly resistance.

Lancer(Sask. Canada)-Awnless. Among lowest yielders and seldom a protein advantage over Lew and Fortuna. Tangled lodging mess due to weak straw. Test weight medium-low.

Leader-(Canada) Among lowest yielders. Seldom a protein advantage over Lew and Fortuna.

Lew(MSU)-Beardless. Septoria tolerance moderate. 3 days later, and slightly lower protein than Fortuna, and susceptible to Fargo. Average yield similar to Fortuna. Avenge herbicide cannot be used. Medium to high test weight. Better shatter resistance than Fortuna. Medium-high protein, but less than fortuna. Good sawfly resistance (10 to 15% less than Fortuna, but 22% more resistant than Amidon).

Tioqa (ND)-Beardless, standard height. Medium test weight, high protein, low yield. Good shatter resistance. Susceptible to lodging. Septoria tolerant.

3) Hollow Stem varieties (sawfly susceptible):

Alex-(ND) beardless. Standard height, semidwarf, medium lodging, high protein. Good shatter resistance and test weight.

Bergen -(Agripro), 1991. For Minnesota. Medium test weight, low protein, semi-dwarf, good lodging resistance, medium-late maturity.

Bronze Chief(Seed Research Inc.)-Very low yield and tough threshability. Very high protein. Used in specialty milling market at Three Forks, MT.

Butte (ND) - Standard height. Early maturity (one day earlier than Fortuna). Low yield. Sawfly susceptible.

Butte 86(ND) - Stronger straw than Butte. Low yield. Medium height. Bearded. Early maturity. Medium test weight, high protein. Septoria susceptible.

Copper(Idaho) - Intended to replace McKay (higher quality) in Idaho, but acreage less than expected. Protein and test weight is 1% less than Pondera. Awned semidwarf. Late maturity. Straw weaker than Pondera and 906R.

Fergus (WPB, TR983239) - Similar to WB926, but is shatter resistant. Red chaff.

Field-(Agripro)-Medium yield, short stiff straw, medium maturity, low test weight and protein.

Grandin (ND)-To replace Stoa in North Dakota. Semidwarf, good lodging resistance, bearded, medium high protein. Maturity similar to Pondera. Yields less than Pondera and Hi-Line.

Gus(ND)-For high yield areas of Eastern Montana. Semidwarf; good lodging resistance, bearded. Very high protein and medium-late maturity (like Newana). Lower yield than Pondera and Hi-Line.

Hi-Line(MT8402) - Semidwarf. Higher protein and 3 days earlier than Newana. Hi-Line yields greater than Newana on dryland, but similar to Newana on irrigated. Test weight slightly higher than Newana. Hi-Line yields similar to Pondera on dryland, but is 3 bu/a better than Pondera on irrigated. Protein and maturity of Hi-Line is similar to Pondera; but height is one inch shorter and test weight is slightly less than Pondera. 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. Fair tolerance to wheat streak mv (2.5 on scale of 1-3).

Kamut (*T. polonicum* 4x)-Polish wheat: about like durum; seeds bigger than durum. Non-allergenic gluten. 1% more protein than Pondera. Pasta & cereal products. 4 to 6" taller than Fortuna. Four days later to mature than Pondera. Too tall for irrigation.

Kodiak -Triple Dwarf-10" lower than Newana; 18" lower than Fortuna. Very low yield.

Len, (ND)-Bearded semidwarf. High protein. Straw not as stiff as Newana. Good quality, shatter resistance, and test weight. Tolerant to septoria. Yields similar to Pondera and Hi-Line, but Len has slightly lower protein.

Marshall (Minn)-Bearded, semidwarf, high yield and test weight on irrigated; good lodging resistance, low protein. Irrigation only.

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

McNeil (MSU) - Semidwarf but slightly taller and more uniform height than Hiline. Higher yield than Hiline. Maturity about equal or slightly earlier than Newana. Very good quality - high protein and loaf volume. Test weight about equal to Newana & Hiline, but 1#/bu less than Pondera. Good lodging resistance. Fair tolerance to wheat streak mv (2.5 on scale of 1-3).

Minnproe (MINN)-Bearded, semidwarf. short stiff straw, medium maturity, low test weight, medium protein.

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

Nomad (WPB)-Semidwarf, good lodging resistance, medium-early maturity, beardless medium test weight (but higher than Glenman), medium protein.

Norak-NAPB.

Nordic-Tall semidwarf; straw and protein are marginal for high yield, irrigation areas.

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

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

Pondera (MSU)-Semidwarf with good lodging resistance. A higher protein, earlier maturity (3 days) version of Newana. Sawfly susceptible. Good on irrigation or dryland. High yield and test weight. Tolerant to septoria.

Prospect (SD)-Bearded, semidwarf, low yield, medium maturity, medium lodging, high protein and test weight.

Probrand 751 (NK)-High yield on irrigated, short stiff straw, low test weight and protein. For irrigation only. Good shatter resistance.

Stoa (ND)-Poor yield in triangle area, but popular in North Dakota because of protein. Bearded standard height. Lew and Pondera compete with it quite well in triangle area. To be replaced in ND by Grandin. Later to mature than Pondera and Grandin.

Success-(Cenex)Medium high yield with irrigation. Semidwarf, late maturity, low test weight and protein. Medium lodging resistance.

Telemark-(Agripro) medium early, good protein, short excellent stiff straw, semidwarf; good yield with irrigation.

Thatcher-Tall beardless. Very low yield.

Vance (MINN)-Bearded semidwarf, medium test weight, low protein.

Vandal (Idaho)-For irrigated only.

Wampum (Mn) - Semidwarf. Very high yield on irrigated. Low protein. Very susceptible to rust.

Westbred Express (WPB) - Among highest yielders when tested at Conrad 1993. Protein about equal to Glenman. Reported to be tolerant to Avenge herbicide.

Westbred 926R (WPB) - Bearded semidwarf. Among highest yielders. Earlier maturity than Newana. Susceptible to Avenge herbicide. See Fergus & 936.

Westbred 936 (WPB) - Possible replacement for 906 and 926. Superior to 906 and 926 as an irrigated variety. (Tested as ph986-61 in 1992). Does not have Hessian fly or dryland root rot resistance, thus 926 is preferred in those areas. 936 is stiffer strawed than 926. Protein appears good. Reportedly tolerant to Avenge herbicide.

Wheaton (MN) Bearded semidwarf, low protein and test weight. High yield with irrigation. Short stiff straw, good lodging and good shatter resistance, medium to low test weight.

4) Soft White Spring Wheat

AC Reed (Alberta, Can.) - Resistant to prevalent races of stripe rust. Higher yield, two days earlier maturity, and higher milling & baking quality than Fielder. Good lodging resistance and moderate shatter resistance. Adapted to irrigated regions of southern Alberta.

Fielder- Semidwarf. Highly susceptible to stripe rust and can lose 40% yield.

Owens (Idaho/Oregon)-Semidwarf. Earlier than Waverly and Treasure, but still may be too late for dryland in most years. Stripe rust resistant. Short straw, medium maturity and test weight.

continued

Penawawa-(Wash/Oregon)Semidwarf. Replacement for Owens? Bearded. shorter and stiffer straw than Owens, later to mature than Owens, and lower test weight.

Sprite-WPB

SWS-52-(Canadian) - Much better lodging resistance than Owens, but 5-6 days later than Owens and Fielder. Resistant to stripe rust (like Owens).

Treasure-Late maturing. Yields higher than Owens on irrigated; and also on dryland in years of favorable moisture.

Waverly-Late maturing.

- 5) Hard White Spring-For specialty market. Protein of hard white will probably need to be at least 13% to meet market standards. In order to be officially classified as Hard White by U.S. Grain Standards, the developer/owner of the variety must petition for classification. Hard whites 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.

Genesis(Canada) - not tested in Montana.

Golden 86 (Private Variety)-Owned by a commercial milling and baking firm north of Three Forks, Montana. A high quality hard white for specialty markets. Yielded more than Klasic, but less than Tanager (1 year), and 1.5 to 2% higher protein than Tanager and Klasic.

Klasic-(NK) Hard white. Adapted to California. Not well adapted to Triangle area. Officially classified as a hard white by U.S. Grain Stds.

MT 8182-Fairly high protein and yield on irrigation or dryland. Bearded, hard white.

Tanager "S"(CIMMYT)-Very high yield (steep BYX) hard white.

DURUM

(Durum quality scale: 1 - 4; 1 = low, 4 = high).

Cando(ND) - Very short semidwarf. Very high lodging resistance. For irrigation or favorable moisture. Not suited for dry conditions. Good shatter resistance and high yield. Test weight medium. Septoria susceptible. Quality = 2.

Coulter (Canada)- Blackbearded, but blackness disappears upon ripening.

Crosby(ND) - Standard height. Fair lodging resistance on dryland, and good shatter resistance. Test weight medium to high. Quality = 2.

Fjord - (Agripro, NAPB developed) - Standard height, medium yield durum.

Golden Ball - Black bearded Canadian - old variety, seed may be hard to find - for wheat weaving.

Laker, Westbred - (WPB) - Semidwarf. High yield, stiff straw, medium lodging resistance, midway between standard height and semidwarf, better height choice for all around production, not as short as Lloyd and Cando. Diseased in irrigated in 1989, while other entries were not. Recommended for Dist 2-6. Protein medium. High test weight. Quality = 3.

Lloyd(ND) - Very short. For irrigation or favorable moisture. Not suited for dry conditions. Very high lodging resistance. Good quality. High yield and good shatter resistance. Test weight is medium.

Medora - (Manitoba, Canada) - Standard height, with fair lodging resistance. Dryland only, medium to early maturity. Good yield on dryland, better than Monroe. Test weight is medium to high. Quality = 4.

Monroe(ND) - Standard height, fair lodging resistance for dryland. Early maturity, dryland only. Test weight is medium. Quality = 4.

Pelissier - Black bearded Canadian. Wheat weaving.

Pendur(WPB) -Does not do well in Triangle area.

Plenty (Canada) - High yield, but very tall weak straw. Lodges easily. Late maturing. Quality = 4.

Regal, Westbred (WPB)-Standard height durum for dryland areas of Montana and North Dakota. Excellent semolina color and strong gluten. Medium yield, high test weight, medium-low protein.

Renville(ND) - (Rollette/Vic) -Standard height. 1 day later and greater yield than Vic. Tall, lodges bad; thus, even though it yields good on irrigation, its weak straw renders it unsuitable for irrigation. Has a niche in the low yield/low rainfall areas. Test weight is medium. Quality = 4.

Rolette(ND)-Standard height. Good shatter resistance and test weight. Good quality. Susceptible to leaf spot diseases.

Rugby(ND)-Standard height. Good shatter resistance. Medium test weight. Good quality. Moderately susceptible to septoria.

Sceptre(Sask. Can.) - Standard to medium height, but fairly stiff straw. Taller than Laker, but shorter than Medora and other standard height varieties. High yield. Quality = 4.

Stockholm - (Agripro, NAPB developed) - Semidwarf (short like Lloyd and Cando), medium early durum. High yield (Similar to Lloyd, and higher than Fjord). Very stiff straw. Protein medium to low. Quality = 3.

Vic(ND) - Tall weak straw. Good shatter resistance and high test weight. Quality = 4.

Ward(ND) - Standard height with fair lodging resistance for dryland, and good shatter resistance. Test weight medium. Tolerant to septoria. Quality = 2.

TRITICALE

- 1) Spring Triticale: Assume all triticales have a potential ergot problem!

Carman (Canada) - early maturing (similar to Newana wheat in maturity) by triticale standards; generally the best for dryland; and generally higher protein. Shorter straw than Welsh triticale, but still tall.

Juan(Calif.)- Too late to mature, resulting in low yield & T.W. some yrs.

Karl(N. Dakota)-Early maturing (similar to Newana wheat in maturity) by triticale standards; generally the best for dryland; and generally higher yield & protein. A semidwarf; thus, easier to manage than taller & later varieties. Similar height as Newana wheat.

Kramer - (N. Dakota) - Very early maturity by triticale standards. Good yield. A semidwarf, but slightly taller than Newana wheat and Karl triticale. Kramer is medium height, while Karl and Newana are short.

Marval(S. Dak.) - Medium maturity. Low yield on dryland in some years.

T-54, T-59, T-61 - (Saskatchewan) Very late maturity. Look like wheat, and have test weights nearly equal to wheat.

Wapiti - (Canada) - To replace Carman and Welsh. High yield but tall weak straw and late maturity.

Welsh - (Canada) - Late maturing, may be discontinued.

Whitman(Wash.) - Too late to mature, resulting in low yield & test weight in some years.

Test weight of triticale = approximately 50 lbs/bu. Proteins were less than Newana wheat, but slightly higher than barley. Triticale seed rate 20% higher than wheat. Relative maturities and heights for triticale:

Newana wheat	very early	short
Kramer	very early	med short
Carman	early	med. tall
Karl	early	short
Marval	medium	very tall
Welsh	medium late	tall
Beagle	late	tall
Wapiti	late	med. tall
Sunland	very late	med. tall
T-54	very late	tall
T-61	very late	tall
Juan	extreme late	tall
Whitman	extreme late	tall

2) Winter Triticale

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

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

Grace - Poor winterhardiness (May be a spring type). Stembreakage and crinkle-joint.

Winteri - (Canada) - Very tall and late maturing.

VTO numbers from 1988: winter types according to Peterson (WSU).

Table 8.

Advanced Yield Dryland Spring Wheat variety trial grown north of Conrad, 1994. 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
WESTBRED 926	58.7	59.0	29	176	14.5
GLENMAN *	54.8	59.4	31	181	13.9
PENAWAWA (s. white)	54.2	58.2	28	178	13.6
NEWANA	53.9	58.8	31	181	14.2
MT 9373	53.3	59.7	30		14.2
MT 9333	52.4	59.4	35		15.3
MT 9265	52.4	59.0	33	180	14.1
VANNA	52.1	56.9	30	178	14.4
BZ990516	50.5	57.6	30		13.1
RAMBO *	50.1	56.5	31		14.1
WESTBRED 936	50.0	57.4	26	176	15.6
OWENS (s. white)	49.4	58.7	30	179	14.3
FORTUNA *	49.1	59.5	39	180	15.4
MT 9311	48.8	59.4	33		14.6
MT 9328	48.7	58.4	34	181	14.8
MT 9354	48.5	60.4	36	180	15.6
MT 9327	48.4	59.0	34		14.9
MCNEAL	48.0	57.9	30	181	15.3
MT 9323	46.8	59.1	37		15.4
MT 9315	46.3	57.7	34		15.3
WESTBRED EXPRESS	46.2	59.1	26	178	14.8
MT 9257	45.8	59.5	31	178	14.6
MT 9336	45.7	58.6	34	180	14.3
BORDER *	45.6	59.4	30	177	14.9
N90-700 *	45.6	59.1	29	177	14.7
MT 9341	45.3	57.8	35		14.6
MT 9324	44.7	56.0	36		15.8
MT 9302	44.6	58.8	32	178	15.5
ND 677 *	44.5	58.8	35	178	15.7
WESTBRED FERGUS	44.4	57.6	32	178	15.0

(continued on next page)

(Advanced yield Spring Wheat) *Continued*

Variety		Yield	Test wt.	Height	Date	Protein
MT 9325		44.2	57.7	38		15.3
MT 9309		44.2	57.4	35	181	15.6
MT 9307		43.8	59.7	36		16.4
MT 9332		43.4	57.6	32	181	15.5
HI-LINE		43.0	59.4	27	177	15.1
LEW	*	42.7	59.9	35	181	15.4
MT 9209		42.6	57.5	33	179	15.1
MT 9340		42.6	56.5	33		14.4
PONDERA		42.0	58.3	31	178	15.2
MT 9322		40.4	56.3	35		15.9
MT 9313		39.3	56.9	33		16.1
STOA		38.7	58.8	36	180	15.1
AMIDON	*	38.1	57.9	35		15.2
AC EATONIA	*	37.8	57.7	36	180	16.4
CUTLESS	*	37.8	58.3	33	180	15.9
BW 688	*	37.7	58.2	35	181	16.3
MT 9360		37.5	59.7	31	179	15.5
LEN		37.0	58.5	31	181	15.8
MT 9339		35.8	57.2	34		15.1
MT 9303		35.3	58.7	32	178	15.9
MT 9321		35.0	58.9	36		14.2
THATCHER		32.1	56.9	36	180	16.0

Cooperator: Western Triangle Ag. Research Center.

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

Fertilizer: 100# 11-52-0 with the seed, + 35# N actual
topdressed before seeding.

Previous crop: Fallow.

Date seeded: April 19, 1994.

Date harvested: August 17, 1994.

Rainfall: From seeding to harvest was 5.23 inches.

Soil probe depth at seeding: 36 + inches.

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

Yield experimental mean: 44.99

Error degrees of freedom: 102.00

F test for var = 2.55, C.V. 2 = 8.18, LSD (0.05) = 10.33

Table 9. **Advanced Yield Dryland Spring Wheat variety trial grown north of Conrad, 1994. Montana Agr. Expt. Station, Western Triangle Ag. Res. Center, Conrad, MT. (abbreviated list)**

Variety	Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	Head date	% protein
WESTBRED 926	58.7	59.0	29	176	14.5
GLENMAN *	54.8	59.4	31	181	13.9
PENAWAWA (s. white)	54.2	58.2	28	178	13.6
NEWANA	53.9	58.8	31	181	14.2
VANNA	52.1	56.9	30	178	14.4
RAMBO *	50.1	56.5	31		14.1
WESTBRED 936	50.0	57.4	26	176	15.6
OWENS (s. white)	49.4	58.7	30	179	14.3
FORTUNA *	49.1	59.5	39	180	15.4
MCNEAL	48.0	57.9	30	181	15.3
WESTBRED EXPRESS	46.2	59.1	26	178	14.8
BORDER *	45.6	59.4	30	177	14.9
ND 677 *	44.5	58.8	35	178	15.7
WESTBRED FERGUS	44.4	57.6	32	178	15.0
HI-LINE	43.0	59.4	27	177	15.1
LEW *	42.7	59.9	35	181	15.4
PONDERA	42.0	58.3	31	178	15.2
STOA	38.7	58.8	36	180	15.1
AMIDON *	38.1	57.9	35		15.2
AC EATONIA *	37.8	57.7	36	180	16.4
CUTLESS *	37.8	58.3	33	180	15.9
LEN	37.0	58.5	31	181	15.8
THATCHER	32.1	56.9	36	180	16.0

Cooperator: Western Triangle Ag. Research Center.

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

Fertilizer: 100# 11-52-0 with the seed, + 35# N actual
topdressed before seeding.

Previous crop: Fallow.

Date seeded: April 19, 1994. Date harvested: Aug. 17, 1994.

Rainfall: From seeding to harvest was 5.23 inches.

Soil probe depth at seeding: 36 + inches.

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

Yield experimental mean: 44.99

Error degrees of freedom: 102.00

F test for var. = 2.55, C.V. 2 = 8.18, LSD (0.05) = 10.33

Table 10. **Five-year summary** for dryland **Spring Wheat** varieties grown near **Conrad, MT.** 1989 - 1990 - 1991 - 1993 - 1994. 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

PENAWAWA (s. white)	69.3	59.8	31.4	188	11.1
RAMBO *	66.5	58.5	32.4	189	13.3
WESTBRED 926	65.4	60.7	31.6	182	13.7
GLENMAN	64.6	60.2	34.4	187	12.8
OWENS (s. white)	64.3	58.7	33.4	185	10.7
WESTBRED EXP.	64.0	59.7	28.7	188	13.2
NEWANA	63.7	59.4	32.4	188	12.8
HI-LINE	63.6	60.8	31.0	184	13.5
AMIDON *	62.5	60.4	39.6	186	13.2
PONDERA	62.3	61.1	33.8	184	13.7
BORDER *	60.3	61.3	33.6	183	13.9
FORTUNA *	58.9	61.4	41.0	186	13.7
LEW *	57.8	61.7	39.8	188	13.7
LEN	56.9	59.8	32.8	183	14.2
STOA	54.1	60.3	39.4	186	13.2
CUTLESS *	53.7	60.6	37.4	186	14.5
THATCHER	51.3	59.5	42.6	186	13.5

Cooperator: Western Triangle Agricultural Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 * = Sawfly resistant varieties. (Amidon, Rambo and Border partial resistance.)

Table 11. Irrigated Spring Wheat variety trial grown north of Conrad, 1994. Mont. Agr. Expt. Station. Western Triangle Ag. Research Center, Conrad, MT.

Variety		Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	Head date	% protein
PENAWAWA	(s. white)	74.2	60.3	31	180	8.5
OWENS	(s. white)	65.3	57.4	34	179	10.0
RAMBO	*	54.6	61.7	31		9.8
MCNEAL		53.2	60.5	33	181	10.0
NEWANA		52.7	60.1	33		9.8
CUTLESS	*	51.4	60.2	33	181	10.5
GLENMAN	*	50.2	61.2	35		8.7
SOJNA		49.8	60.2	29	180	8.8
N90-700	*	49.5	60.0	32	178	11.2
HI-LINE		49.4	61.9	31	181	10.2
GRANDIN		48.7	59.6	37	181	11.8
WESTBRED 926		48.5	60.0	30	177	10.1
PONDERA		47.3	60.9	36		10.1
AMIDON	*	47.0	58.6	40		10.3
LANCER	*	45.8	60.8	45		12.1
ND 677	*	45.3	58.6	39	180	12.8
KLASIC	(h. white)	44.3	60.2	23	176	10.5
LEW	*	42.9	61.4	42		10.0
BW 688	*	41.1	58.6	40	180	11.8
AC EATONIA	*	40.8	59.6	41	181	12.8
LEN		39.3	59.5	33	181	11.2
BORDER	*	39.0	60.7	33	177	10.7
STOA		39.0	58.1	38	181	10.8
KRONA		38.8	60.3	30		9.1
FORTUNA	*	35.9	61.4	40		10.1

Cooperator: Western Triangle Ag. Research Center.

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

Fertilizer: 100# 11-52-0 with the seed, + 35# N topdressed.

Previous crop: Fallow.

Date seeded: April 19, 1994. Date harvested: Aug. 23, 1994.

Rainfall: From seeding to harvest was 5.23 inches.

Irrigation dates: June 20, June 30, July 11. (Approximately 2 inches of water applied per irrigation.)

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

Yield experimental mean = 47.76, Error degrees of freedom = 48
F test for var. = 2.60, C.V. 2 = 10.99, LSD (0.05) = 14.92

Table 12. **Five-year summary for Irrigated Spring Wheat varieties grown near Conrad, MT. 1989 - 1990 - 1991 - 1993 - 1994. 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

PENAWAWA	(s. white)	83.8	60.9	33.8	186	9.0
OWENS	(s. white)	74.7	59.3	35.0	186	9.5
RAMBO	*	68.1	59.3	33.4	187	10.6
NEWANA		65.8	61.2	34.2	187	11.1
HI-LINE		65.7	62.5	33.4	184	11.7
GLENMAN	*	65.0	61.7	36.0	186	10.8
PONDERA		64.1	62.4	35.2	185	12.0
AMIDON	*	63.5	60.7	40.8	185	11.8
CUTLESS	*	62.0	61.5	35.4	186	12.0
KLASIC	(h. white)	61.4	62.5	25.1	184	11.2
WESTBRED 926		61.1	57.1	29.7	183	11.1
LEW	*	60.9	62.8	41.8	187	11.5
LEN		57.7	58.3	31.2	182	11.2
FORTUNA	*	57.3	62.9	40.4	184	11.6
GRANDIN		55.5	57.5	33.9	184	11.6
STOA		53.3	58.0	37.3	184	11.0
LANCER	*	46.2	57.7	40.0	186	11.8

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

Table 13.

Dryland Spring Wheat variety trial grown near
Cut Bank, 1994. Mont. Agr. Expt. Sta., Western
Triangle Ag. Research Center, Conrad, MT.

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Protein
PENAWAWA	(s. white)	48.2	61.7	26	8.7
OWENS	(s. white)	42.2	61.3	29	8.7
FORTUNA	*	41.7	61.5	33	10.3
STOA		40.6	67.7	33	10.3
AMIDON	*	40.5	59.9	36	10.6
GRANDIN		40.1	61.5	32	10.7
MCNEAL		40.1	61.5	28	10.2
LEN		39.4	61.4	31	11.3
N90-700	*	39.0	62.5	28	10.4
ND 677	*	38.4	62.2	34	10.8
WESTBRED 926		38.1	61.1	28	10.3
GLENMAN	*	37.5	61.0	30	9.7
NEWANA		37.4	61.2	27	10.0
HI-LINE		37.1	61.8	26	10.3
AC EATONIA	*	37.0	59.9	34	10.7
RAMBO	*	36.9	60.5	27	10.7
PONDERA		36.8	62.0	29	11.2
CUTLESS	*	36.1	61.7	32	11.1
KLASIC	(h. white)	36.1	62.2	21	8.8
LEW	*	35.7	61.7	35	10.1
BW 688	*	35.4	60.3	31	10.3
SHOOFLY	*	34.8	61.3	27	8.1
BORDER	*	34.4	62.8	28	10.1
LANCER	*	28.5	61.9	34	10.6

Cooperator: Don Bradley.

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

Fertilizer: 100# 11-52-0 with the seed.

Previous crop: Fallow.

Date seeded: May 4, 1994. Date harvested: Aug. 23, 1994.

Rainfall: From seeding to harvest was 3.75 inches.

Soil probe depth at seeding: 36 + inches.

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

Yield experimental mean = 38.01, Error degrees of freedom = 46
F test for var = 3.72, C.V. 2 = 4.91, LSD (0.05) = 5.31

Table 14. **Five-year summary** for dryland **Spring Wheat** varieties grown near **Cut Bank, MT.** 1990 - 1991 - 1992 - 1993 - 1994. 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	% Protein

PENAWAWA	(s. white)	47.7	59.0	28.8	9.8
OWENS	(s. white)	45.0	57.5	31.0	10.0
AMIDON	*	41.8	58.1	37.0	11.7
HI-LINE		40.1	60.0	28.8	11.5
GLENMAN	*	39.9	58.1	30.4	10.9
PONDERA		39.3	60.2	30.2	12.1
LEN		39.2	58.4	30.0	12.0
STOA		39.0	60.1	34.4	11.2
RAMBO	*	39.0	58.4	29.4	11.0
WESTBRED 926		38.9	58.3	29.6	11.5
GRANDIN		38.5	59.9	32.6	12.2
FORTUNA	*	37.4	60.0	35.4	11.8
LEW	*	36.7	58.9	35.6	11.4
NEWANA		36.7	58.3	28.8	11.3
CUTLESS	*	36.0	59.6	33.8	12.0
KLASIC	(h. white)	35.2	60.2	22.9	11.2
LANCER	*	33.8	59.9	37.2	11.6

Cooperator: Don Bradley.

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

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

Table 15. **Dryland Spring Wheat variety trial grown near Oilmont, 1994. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.**

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% protein
BW 688	*	17.6	54.2	24	17.7
KLASIC	(h.white)	16.4	56.8	17	18.9
AMIDON	*	16.1	57.1	25	17.4
N90-700	*	15.9	56.9	20	18.9
AC EATONIA	*	15.9	54.9	20	19.4
FORTUNA	*	15.8	58.4	25	17.3
LEW	*	15.5	55.9	25	19.2
MCNEAL		15.4	54.0	21	19.1
ND 677	*	14.6	58.6	24	18.3
NEWANA		14.5	54.5	22	16.6
GLENMAN	*	14.4	54.1	23	17.7
WESTBRED 926		14.4	55.3	20	19.3
GRANDIN		14.2	53.6	24	18.3
PENAWAWA	(s. white)	13.7	55.5	19	18.3
LEN		13.5	56.9	23	18.6
BORDER	*	13.2	50.2	21	20.2
LANCER	*	13.2	56.2	23	17.7
HI-LINE		12.9	54.8	20	19.4
STOA		12.7	56.1	25	18.4
OWENS	(s. white)	12.6	52.8	20	18.4
PONDERA		12.6	56.7	23	18.3
CUTLESS	*	10.6	56.4	21	18.8
RAMBO	*	9.1	58.6	20	18.4

Cooperator: Terry Alme.
 Location: Eight miles east of Oilmont. (Toole County)
 Fertilizer: 100# 11-52-0 with the seed.
 Previous crop: Fallow.
 Date seeded: April 11, 1994.
 Date harvested: Aug. 2, 1994.
 Rainfall: From May 3 to harvest was 2.8 inches.
 Soil probe depth at seeding: 36 + inches.
 * = Sawfly resistant varieties. (Amidon and Rambo have partial resistance.)

Yield experimental mean: 14.12
 Error degrees of freedom: 44.00
 F test for var. = 4.85, C.V. 2 = 6.25, LSD (0.05) = 2.51

Table 16. **Five-year summary for dryland Spring Wheat varieties grown near Oilmont, MT. 1990 - 1991 - 1992 - 1993 - 1994. 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	% Protein

PENAWAWA	(s. white)	40.7	56.0	26.6	13.9
GLENMAN	*	40.4	57.0	29.4	14.6
AMIDON	*	37.2	58.2	33.4	15.9
WESTBRED	926	36.9	57.1	27.0	16.6
OWENS	(s. white)	36.7	55.3	27.8	14.7
GRANDIN		36.3	56.2	30.2	17.2
LEW	*	35.8	58.5	34.0	16.1
NEWANA		35.6	56.3	27.6	15.0
LEN		35.4	56.6	30.0	16.2
FORTUNA	*	34.8	58.7	33.2	15.6
HI-LINE		34.8	55.2	27.4	16.9
KLASIC	(h. white)	34.6	57.9	21.6	16.8
PONDERA		34.5	58.3	28.6	16.2
STOA		33.3	56.7	33.8	16.5
RAMBO	*	33.0	58.8	26.8	15.9
LANCER	*	33.0	58.0	33.8	16.5
CUTLESS	*	29.9	57.8	28.8	16.6

Cooperator: Terry Alme.

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

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

Table 17. Dryland Spring Wheat variety trial grown near Choteau, 1994. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety		Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% protein
HI-LINE		34.4	58.1	23	16.0
MCNEAL		34.2	56.1	25	15.5
AC EATONIA	*	33.9	57.9	29	16.5
GLENMAN	*	33.3	55.1	26	15.0
NEWANA		32.9	54.4	23	15.2
OWENS	(s. white)	32.9	56.7	23	15.7
PENAWAWA	(s. white)	32.0	56.7	23	15.2
RAMBO	*	31.9	58.6	22	15.4
BW 688	*	31.7	56.6	27	16.1
BORDER	*	31.6	56.6	25	15.9
AMIDON	*	30.3	56.5	26	15.3
PONDERA		30.0	58.1	25	16.7
N90-700	*	29.4	57.4	24	15.6
STOA		29.3	56.7	26	16.3
LEW	*	29.0	57.4	28	15.7
GRANDIN		28.5	56.9	24	16.2
WESTBRED 926		28.0	55.6	23	16.4
LANCER	*	27.7	57.1	29	16.3
ND 677	*	27.6	58.3	26	16.5
FORTUNA	*	27.5	57.7	28	16.9
CUTLESS	*	27.4	58.3	23	16.3
LEN		26.6	57.0	25	15.7
KLASIC	(h. white)	26.3	58.3	17	15.6

Cooperator: Roy Inbody.

Location: Twelve miles northeast of Choteau. (Teton County)

Fertilizer: 100# 11-52-0 with the seed, + 70# AA-N.

Previous crop: Fallow.

Date seeded: April 12, 1994.

Date harvested: Aug. 24 1994.

Rainfall: From May 3 to harvest was 2.4 inches.

Soil probe depth at seeding: 36 + inches.

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

Yield experimental mean: 30.28

Error degrees of freedom: 44.00

F test for var. = 1.98, C.V. 2 = 6.10, LSD (0.05) = 5.27

Table 18. **Five-year summary** for Dryland **Spring Wheat** varieties grown near **Choteau, MT.** 1990 - 1991 - 1992 - 1993 - 1994. 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	% Protein

GLENMAN	*	39.8	56.7	30.8	14.7
HI-LINE		36.0	59.0	28.2	15.2
FORTUNA	*	35.3	58.8	34.6	15.7
PENAWAWA (s. white)		34.7	58.3	28.8	13.2
RAMBO	*	34.7	56.8	28.4	14.6
PONDERA		34.2	59.1	29.4	15.4
LEW	*	34.1	57.5	34.2	15.4
AMIDON	*	32.8	56.4	34.4	15.6
NEWANA		32.4	57.0	28.2	14.6
LANCER	*	32.0	58.7	35.8	16.3
WESTBRED 926		32.0	57.4	28.0	15.1
OWENS (s. white)		31.8	57.0	29.4	13.6
LEN		31.4	57.3	28.8	15.1
CUTLESS	*	31.3	58.9	30.6	16.1
GRANDIN		31.0	57.9	30.4	15.9
STOA		30.6	56.7	33.2	15.4
KLASIC (h. white)		26.3	57.6	19.6	15.4

Cooperator: Roy Inbody in 1994 and Rick Corey in 1990 - 1993.
 Location: Northeast of Choteau, MT. (Teton County)
 * = Sawfly resistant varieties. (Amidon and Rambo have partial resistance.)

Table 19. **Dryland Durum** variety trial grown north of **Conrad**, 1994. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Head date	% Protein
STOCKHOLM	46.5	58.0	28		13.3
LAKER	45.0	56.2	30		14.1
CANDO	43.1	58.0	28		13.9
CROSBY	42.5	57.1	35	180	15.5
LLOYD	41.9	53.0	27		13.7
RENVILLE	39.8	56.2	35		15.0
MEDORA	38.1	57.5	34	179	15.4
SCEPTRE	37.4	56.0	33	181	15.2
PLENTY	37.2	55.7	35	180	15.2
MONROE	36.6	57.4	32	177	15.4
VIC	35.7	56.7	37	180	15.1
WARD	33.8	55.5	34	180	15.8

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 Fertilizer: 100# 11-51-0 with the seed, + 35# N actual
 topdressed before planting.
 Previous crop: Fallow
 Date seeded: April 19, 1994.
 Date harvested: August 17, 1994.
 Rainfall: From seeding to harvest, 5.23 inches.
 Soil probe test at time of seeding: 36 + inches.
 Yield experimental mean: 39.79
 Error degrees of freedom: 22.00
 F test for var.: 2.17
 C.V. 2: 6.79
 LSD (0.05): 7.92

Table 20. **Five-year summary for Dryland Durum varieties grown north of Conrad, MT. 1989 - 1990 - 1991- 1993 - 1994. 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	head date	% Protein

STOCKHOLM	68.6	61.2	30.2	187	11.9
LLOYD	65.3	58.2	28.0	188	12.0
CANDO	64.4	60.9	28.6	187	12.3
RENVILLE	61.3	60.8	40.0	187	13.2
LAKER	61.0	60.3	32.4	188	12.7
PLENTY	60.5	60.0	38.4	189	13.1
SCEPTRE	58.5	60.3	37.0	187	13.3
CROSBY	56.8	61.4	39.0	184	13.9
MEDORA	55.9	61.6	38.8	186	13.8
MONROE	55.3	61.0	37.8	183	13.6
VIC	53.2	61.2	39.6	186	13.5
WARD	52.6	60.8	39.8	185	13.7

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

Table 21. Irrigated Durum variety trial grown north of Conrad, 1994. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Head date	% Protein
LAKER	51.7	57.9	33		8.9
STOCKHOLM	48.6	58.2	34		8.8
RENVILLE	47.4	58.4	39	181	8.8
CANDO	45.3	59.5	40	181	9.2
VIC	44.0	60.7	37	181	9.9
LLOYD	41.4	55.9	27		9.3
SCEPTRE	39.8	58.0	30	180	9.1
PLENTY	39.3	59.3	32	181	9.7
MONROE	39.1	59.6	37	179	10.3
CROSBY	38.9	60.2	36	180	10.7
MEDORA	38.6	60.8	38	180	10.2
WARD	37.5	59.8	31	181	10.4

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 Fertilizer: 100# 11-51-0 with the seed, + 35# N actual
 topdressed before planting.
 Previous crop: Fallow
 Date seeded: April 19, 1994.
 Date harvested: August 23, 1994.
 Rainfall: From seeding to harvest, 5.23 inches.
 Irrigation dates: June 20, June 30, July 11. (Approximately
 2 inches of water applied per irrigation.)
 Yield experimental mean: 42.63
 Error degrees of freedom: 22.00
 F test for var.: 2.27
 C.V. 2: 7.26
 LSD (0.05): 9.08

Table 22. **Five-year** summary for **Irrigated Durum** varieties grown north of Conrad, MT. 1989 - 1990 - 1991 - 1993 - 1994. 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	head date	% Protein

STOCKHOLM	71.5	61.9	31.8	186	9.6
CANDO	71.3	62.4	32.6	187	9.6
LAKER	67.6	61.7	32.0	187	10.4
RENVILLE	66.7	61.5	40.6	186	10.1
PLENTY	66.4	62.1	33.6	189	10.4
LLOYD	66.4	60.5	29.4	188	9.8
SCEPTRE	63.5	61.7	35.0	186	10.4
MEDORA	61.7	62.6	40.2	186	11.2
CROSBY	60.6	62.5	38.4	184	11.6
WARD	59.6	62.1	37.8	185	11.5
MONROE	59.5	61.9	39.0	182	11.1
VIC	58.9	62.4	39.8	185	11.2

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

Table 23 **Emmer** dryland variety yield trial grown north of **Conrad**, 1994. Montana Agr. Expt. Station, Western Triangle Ag. Res. Center, Conrad, MT.

Variety	Yield bu/ac	Test weight lbs/bu	Plant hgt. inches	Head date
PI148 EMMER (SARC)	63.1	33.8	25	177
BOWMAN EMMER	56.4	33.7	42	181
CENEX EMMER	53.4	34.0	39	
N.D. COMMON EMMER	41.4	33.9	39	
PI148 EMMER (IDAHO)	40.5	32.9	25	178

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
Fertilizer: 100# 11-52-0 with the seed, + 35# N actual
 topdressed before seeding.
Previous crop: Fallow.
Date seeded: April 19, 1994.
Date harvested: August 17, 1994.
Rainfall: From seeding to harvest was 5.23 inches.
Soil probe depth at seeding: 36 + inches.
Yield experimental mean: 50.95
Error degrees of freedom: 8.00
F test for var: 4.73
C.V. 2: 8.86
LSD (0.05): 14.73

BARLEY VARIETY NOTES

Andre 2-row from WSU- never made it.

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

BA 1215 (Busch Ag) 2-row malt. Very high irrigated yields, and very good lodging resistance. Maturity 4 days later than Harrington. Tested as BA8529 prior to 1990.

BA 5133 (Busch Ag) - experimental 2-row type. Earlier maturity than 1202, 2 days earlier than Harrington.

BA 5648 (Busch Ag) - experimental 2-row type. Later maturity than 1202, 7 days later than Harrington. Taller than Harrington.

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

BA 1614 (Busch Ag) 6-row experimental. Taller than 2601, shorter than Morex. Stronger strawed & higher yield than Morex. Nodding head.

Baronnesse (Ackermann-Germany) - Seed produced in USA by Western Plant Breeders. 2-row feed. Short straw and good lodging resistance. Among highest yielders when tested in favorable moisture conditions (not tested in dry years yet). Four days later maturity than Pirolina and Gallatin; equal or slightly later maturity than Harrington; thus, may possibly rank lower for yield in dry years without irrigation. Recommended list for irrigated.

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

Bellona Dropped from recommended list, due to nonavailability of seed. High yield on irrigation, and excellent lodging resistance.

Bowman(ND) 2-row. Strictly for drought conditions. Early maturing, large seeded, feed type. Highest yielder on dryland in drought years; but in wet years, only medium to low yield. Weak straw. Stark is a possible alternative.

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

Clark(MSU) 2-row feed. Better yield and earlier maturity than Klages. Does not have the malt quality of Harrington. Dryland primarily.

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

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

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

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

Excel (Minn.) 6-row malt. Supposed to combine the superior agronomics of Robust and the malt quality of Morex. Stiff straw. Higher yield and later maturity than Morex. On Minnesota AMBA list; will be on ND AMBA soon. Probably will not be used in Montana.

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

Gallatin (MSU) 2-row feed. A stiff strawed variety with good lodging resistance (more than Hector, Klages, Lewis, and Clark); yields high in both dry and wet conditions; thus a broadly adapted feed barley. Good drought tolerance. Slightly earlier than Hector, and earlier than Bearpaw.

Harrington (Sask. Canada) 2-row malt. Sensitive to hot dry areas; yields good in moist areas. Matures later than Clark and Bearpaw, but earlier than Klages. Lodging resistance better than Klages. 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.

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). Caution: any cereal grain grown for hay should be tested for nitrate level prior to cutting.

Hector (Lethbridge, Alberta) 2-row feed type. High yield on dryland (similar to Gallatin); slightly later to mature and weaker strawed than Gallatin. Yields less than Gallatin on irrigated.

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

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

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

Klages (ID) 2-row malt type. Late maturity; for irrigation or high rainfall only. Being replaced on contracted acres by Harrington, BA-1215, etc.

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

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

Manley (TR 409) 2-row. A little 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 (Western Pl. Breeders) 6-row feed. Very high yield at Conrad 1993 under high rainfall conditions. Semidwarf with very stiff straw, but can be lodged in very high yield conditions (but WB 501 reportedly "cannot" be lodged). Not intended for dryland as test weight may drop unless high rainfall.

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

Menuet (Netherlands)-Marketed by Cenex. 2-row. Short stiff straw. Feed.

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

Morex (Minn.) 6-row malt type. Shatters readily - swathing advised.

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

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 6-row malt type-ND AMBA list; but not Montana's, in order to keep Montana clear for Morex. 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. Was planned for possible replacement for Karla on dryland as a malt, but did not pass AMBA tests. However, Russell may be contracted for malt in some areas.

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

Stander (Minn, M-64) - May replace Excel and Robust as a 6-row malt variety in the mid-west. Stiffer straw than other 6-row malt types. Better yield stability than Excel.

Stark (N. Dakota, ND 9866) 2-row feed. Medium to high yield. Related to Bowman; but yields higher than Bowman except in extremely dry conditions. Probably not as drought tolerant as Bowman. Weak straw. Birds selectively damaged this variety 2 years in a row.

Steptoe (Wash.) 6-row. Among the highest yielders on irrigation or dryland. Feed type. Low test weight dryland.

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

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

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

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

Westford, Westbred (WPB) 6-row hooded hay barley. Seed yield low (similar to Horsford). Hay yields considerably higher than Horsford. Maturity considerably later than Horsford and Whitford, allowing for greater forage production. 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. Testing of the forage for nitrate should be done before the crop is harvested.

Westbred 501 (WPB) - 6-row feed. Marketed mainly in Idaho. Very stiff straw (supposedly doesn't lodge).

Table 24. **Dryland Intrastate Barley variety trial grown north of Conrad, 1994.** 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
MT890008	105.8	50.7	33	95	2	182	11.2
MT920234	98.7	52.2	34	87	3	179	11.0
MT900002	97.9	51.6	35	95	1	177	11.8
Gallatin	97.7	52.4	35	93	2	179	11.4
MT920167	96.0	52.1	34	91	2	178	11.3
863829H7	95.8	52.1	31	93	1	180	11.5
Baronesse	95.2	50.0	30	72	9	179	11.7
MT851032	95.2	51.1	36	88	2	181	11.4
2B894311	93.9	50.5	34	89	3	182	11.8
MT140523	92.6	51.6	36	91	3	178	12.1
MT920053	92.0	51.3	37	79	5	178	11.7
H3851032	91.2	51.1	32	94	1	181	11.6
MT 81161	91.1	50.6	34	90	2	178	11.6
MT890070	90.1	53.1	34	98		176	11.4
MT920064	90.0	50.7	36	89	3	181	10.9
MT920072	89.9	51.1	32	81	5	179	11.6
21140523	89.5	51.2	35	91	2	178	11.6
MT886610	89.2	50.9	33	84	5	179	11.2
MT910160	89.0	52.4	34	92	2	180	12.3
MT920163	88.0	51.2	35	87	4	178	11.7
Sissi	87.9	49.7	31	92	1	181	11.3
MT920161	87.8	50.9	35	80	5	177	11.9
MT851195	87.7	50.0	33	81	7	178	12.5
MT920047	87.6	51.2	32	89	3	178	11.2
Stark	87.5	52.8	31	95	1	177	11.5
H1851195	86.9	50.9	35	92	2	178	12.9
Harrington	86.9	50.1	35	84	4	178	12.1
MT900145	85.8	51.3	33	89	3	179	11.5
MT920207	85.6	52.4	31	93	1	179	12.2
Lewis	85.6	52.8	33	92	1	180	11.5
Steptoe	85.4	46.8	32	85	4	176	11.4
MT910033	84.8	52.1	31	92	1	177	11.8
MT920027	84.2	47.4	34	79	7	176	9.5

(continued on next page)

(Dryland Intrastate Barley trial continued)

Hector	84.2	52.1	32	91	3	178	11.8
MT920073	83.5	50.0	31	74	8	177	12.0
MT920070	83.4	52.8	34	94	1	179	11.5
MT920041	83.3	52.4	32	95	1	178	11.9
BA 1215	83.3	50.2	32	76	5	179	11.3
MT860756	83.2	51.7	35	92	2	178	11.4
MT861596	83.0	52.0	35	85	4	179	12.3
Bowman	82.8	52.4	30	98		176	11.7
90014-DH	81.8	43.7	26	24	30	182	12.1
MT900176	81.7	43.7	33	80	5	177	11.5
MT900111	81.0	51.8	32	96		177	11.7
MT920059	80.3	50.7	33	88	3	180	11.7
MT920024	80.2	49.1	32	71	7	179	11.6
MT890018	80.1	52.1	29	84	3	179	12.1
MT900132	79.9	49.7	33	73	7	180	12.5
MT910189	79.5	50.2	29	80	5	177	10.9
H5870120	78.3	45.4	30	74	8	176	11.0
MT910150	77.7	51.5	33	81	5	178	12.1
MT920208	77.3	49.7	33	85	3	179	12.3
MT889106	76.8	51.9	32	96		176	12.1
MT890128	76.8	47.6	27	80	6	176	10.9
MT920129	76.8	46.6	29	41	18	178	12.7
BA 1202	76.1	47.1	33	75	11	181	13.0
H6860756	75.5	50.3	31	86	3	178	11.7
MT920201	75.0	49.9	33	65	9	178	12.6
H2860224	74.9	48.0	33	67	9	180	12.9
Shonkin	74.6	50.4	36	60	10	182	13.2
MT920071	73.9	49.4	29	64	10	178	11.9
H3860224	73.3	48.5	31	77	7	181	12.8
Merlin	72.4	50.7	22	53	18	182	14.2
H5860219	71.9	50.0	33	81	5	180	12.4

Cooperator: Western Triangle Ag. Research Center.

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

Fertilizer: 100# 11-51-0 with the seed, + 35# N topdressed.

Previous crop: Fallow.

Date seeded: April 19, 1994. Date harvested: Aug. 10, 1994.

Rainfall: From seeding to harvest was 5.23 inches.

Soil probe depth at seeding: 36 + inches.

Yield experimental mean: 84.91

Error degrees of freedom: 126

F test for var. = 1.38, C.V. 2 = 7.42, LSD (0.05) = 17.63

Table 25. **Dryland Intrastate Barley** variety trial grown north of **Conrad**, 1994. 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
Gallatin	97.7	52.4	35	93	2	179	11.4
Baronesse	95.2	50.0	30	72	9	179	11.7
MT140523	92.6	51.6	36	91	3	178	12.1
MT886610	89.2	50.9	33	84	5	179	11.2
Sissi	87.9	49.7	31	92	1	181	11.3
Stark	87.5	52.8	31	95	1	177	11.5
Harrington	86.9	50.1	35	84	4	178	12.1
Lewis	85.6	52.8	33	92	1	180	11.5
Steptoe	85.4	46.8	32	85	4	176	11.4
Hector	84.2	52.1	32	91	3	178	11.8
BA 1215	83.3	50.2	32	76	5	179	11.3
MT860756	83.2	51.7	35	92	2	178	11.4
Bowman	82.8	52.4	30	98		176	11.7
BA 1202	76.1	47.1	33	75	11	181	13.0
Shonkin	74.6	50.4	36	60	10	182	13.2
Merlin	72.4	50.7	22	53	18	182	14.2

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 Fertilizer: 100# 11-51-0 with the seed, + 35# N actual
 topdressed before planting.
 Previous crop: Fallow.
 Date seeded: April 19, 1994.
 Date harvested: Aug. 10, 1994.
 Rainfall: From seeding to harvest was 5.23 inches.
 Soil probe depth at seeding: 36 + inches.
 Yield experimental mean: 84.91
 Error degrees of freedom: 126
 F test for var. = 1.38, C.V. 2 = 7.42, LSD (0.05) = 17.63

Table 26. **Five-year summary for Dryland Barley varieties grown north of Conrad, MT. 1989 - 1990 - 1991 1993 - 1994. 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	104.9	52.4	31.3	84.2	5.2	186	10.5
GALLATIN	99.5	53.3	34.8	91.0	2.8	184	10.6
MT 140523	97.4	52.6	34.8	91.6	3.4	185	11.2
MT 81161	96.7	52.3	34.4	93.8	1.8	184	11.0
MT 860756	96.1	53.7	33.4	93.8	1.4	185	11.0
STARK	95.7	53.5	35.9	95.5	1.3	182	10.8
LEWIS	95.3	53.8	35.8	92.6	2.0	186	11.1
STEPTOE	94.5	47.8	35.4	88.4	3.8	179	10.4
BA 1215	93.3	52.4	32.9	84.6	4.0	186	10.4
HECTOR	91.9	53.0	35.8	92.2	2.0	185	10.6
HARRINGTON	91.7	51.4	35.8	87.4	3.2	186	10.9
BOWMAN	90.1	52.9	33.2	96.2	1.0	181	11.3
SHONKIN	80.4	54.7	36.8	62.0	11.6	188	12.3
BA 1202	89.8	50.6	34.4	85.1	7.9	185	11.8

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

Table 27. **Irrigated Intrastate Barley** variety trial grown north of **Conrad**, 1994. 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
MT890008	101.7	53.6	30	95	2		8.0
MT920167	95.5	54.1	33	92	4	178	9.5
Baronesse	94.0	54.7	27	98	1	181	7.0
90014-DH	92.1	50.9	27	88	4		6.8
MT920234	89.4	54.0	35	94	2	181	8.7
Galena	88.1	52.6	27	97	1		8.0
H5851161	87.6	54.2	34	95	2	181	8.9
BU585-82	87.1	50.7	25	95	1	177	7.8
Gallatin	86.1	54.8	34	96	2	177	8.3
863847/7	86.0	53.8	34	94	2	179	8.2
MT920064	85.2	53.8	33	96	2	180	8.8
H3851032	84.9	53.7	35	95	2		8.3
H5860219	84.1	53.8	30	94	3	179	8.9
IdaGold	84.0	50.9	29	91	3		7.7
Steptoe	83.9	49.2	28	92	3	175	8.6
MT920073	83.4	54.7	31	94	2	177	8.1
MT910160	82.9	55.5	34	98		177	8.3
MT920201	82.6	54.8	33	89	2	181	8.5
H5870120	82.6	49.7	27	92	3	175	8.7
Coors C16	82.3	54.0	31	95	2	181	9.3
BA 1215	81.7	54.8	33	96	1	181	7.8
MT910167	81.5	53.0	29	76	7		8.6
Klages	81.0	52.0	34	82	7		8.1
MT920161	81.0	54.9	32	97	1	179	8.0
MT920047	80.9	53.1	31	93	3	179	8.8
MT920071	80.7	54.3	33	91	4	179	7.8
MT920059	80.7	55.5	32	95	2	179	8.2
MT851195	80.4	54.1	34	93	3	179	8.0
MT900176	79.8	49.2	31	95	2	175	8.8
MT920072	79.6	54.3	34	92	2	179	7.8
MT890128	79.3	49.9	27	88	4	176	8.1
MT920129	78.9	54.3	33	92	2	180	8.2
MT920024	78.7	54.2	32	94	2	178	7.3

(continued on next page)

(Irrigated Intrastate Barley continued)

MT920207	78.7	54.8	32	95	1	179	8.7
MT910150	78.6	55.5	30	95	1	179	9.3
BA 1202	78.6	53.1	34	97	1	181	8.9
Hector	78.5	53.6	33	91	3	178	8.2
MT920163	78.5	53.8	36	94	3	179	8.4
H1851195	78.3	53.7	34	95	2	178	7.8
H2860224	78.2	51.5	31	97	2	178	8.7
MT886610	77.9	54.4	32	92	3	179	7.7
MT920041	77.6	54.7	31	96	3	177	9.4
Coors C14	77.1	55.7	25	93	3	176	8.4
Sissi	76.1	53.8	29	97	1	179	8.2
Merlin	75.9	58.7	25	86	3		9.7
Stark	75.9	54.5	34	96	2	176	8.9
MT890018	75.8	55.5	30	95	2	178	8.8
MT920208	74.6	53.4	30	94	4	178	9.0
Harrington	74.3	54.0	35	94	2	181	7.5
H3860224	74.0	54.1	31	97	1	180	8.4
MT861596	73.7	53.8	31	87	6	180	8.6
Lewis	72.6	54.9	32	92	2	180	7.8
MT140523	72.0	53.6	33	89	4	179	7.9
21140523	70.9	53.1	33	90	4	178	7.8
MT900111	70.9	53.2	34	97	2	177	9.4
2B894311	69.6	52.8	33	86	4	181	7.7
MT920053	69.2	55.0	32	95	2	178	7.3
MT890070	68.7	53.4	32	96	2	177	8.6
MT860756	68.4	53.3	29	93	3	177	8.9
MT889106	67.8	53.7	32	95	2	176	9.4
MT920070	67.2	54.4	33	92	3	179	8.4
MT920027	66.6	49.9	29	86	5	175	7.2
DA587170	65.3	50.8	26	91	3	180	7.4
H6860756	63.4	53.0	33	92	2	179	9.0

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 Fertilizer: 100# 11-51-0 with the seed, + 35# N topdressed.
 Previous crop: Fallow.
 Date seeded: April 19, 1994. Date harvested: Aug. 15, 1994.
 Rainfall: From seeding to harvest was 5.23 inches.
 Irrigation dates: June 20, June 30, July 11. (approximately
 2 inches of water applied per irrigation.)
 Yield exp. mean = 79.10, Error degrees of freedom = 126
 F test for var. = 1.58, C.V. 2 = 7.47, LSD (0.05) = 16.53

Table 28. **Irrigated Intrastate Barley** variety trial grown north of Conrad, 1994. 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	94.0	54.7	27	98	1	181	7.0
Galena	88.1	52.6	27	97	1		8.0
Gallatin	86.1	54.8	34	96	2	177	8.3
IdaGold	84.0	50.9	29	91	3		7.7
Stephoe	83.9	49.2	28	92	3	175	8.6
BA 1215	81.7	54.8	33	96	1	181	7.8
Klages	81.0	52.0	34	82	7		8.1
BA 1202	78.6	53.1	34	97	1	181	8.9
Hector	78.5	53.6	33	91	3	178	8.2
MT886610	77.9	54.4	32	92	3	179	7.7
Sissi	76.1	53.8	29	97	1	179	8.2
Merlin	75.9	58.7	25	86	3		9.7
Stark	75.9	54.5	34	96	2	176	8.9
Harrington	74.3	54.0	35	94	2	181	7.5
Lewis	72.6	54.9	32	92	2	180	7.8
MT140523	72.0	53.6	33	89	4	179	7.9
MT860756	68.4	53.3	29	93	3	177	8.9

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 Fertilizer: 100# 11-51-0 with the seed, + 35# N actual
 topdressed before planting.
 Previous crop: Fallow.
 Date seeded: April 19, 1994.
 Date harvested: August 15, 1994.
 Rainfall: From seeding to harvest was 5.23 inches.
 Irrigation dates: June 20, June 30, July 11. (approximately
 2 inches of water applied per irrigation.)
 Yield experimental mean: 79.10
 Error degrees of freedom: 126
 F test for var. = 1.58, C.V. 2 = 7.47, LSD (0.05) = 16.53

Table 29. **Five-year summary for Irrigated Barley varieties grown north of Conrad, MT. 1989 - 1990 - 1991 1993 - 1994. 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	106.1	53.7	30.4	95.6	1.0	186	9.1
GALENA	104.3	51.4	29.6	93.9	1.7	192	9.6
GALLATIN	97.8	54.6	34.6	93.6	2.2	182	9.7
BA 1215	97.2	53.5	34.4	95.5	1.5	185	9.3
STEPTOE	95.5	47.9	31.8	91.8	2.8	179	9.6
LEWIS	94.1	54.6	34.2	95.0	1.7	184	10.4
STARK	93.0	53.9	35.1	95.5	1.9	181	10.3
BA 1202	92.3	52.2	35.1	95.3	1.2	185	10.6
IDAGOLD	91.9	51.7	27.1	88.0	3.5	193	9.1
MT 860756	91.6	53.8	32.1	93.0	2.4	183	9.8
HECTOR	88.9	52.8	35.6	91.0	2.6	183	10.0
MT 140523	86.6	51.8	34.0	90.8	2.8	183	9.9
HARRINGTON	82.6	52.0	34.8	89.4	3.4	186	8.9

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

Table 30. **Dryland Barley** variety trial grown north of Cut Bank, 1994. 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
MT890008	64.5	49.9	23	90	3	8.9
MT851195	64.0	50.6	26	96	1	9.8
Harrington	61.6	49.7	27	88	2	9.2
MT886610	61.5	51.4	27	92	2	8.9
Bowman	60.5	51.8	28	98	0	10.1
Baronesse	60.3	48.8	24	77	6	9.4
MT861596	59.0	51.1	25	79	5	9.1
Stark	58.5	53.1	27	95	1	10.2
Steptoe	58.2	42.5	25	80	5	9.6
Piroline	57.9	52.6	29	89	1	9.4
MT860756	57.6	51.6	25	96	1	8.6
Hector	57.5	50.0	26	81	5	9.6
Gallatin	57.2	50.9	27	88	2	9.1
MT140523	57.0	50.8	25	86	3	9.3
Lewis	56.4	50.7	25	82	3	9.4
Colter	56.3	45.1	24	72	8	8.6
MT889106	54.7	52.1	25	98	1	9.6
Medallion	52.9	45.3	22	55	12	9.0

Cooperator: Don Bradley.
 Location: Fifteen miles north of Cut Bank, MT. (Glacier Co.)
 Fertilizer: 100# 11-51-0 with the seed.
 Previous crop: Fallow.
 Date seeded: May 4, 1994.
 Date harvested: August 18, 1994.
 Soil probe depth at seeding: 36 + inches.
 Rainfall: From seeding to harvest was 3.75 inches.
 Yield experimental mean: 58.64
 Error degrees of freedom: 34.00
 F test for var. = 1.09, C.V. 2 = 4.89, LSD (0.05) = 8.25

Table 31. **Five-year summary for Barley varieties grown near Cut Bank, MT. 1990 - 1991 - 1992 - 1993 - 1994. 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
BARONESSE	67.7	48.8	25.6	88.2	3.5	8.8
STEPTOE	59.2	43.9	26.2	87.4	3.6	9.2
HARRINGTON	56.8	49.8	27.8	90.0	2.4	9.4
HECTOR	56.1	50.2	28.0	88.0	3.4	9.3
PIROLINE	54.4	51.4	28.0	89.8	1.8	9.9
MT 140523	53.6	50.9	27.0	90.4	2.6	9.0
LEWIS	53.1	50.7	26.7	87.2	4.0	9.3
MT 860756	51.9	51.5	27.3	92.7	2.3	9.0
GALLATIN	51.0	50.8	28.0	89.6	3.0	9.3
STARK	48.9	51.3	29.2	95.6	1.2	9.7
BOWMAN	48.7	50.8	27.0	94.8	1.7	10.1
COLTER	45.2	43.8	24.8	70.3	10.8	9.1

Cooperator: Don Bradley.

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

* = Plant height averages based on four years only. (1990-1991-1992-1994)

Table 32. **Dryland Barley** variety trial grown east of Oilmont, 1994. 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
Bowman	44.3	46.6	27	68	11	13.5
Stark	43.6	44.5	26	19	41	15.9
MT889106	43.3	45.7	27	30	27	15.4
MT860756	41.6	47.6	24	22	39	18.0
MT140523	39.5	45.5	26	6	55	17.7
Hector	39.4	46.0	26	15	41	17.1
MT851195	39.0	47.0	24	17	30	18.9
Gallatin	37.5	45.9	26	8	55	15.4
Lewis	37.4	46.6	25	16	44	14.8
Baronesse	36.3	49.0	21	16	34	17.3
MT890008	34.7	45.6	22	7	49	18.2
MT861596	33.4	47.1	25	3	64	18.4
Step toe	33.2	36.1	25	11	55	13.1
Piroline	33.0	45.4	26	5	67	15.5
MT886610	32.2	44.7	25	9	52	18.4
Harrington	30.1	47.6	22	23	29	18.8
Colter	24.6	36.4	22	4	79	14.5
Medallion	19.2	40.6	16	5	72	17.8

Cooperator: Terry Alme.
 Location: Eight miles east of Oilmont, MT. (Toole County)
 Fertilizer: 100# 11-51-0 with the seed.
 Previous crop: Fallow.
 Date seeded: April 11, 1994.
 Date harvested: August 2, 1994.
 Soil probe depth at seeding: 36 + inches.
 Rainfall: From May 3 to harvest was 2.8 inches.
 Yield experimental mean: 35.67
 Error degrees of freedom: 34.00
 F test for var. = 9.20, C.V. 2 = 6.08, LSD (0.05) = 6.24

Table 33. **Five-year summary for Barley varieties grown near Oilmont, MT. 1990 - 1991 - 1992 - 1993 - 1994. 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
MT 140523	65.7	46.8	29.2	53.8	34.4	14.0
BOWMAN	65.5	47.6	29.8	71.0	15.8	12.7
LEWIS	64.2	47.7	30.0	56.6	27.6	13.2
BARONESSE	64.2	47.1	26.8	47.1	33.8	13.6
STARK	62.0	47.2	31.2	58.2	24.0	13.1
PIROLINE	61.9	47.7	31.4	51.2	39.2	13.3
HECTOR	61.5	47.3	31.8	50.6	34.0	13.5
MT 860756	60.9	46.9	28.5	58.7	24.5	13.6
GALLATIN	59.5	47.5	30.2	51.0	31.2	12.9
STEPTOE	58.1	40.9	27.8	56.0	29.0	11.6
HARRINGTON	53.0	47.6	28.8	58.6	23.2	13.9
COLTER	49.7	39.9	26.2	43.5	52.7	12.2

Cooperator: Terry Alme.

Location: Eight miles east of Oilmont, MT.

(Toole County)

Table 34. **Dryland Barley** variety trial grown northeast of Choteau, 1994. 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
MT889106	69.3	52.1	27	88	3	12.6
Baronesse	68.9	50.3	24	50	14	13.7
Stark	68.5	51.7	27	83	3	12.6
MT140523	67.9	49.5	27	40	19	13.5
Hector	67.9	50.1	27	60	12	13.0
MT890008	67.7	47.7	23	33	20	12.6
MT851195	67.4	50.1	28	77	5	13.5
MT860756	67.3	50.2	27	69	8	13.0
MT861596	66.0	51.2	27	35	21	13.3
Lewis	63.8	51.1	26	61	12	12.7
Piroline	63.7	50.4	27	40	16	13.4
Gallatin	63.0	49.7	26	54	13	13.0
Bowman	62.7	51.2	27	86	3	12.7
MT886610	62.7	49.4	27	49	17	13.3
Colter	62.5	43.7	25	30	32	10.9
Step toe	54.6	44.2	25	70	8	11.7
Harrington	54.0	48.7	24	49	15	13.1
Medallion	53.0	43.5	23	16	49	12.6

Cooperator: Roy Inbody.
 Location: Twelve miles northeast of Choteau. (Teton Co.)
 Fertilizer: 100# 11-51-0 with the seed, + 70# AA-N.
 Previous crop: Fallow.
 Date seeded: April 12, 1994.
 Date harvested: Aug. 24, 1994.
 Soil probe depth at seeding: 36 + inches.
 Rainfall: From May 3 to harvest was 2.4 inches.
 Yield experimental mean: 63.93
 Error degrees of freedom: 34
 F test for var. = 13.58, C.V. 2 = 2.20, LSD (0.05) = 4.05

Table 35. **Five-year summary for Dryland Barley varieties grown near Choteau, MT. 1989 - 1990 - 1991 - 1993 - 1994. 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
BARONESSE	83.9	51.2	29.7	75.2	7.7	12.2
STEPTOE	80.9	45.3	31.2	80.4	6.0	10.5
MT 860756	79.0	51.7	30.2	86.2	4.2	11.5
MT 140523	78.5	50.8	30.8	68.0	10.4	12.1
STARK	78.4	52.5	32.6	93.4	2.6	11.9
LEWIS	75.6	51.9	30.8	80.0	5.8	11.8
HECTOR	75.4	51.0	32.4	79.0	6.2	12.1
GALLATIN	74.6	51.3	31.6	74.8	8.2	11.9
PIROLINE	72.5	51.8	31.2	66.8	11.0	12.4
BOWMAN	71.1	51.4	31.8	91.6	2.2	12.1
COLTER	70.8	44.6	28.6	58.7	16.2	10.2
HARRINGTON	69.2	48.8	31.4	81.2	6.6	12.1

Cooperator: Roy Inbody in 1994 and Rick Corey in 1989 - 1993.
 Location: Northeast of Choteau. (Teton County)

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

Year: 1994

Location: Western Triangle Agricultural Research Center, Conrad.

Personnel:

Project Leader: Gregory D. Kushnak

Cooperators: Luther Talbert & Sue Lanning (Spring Wheat)
Tom Blake & Pat Hensleigh (Barley).

Objectives: Identify small grain varieties most 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 1993, fallow in 1992, and barley in 1991. Planting was accomplished with a double-disc no-till plot planter constructed by our Research Center Staff. The double disc openers were supplied by Acra-Plant, Inc., Garden City, KS. Row space was 12 inches. MAP was applied with the seed to provide 51 lbs P₂O₅/a. Ammonium nitrate (34-0-0) was topdressed to provide 60 lbs N/a. Herbicides included Roundup for pre-seeding vegetation control; Hoelon for wild oat control; and Bronate for boadleaf control. Planting date was April 21, 1994.

Results: Data for spring wheat and barley are presented in Tables 36 & 38, respectively, for 1994. Recrop yields were considered good, given that growing season rainfall was 3.5 inches below average (61% of average). Soil moisture depth at planting time was 36 inches, and most of the rainfall was distributed during tillering and elongation stages of plant growth. Moisture depletion eventually stressed the crops, producing test weights in the low 50's for wheat and mid 40's for most barleys. Disease was not detected in spring wheat, and barley showed very slight symptoms of net blotch.

Five-year average recrop yields are presented in Tables 37 & 39. Four of the five years were exceptionally moist, as reflected in the high average yields.

Table 36. **Dryland Recrop No-till Spring Wheat** variety trial grown north of **Conrad**, 1994. 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
PENAWAWA	(s. white)	32.8	54.8	23	178	8.5
AC EATONIA	*	31.5	53.5	29	177	10.3
STOA		30.9	51.7	28	180	9.4
BW 688	*	30.8	52.7	28	179	10.8
WESTBRED 926		30.1	50.1	25	176	10.2
SHOOFLY	*	29.1	52.5	22	179	9.2
LEN		28.7	48.1	24	181	10.4
RAMBO	*	28.6	50.8	23	179	9.9
NEWANA		28.3	52.8	24	180	9.9
AMIDON	*	28.2	51.9	28	179	10.0
KLASIC	(h. white)	28.1	52.8	20	177	8.3
N90-700	*	28.0	50.3	24	177	9.4
CUTLESS	*	28.0	55.3	25	179	9.3
LEW	*	27.9	52.3	29	180	10.4
GRANDIN		27.3	51.6	26	178	10.4
ND 677	*	27.1	52.4	30	180	10.1
MCNEAL		27.0	50.3	25	178	10.6
GLENMAN	*	27.0	50.7	25	181	10.2
OWENS	(s. white)	26.7	52.1	24	178	9.5
BORDER	*	26.0	48.2	25	177	10.0
LANCER	*	26.0	52.4	31	180	11.5
FORTUNA	*	25.5	52.1	27	178	11.5
HI-LINE		25.1	51.9	24	177	11.5
PONDERA		24.3	52.5	26	178	10.4

Cooperator: Western Triangle Ag. Research Center.

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

Fertilizer: 100# 11-52-0 with the seed, + 60# N topdressed.

Previous crop: Barley.

Date seeded: April 21, 1994.

Date harvested: Aug. 10, 1994.

Rainfall: From seeding to harvest was 5.23 inches.

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

Yield experimental mean: 28.05

Error degrees of freedom: 46.00

F test for var. = 2.68, C.V. 2 = 4.52, LSD (0.05) = 3.61

Table 37. Five-year summary for No-till Recrop Spring Wheat varieties grown near Conrad, MT. 1989 - 1990 - 1991 - 1993 - 1994. 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

PENAWAWA	(s. white)	47.2	59.5	27.3	188	8.5
WESTBRED	926	43.0	58.5	28.5	183	10.5
OWENS	(s. white)	41.9	57.1	28.5	187	9.5
RAMBO	*	40.8	57.6	28.5	190	11.0
GLENMAN	*	40.4	58.2	29.5	188	10.5
STOA		40.0	59.2	34.3	187	11.4
AMIDON	*	39.5	59.3	33.8	188	11.1
HI-LINE		39.2	60.6	28.5	186	11.1
NEWANA		38.8	59.3	27.5	189	10.6
KLASIC	(h. white)	38.7	60.9	23.7	182	9.6
LEN		38.7	58.1	28.3	186	11.4
FORTUNA	*	38.6	60.1	34.0	186	11.7
PONDERA		38.3	60.3	29.0	186	11.5
LEW	*	38.3	60.3	34.3	189	11.0
GRANDIN		37.6	59.7	30.3	185	10.8
CUTLESS	*	36.5	49.9	31.3	188	11.5
LANCER	*	36.0	60.2	35.8	189	11.7

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

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

@ = Plant height averages based on four years only. (1989 - 1990 - 1991 - 1994)

Table 38. **Dryland Recrop No-till Barley** variety trial grown north of Conrad, 1994. 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
Gallatin	54.0	44.7	23	75	6	177	9.1
MT890008	52.0	44.5	21	61	9	179	9.2
Stark	51.5	49.0	23	76	6	177	10.0
Baronesse	50.8	47.1	22	57	12	177	10.0
Piroline	49.0	49.0	25	51	14	174	9.4
MT140523	47.6	46.7	25	50	15	177	10.5
Bowman	47.5	48.0	24	88	3	178	10.0
MT860756	47.5	46.2	21	75	10	179	10.1
MT851195	47.3	45.4	24	68	7	179	9.8
MT886610	46.1	46.0	24	45	21	176	9.9
MT889106	45.4	48.3	24	80	5	175	9.8
Step toe	45.2	44.2	23	66	11	174	9.9
Colter	44.9	43.0	22	68	19	177	9.1
Hector	44.8	44.9	25	60	12	180	9.4
Lewis	44.7	46.8	23	61	12	178	10.1
MT861596	44.2	46.7	24	41	22	177	9.9
Harrington	41.3	45.1	22	61	11	178	9.4
Medallion	40.1	44.4	22	39	27	177	10.7

Cooperator: Western Triangle Ag. Research Center.
 Location: Ten miles north of Conrad, MT. (Pondera County)
 Fertilizer: 100# 11-51-0 with the seed, + 60# N actual
 topdressed before planting.
 Previous crop: Barley.
 Method of seeding: Double-disc drill.
 Date seeded: April 21, 1994.
 Date harvested: August 4, 1994.
 Soil probe depth at seeding: 36 + inches.
 Rainfall: From seeding to harvest was 5.23 inches.
 Yield experimental mean: 46.88
 Error degrees of freedom: 34.00
 F test for var. = 2.39, C.V. 2 = 4.99, LSD (0.05) = 6.72

Table 39. **Five-year summary for Recrop Dryland No-Till Barley varieties grown north of Conrad, MT. 1989 - 1990 - 1991 - 1993 - 1994. Mont. Agr. Expt. Station, Western Triangle Agr. Res. Center, Conrad, MT.**

5 - year comparable average							
Variety	Yield bu\ac	Test weight lbs\bu	Plant hgt.* inches	% Plump	% thin	Head date	% Protein

BARONESSE	71.9	51.7	25.9	79.5	5.1	189	8.5
MT 860756	65.6	51.3	25.1	91.5	4.8	189	9.1
GALLATIN	64.3	51.5	28.4	83.8	4.6	187	8.9
HECTOR	62.3	50.9	28.8	76.8	7.0	189	9.0
MT 140523	62.2	51.1	28.6	79.2	6.0	188	9.3
PIROLINE	61.3	53.4	29.9	83.8	4.8	186	8.9
LEWIS	61.1	52.1	27.8	81.0	5.8	189	9.3
STEPTOE	60.9	46.2	27.3	81.8	6.8	182	8.6
HARRINGTON	58.1	50.0	27.9	83.0	4.8	190	8.8
BOWMAN	57.6	51.8	28.3	94.0	2.2	185	10.1
STARK	56.1	53.0	28.7	91.9	2.9	185	9.4
COLTER	52.5	46.5	26.3	76.7	10.6	185	8.9

Cooperator: Western Triangle Ag. Research Center.

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

* = Plant hgt. averages based on four years only. (89-90-91-94)

Table 40. Effect of **Crop residue** management and **Tilt fungicide** in recrop barley stubble, 1994. Western Triangle Agr. Research Center, Conrad, MT.

Tillage/ Variety	Fungicide treatment	Yield bu/ac	Test wt.	% plump	% thin	% protein
<i>Burned - Cultivated - NoTill</i> combined averages.						
Harrington	Tilt	50.7	46.2	62.7	10.7	8.5
Harrington	Untreated	54.9	45.7	60.7	11.3	8.5
Baronesse	Tilt	54.9	47.0	60.3	10.7	8.4
Baronesse	Untreated	51.2	46.9	51.7	15.3	8.4
<i>Burned</i> treated and untreated averages.						
Harrington		53.2	46.1	61.3	9.1	8.9
Baronesse		58.8	47.9	60.1	10.4	8.7
<i>Cultivated</i> treated and untreated averages.						
Harrington		49.3	45.7	61.5	11.5	8.0
Baronesse		50.3	46.0	51.9	15.3	8.5
<i>NoTill</i> treated and untreated averages.						
Harrington		46.5	45.9	62.3	12.3	8.6
Baronesse		50.1	47.0	56.0	13.4	8.5
<i>Burned</i> average of both varieties.						
Tilt		57.2	47.2	60.9	9.1	8.8
No Tilt		54.7	46.9	60.5	10.4	8.8
<i>Cultivated</i> average of both varieties.						
Tilt		51.0	46.1	58.9	11.8	8.0
No Tilt		48.6	45.6	54.5	15.0	8.1
<i>NoTill</i> average of both varieties.						
Tilt		50.2	46.5	64.8	11.1	8.6
No Tilt		46.4	46.4	53.5	14.5	8.5

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

Planting date: April 20, 1994.

Harvest date: July 28, 1994.

Previous crop: Harrington barley.

Fertilizer: 100# 11-51-0 with the seed + 60# N actual
topdressed after planting.

Seeding was done with a no-till double disc drill.

Rainfall: From seeding to harvest was 5.21 inches.

Table 41. Effect of **Crop residue management and Tilt fungicide** in recrop wheat stubble, 1994. Western Triangle Agr. Research Center, Conrad, MT.

Tillage/ Variety	Fungicide treatment	Yield bu/ac	Test wt.	% protein
<u>Burned - Cultivated - NoTill</u> combined averages.				
Fortuna	Tilt	27.5	60.2	12.1
Fortuna	Untreated	29.7	60.0	11.4
Express	Tilt	32.8	59.3	10.1
Express	Untreated	33.7	59.3	9.9
<u>Burned</u> treated and untreated averages.				
Fortuna		29.9	60.0	11.3
Express		33.5	59.2	10.0
<u>Cultivated</u> treated and untreated averages.				
Fortuna		26.9	60.6	9.6
Express		33.0	59.7	10.7
<u>NoTill</u> treated and untreated averages.				
Fortuna		29.5	59.8	12.2
Express		33.1	59.0	10.4
<u>Burned</u> average of both varieties.				
Tilt		30.9	59.5	11.0
No Tilt		32.6	59.8	10.3
<u>Cultivated</u> average of both varieties.				
Tilt		29.1	60.3	10.9
No Tilt		30.8	59.9	10.6
<u>NoTill</u> average of both varieties.				
Tilt		30.5	59.5	11.5
No Tilt		31.7	59.3	11.1

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

Planting date: April 20, 1994.

Harvest date: August 10, 1994.

Previous crop: Newana wheat.

Fertilizer: 100# 11-51-0 with the seed, + 60# N actual
topdressed after seeding.

Seeding was done with a no-till double disc drill.

Rainfall: From seeding to harvest was 5.21 inches.

Table 42. Canola variety trial grown north of Conrad, MT. 1994. Montana Agr. Expt. Station, Western Triangle Ag. Res. Center, Conrad, MT.

Variety	Yield in pounds per acre	Plant height in inches
TOBIN	604	24
LG-45	423	35
WESTAR	394	33
LG-69	356	26
LG-44	342	32

Cooperator: Western Triangle Ag. Research Center.
Location: Ten miles north of Conrad, MT. (Pondera County)
Fertilizer: 35# phosphorus with the seed, + 70# N actual
topdressed after seeding.
Previous crop: Harrington barley.
Date seeded: May 11, 1994.
Date harvested: August 16, 1994.
Rainfall: From seeding to harvest was 5.03 inches.
Seeding was with a double disc drill into standing stubble.
Yield experimental mean: 423.93
Error degrees of freedom: 8.00
F test for var: 13.89
C.V. 2: 6.69
LSD (0.05): 92.49

TITLE: Canola, rapeseed, and peas as enhancers of soil nutrient availability and crop productivity in cereal rotations

YEAR: 1994

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

PERSONNEL: Grant Jackson, Larry Christiaens, and Mal Wescott-
Western Ag. Research Center, Corvallis

OBJECTIVES: To develop a low-input system of enhancing nutrient availability through the use of canola and rapeseed grown with legumes in rotation with cereal crops, and to integrate biological disease control into a rotational system. 1. Study nutrient accumulation by rapeseed, cereal hay, and cereal grain crops; and legume, rapeseed, and legume-rapeseed green manure combinations. 2. Determine the effects of the above rotations on nutrient availability to a subsequent barley crop. 3. Identify the influence of rotations Brassica spp. differing in glucosinolate levels on populations and activities of soilborne plant pathogens and integrate rotational sequencing with biological control of seedling diseases.

PROCEDURES: Fourteen crop and green manure crops were seeded no-till in 1992 in a RCB design with 4 replications. Treatments were:

1. High glucosinolate 'R 500' spring rapeseed as a crop
2. Low glucosinolate 'Westar' spring canola as a crop
3. 'Latah' spring pea as a crop
4. High glucosinolate 'Humus' winter rapeseed as a green manure
5. Low glucosinolate 'Imerald' winter canola as a green manure
6. 'Latah' spring pea as a green manure
7. 25% no. 4 and 75% no. 6 as a green manure
8. 50% no. 4 and 50% no. 6 as a green manure
9. 75% no. 4 and 25% no. 6 as a green manure
10. 25% no. 5 and 75% no. 6 as a green manure
11. 50% no. 5 and 50% no. 6 as a green manure
12. 25% no. 5 and 75% no. 6 as a green manure
13. 'Haybet barley as hay crop (low residue level)
14. 'Gallatin' barley as grain crop (high residue level)

Plot size was 10 x 20'; plots were arranged for irrigation. Preplant weed control was accomplished with glyphosate. Thirty lbs P₂O₅/a as 0-45-0 were applied on all plots; small grain plots received 50 lb N/a as 46-0-0. Seeding rates were or based on 150 lbs/a for the spring peas, 6 lbs/a for canola and rapeseed, and 70 lbs/a for the small grains. Seeding depth was 1.5" for peas and small grains and 0.75" for the canola and rapeseed. Plots were seeded twice to accomplish the desired seeding depths. This resulted in poor stands of some winter canola. Plots were sampled for total yield and N, P, K, and S. content and harvested or green manured. Dicamba and glyphosate were used kill the vegetation so the plot area would remain untilled. Addition information

including soil tests and soil pathogen assays are located in Table 52, 1993 annual report. In 1993 the plot area was seeded no-till, to 'Harrington' barley and no fertilizer was applied. Weeds were controlled with Bronate and Hoelon. Treatments were sampled for nutrients, grain yield, and grain quality, and the results published in the 1993 annual report. In 1994 the plot area was again seeded to 'Harrington' barley, no-till without fertilization and weeds controlled with Bronate and Hoelon.

RESULTS: Grain yields were about half of the 1993 yields. The green manure treatments ranked about the same as 1993. An exception was the Gallatin barley treatment. A possible explanation is the nutrients from the "hailed out" 1992 crop became available for the 1994 crop, or it takes longer for nutrients in barley stubble to cycle than broad-leaf green manures.

TABLE 43. EFFECT OF NO-TILL GREEN MANURE CROPS ON NO-TILL BARLEY YIELD AND QUALITY. Western Triangle Ag. Research Center, Conrad, MT. 1994.

TREATMENT	GRAIN YIELD	GRAIN PROTEIN	TEST WEIGHT	PLUMP	THINS
crop/mix/system	bu/ac	%	lb/bu	%	%
75% PEA, 25% WINTER RAPESEED-GM	43.70	7.20	53.35	94.50	1.75
SPRING PEA-GM	41.00	6.75	53.53	92.25	3.00
75% WINTER CANOLA, 25% PEA-GM	40.28	7.63	52.35	95.25	2.25
50% WINTER CANOLA, 50% PEA-GM	37.40	7.18	53.25	94.75	2.25
50% PEA, 50% WINTER RAPESEED-GM	37.30	7.05	53.70	94.75	1.75
25% WINTER CANOLA, 75% PEA-GM	36.95	7.20	53.53	94.25	2.50
SPRING CANOLA-CROP	35.43	7.35	51.30	92.50	4.00
GALLATIN BARLEY-CROP	35.25	7.80	50.60	90.50	6.50
WINTER RAPESEED-GM	33.60	7.23	52.28	92.75	3.00
25% PEA, 75% WINTER RAPESEED-GM	33.58	7.00	52.45	92.50	2.75
SPRING PEA-CROP	32.45	7.00	51.70	93.00	3.25
WINTER CANOLA-GM	31.25	7.33	52.25	92.50	3.00
HAYBET BARLEY-HAY CROP	30.43	7.73	50.98	94.50	2.25
SPRING RAPESEED-CROP	27.60	7.30	51.43	92.00	3.25
***** STATISTICAL TABLE *****					
EXPERIMENTAL MEANS	35.44	7.27	52.33	93.29	2.96
TOTAL OBSERVATIONS	56.00	56.00	56.00	56.00	56.00
NO. OF REPLICATIONS	4.00	4.00	4.00	4.00	4.00
NO. OF TREATMENTS	14.00	14.00	14.00	14.00	14.00
REP. MEAN SQUARE	321.95	1.60	7.90	.71	5.21
TREATMENT MEAN SQUARE	77.57	.34	4.23	7.61	5.69
ERROR MEAN SQUARE	35.05	.35	1.68	9.45	5.70
ERROR DEGREES OF FREEDOM	39.00	39.00	39.00	39.00	39.00
F TEST FOR REPS.	9.19	4.62	4.70	.08	.91
F TEST FOR TREATMENTS	2.21	.98	2.52	.81	1.00
P-VALUE	0.03	0.49	0.01	0.66	0.47
STANDARD ERROR	5.92	.59	1.30	3.07	2.39
STANDARD ERROR OF THE MEAN	2.96	.29	.65	1.54	1.19
C.V. 1: (S/MEAN)*100	16.70	8.11	2.48	3.29	80.55
C.V. 2: (S OF MEAN/MEAN)*100	8.35	4.06	1.24	1.65	40.28
LSD (0.05)	8.47	NS	1.85	NS	NS

Grain yields reported with 48 lb/bu as standard test weight.

Planted: May 13, 1994 Harvested: August 23, 1994

Growing Season Precip: 3.51" Irrigated three times: 7.25"

TABLE 44. EFFECT OF NO-TILL GREEN MANURE CROPS ON NO-TILL BARLEY TISSUE COMPOSITION. Western Triangle Ag. Research Center, Conrad, MT. 1994.

TREATMENT	-----NUTRIENT-----			
	N	P	K	S
crop/mix/system	-----%			
GALLATIN BARLEY-CROP	0.88	0.22	2.52	0.20
75% WINTER CANOLA, 25% PEA-GM	0.88	0.19	1.73	0.16
75% PEA, 25% WINTER RAPESEED-GM	0.81	0.18	1.72	0.19
25% WINTER CANOLA, 75% PEA-GM	0.82	0.20	1.63	0.18
SPRING PEA-GM	0.78	0.17	1.82	0.19
SPRING PEA-CROP	0.78	0.20	2.16	0.21
50% PEA, 50% WINTER RAPESEED-GM	0.80	0.21	1.55	0.18
WINTER CANOLA-GM	0.83	0.23	1.62	0.20
SPRING RAPESEED-CROP	0.75	0.22	1.83	0.16
HAYBET BARLEY-HAY CROP	0.95	0.24	1.93	0.19
WINTER RAPESEED-GM	0.85	0.21	1.60	0.18
25% PEA, 75% WINTER RAPESEED-GM	0.83	0.20	1.72	0.20
SPRING CANOLA-CROP	0.83	0.22	1.94	0.19
50% WINTER CANOLA, 50% PEA-GM	0.86	0.20	1.74	0.18
*****STATISTICAL TABLE*****				
EXPERIMENTAL MEANS	0.83	.21	1.82	0.18
TOTAL OBSERVATIONS	56.00	56.00	56.00	56.00
NO. OF REPLICATIONS	4.00	4.00	4.00	4.00
NO. OF TREATMENTS	14.00	14.00	14.00	14.00
REP. MEAN SQUARE	0.01	0.00	0.22	0.00
TREATMENT MEAN SQUARE	0.01	0.00	0.27	0.00
ERROR MEAN SQUARE	0.01	0.00	0.08	0.00
ERROR DEGREES OF FREEDOM	39.00	39.00	39.00	39.00
F TEST FOR REPS.	1.20	2.81	2.83	1.68
F TEST FOR TREATMENT	1.19	2.77	3.42	0.56
P-VALUE	0.32	0.00	0.00	0.87
STANDARD ERROR	0.09	0.02	0.28	0.04
STANDARD ERROR OF THE MEAN	0.05	0.01	0.14	0.02
C.V. 1: (S/MEAN)*100	11.01	10.94	15.35	19.14
C.V. 2: (S OF MEAN/MEAN)*100	5.51	5.47	7.68	9.57
LSD (0.05)	NS	0.03	0.40	NS

TABLE 45. EFFECT OF NO-TILL GREEN MANURE CROPS ON NO-TILL BARLEY PLANT YIELD AND NUTRIENT UPTAKE. Western Triangle Ag. Research Center, Conrad, MT 1994.

TREATMENT	PLANT YIELD	N UPTAKE	P UPTAKE	K UPTAKE	S UPTAKE
crop/mix/system	cwt/a	-----lb/a-----			
GALLATIN BARLEY-CROP	37.70	33.22	8.33	93.83	7.20
75% WINTER CANOLA, 25% PEA-GM	36.38	31.65	6.90	62.40	5.68
75% PEA, 25% WINTER RAPESEED-GM	36.33	29.28	6.58	63.05	6.53
25% WINTER CANOLA, 75% PEA	34.95	28.60	6.93	56.13	6.13
SPRING PEA-GM	34.17	26.33	5.70	61.98	6.23
SPRING PEA-CROP	33.95	26.43	6.58	73.63	6.85
50% PEA, 50% WINTER RAPESEED-GM	33.20	26.50	6.83	51.08	6.00
WINTER CANOLA-GM	32.98	27.07	7.48	52.75	6.30
SPRING RAPESEED-CROP	32.98	24.68	7.05	60.65	5.30
HAYBET BARLEY-HAY CROP	30.25	28.70	7.13	58.70	5.60
WINTER RAPESEED-GM	30.18	25.88	6.40	48.40	5.30
25% PEA, 75% WINTER RAPWSEED-GM	28.50	23.50	5.70	48.88	5.60
SPRING CANOLA-CROP	28.18	23.45	6.40	55.10	5.40
50% WINTER CANOLA, 50% PEA-GM	28.05	23.88	5.58	48.58	4.95
***** STATISTICAL TABLE *****					
EXPERIMENTAL MEANS	32.70	27.08	6.68	59.65	5.93
TOTAL OBSERVATIONS	56.00	56.00	56.00	56.00	56.00
NO. OF REPLICATIONS	4.00	4.00	4.00	4.00	4.00
NO. OF TREATMENTS	14.00	14.00	14.00	14.00	14.00
REP. MEAN SQUARE	16.12	8.80	.45	521.74	.74
TREATMENT MEAN SQUARE	40.91	34.84	2.19	587.46	1.66
ERROR MEAN SQUARE	43.41	31.98	1.74	188.54	1.68
ERROR DEGREES OF FREEDOM	39.00	39.00	39.00	39.00	39.00
F TEST FOR REPS.	0.37	0.28	0.26	2.77	0.44
F TEST FOR TREATMENTS	0.94	1.09	1.26	3.12	0.99
P-VALUE	0.53	0.40	0.28	0.00	0.48
STANDARD ERROR	6.59	5.65	1.32	13.73	1.30
STANDARD ERROR OF THE MEAN	3.29	2.83	0.66	6.87	0.65
C.V. 1: (S/MEAN)*100	20.15	20.88	19.75	23.02	21.85
C.V. 2: (S OF MEAN/MEAN)*100	10.08	10.44	9.88	11.51	10.92
LSD (0.05)	NS	NS	NS	19.64	NS

TITLE: Effect of nitrogen, phosphorus, potassium, and chloride on grain yield and quality of spring wheat.

YEAR: 1994

LOCATIONS:

1. Patricia Hellinger Farm, east of Ethridge;
2. Ron Long Farm, north of Shonkin;
3. Bruce Bradley Farm, northwest of Cut Bank;
4. Don Bradley Farm, northeast of Cut Bank;
5. Bob Inabnit Farm, east of Ledger;
6. Allan Skari Farm, north of Lothair;
7. Moog Farms, north of Joplin;
8. Ray Ramberg Farm, north of Inverness
9. Lyle McKeever Farm, northeast of Loma.

PERSONNEL: Grant Jackson, Larry Christiaens, Robert Kirby-Glacier County Agent, Joe Broesder-Toole County Agent, John Maatta-Liberty County Agent, Judy Wargo-Chouteau County Agent, and Robert Brastrup-Hill County Agent.

OBJECTIVES: Determine the response of spring wheat to N, P, K, and Cl fertilizers, and calibrate nitrate-N and P soil tests to spring wheat response.

PROCEDURES: Fourteen fertilizer treatments, described in each data table, were applied via a double disc between paired rows while planting (P fertilizer was placed with the seed). Plots were seeded with a double disc plot planter with a 6 x 14" paired row spacing. Plot size was 5 x 20 feet with four replications. Location characteristics such as variety, fertilizer applied with the seed, soil test results, etc. are shown in each table also. Chlorophyll content of the flag leaf at flowering was measured using a SPAD meter at some locations. Since chlorophyll content is related to N and protein, a relationship between a SPAD reading of the flag leaf and final grain protein content may exist. Total plant (above ground) samples at maturity were analyzed for N and P at two locations. Post-harvest soil samples from treatments 5-8 were analyzed for nitrate and ammonium-N at three locations.

RESULTS: Data are summarized in Tables 46 through 58 and Figures 1 through 4. Comments about individual locations are shown at the bottom of each table. Six of 9 sites (see Figs. 1 and 2) had a significant N yield increases, and all locations (figure 3) had significant protein increases due to N. Optimum yields occurred when soil and fertilizer N was about 80 to 100 N, while the N requirement for 14% protein was about 120 to 140 N. Phosphorus significantly lowered protein, slightly at two locations (north of Cut Bank and Northeast of Cut Bank). Phosphorus increased yield at four sites. These locations had very low P soil tests and needed about 50 lbs P₂O₅ for optimum yields (see figures 5 through 7). Note the necessity of P for N response. Two locations (Northeast of Cut Bank and Joplin) had Fargo damage, and one (Inverness) suffered from wheat streak mosaic virus.

Two locations were selected for N and P analysis of the plant tops; these data are presented in Tables 55 and 56. Water stress conditions at the Ledger site reduced nutrient uptake levels. Fargo damage probably affected the Cut Bank location, and N and P contents were less than expected. Nitrogen use efficiency (Table 57) was probably reduced by the same reasons. Post-harvest soil nitrate and ammonium-N levels are shown in Table 58. Soil nitrate-N in the surface foot of the 150 lbs N/acre treatments increased at the three locations. Chlorophyll readings for protein prediction were inconclusive, and another year of data will be collected.

Figure 4 shows the relationship of P soil test and % yield of the P experiments conducted on spring wheat since 1988. Percent yield for each location is calculated by dividing the check plot yield (0 P treatment) by the highest yield of the P treatments and multiplying by 100. Therefore the number can exceed 100 % if P fertilization reduces yields. This figure is called a "Cate-Nelson" plot and is used to determine soil test critical levels. According to this method, the critical level for spring wheat is 13 ppm. Thus the critical level, as determined by this method, could change as more data are collected.

TABLE 46. EFFECT OF N, P, K, and Cl ON SPRING WHEAT.
 Experiment located north of Cut Bank. Western Triangle
 Ag. Research Center, Conrad, 1994.

TREATMENT	GRAIN YIELD	TEST WT.	GRAIN PROTEIN	SPAD READING
NO. N-P ₂ O ₅ -K-Cl	bu/ac	lb/bu	%	#
8 150-25-30-27	43.47	56.53	14.48	46.57
10 50-50-30-27	40.22	56.47	13.07	46.75
6 50-25-30-27	39.65	56.28	13.38	47.28
3 100-0-30-27	38.15	57.70	13.72	46.50
12 150-50-30-27	37.38	56.05	14.35	45.20
2 50-0-30-27	37.30	57.25	13.48	47.07
13 100-25-0-27	37.28	55.85	14.00	45.55
14 100-25-30-0	36.78	55.83	14.53	46.90
7 100-25-30-27	36.65	56.75	14.30	45.78
11 100-50-30-27	35.92	55.40	13.88	47.85
4 150-0-30-27	35.50	56.22	14.63	46.85
1 0-0-30-27	33.30	58.40	10.55	42.47
5 0-25-30-27	32.33	57.80	11.20	42.35
9 0-50-30-27	31.90	57.10	10.23	41.93
STATISTICAL TABLE				
EXPERIMENTAL MEANS	36.84	56.69	13.27	45.65
ERROR MEAN SQUARE	16.13	1.194	.2519	5.907
P-VALUE FOR TREAT.	.0157	.0126	.0000	.0090
STANDARD ERROR	4.016	1.093	.5019	2.430
STANDARD ERROR OF THE MEAN	2.008	.5463	.2509	1.215
C.V. 1: (S/MEAN)*100	10.90	1.927	3.782	5.325
LSD (0.05)	5.744	1.563	.7179	3.476
NITROGEN SUMMARY				
0	32.51	57.77	10.66	42.25
50	39.06	56.67	13.31	47.03
100	36.91	56.62	13.97	46.71
150	38.78	56.27	14.48	46.21
LSD (0.05)	3.31	0.90	0.41	2.01
PHOSPHORUS SUMMARY				
0	36.06	57.39	13.09	45.73
25	38.03	56.84	13.34	45.49
50	36.36	56.26	12.88	45.43
LSD (0.05)	NS	0.78	0.36	NS

Grain yields based on 60 lb/bu.

Variety: Amidon Previous crop: Fallow
 Growing Season ppt. = 3.00" Depth of Moist Soil = > 3'
 Seeding Date: May 4 Harvest Date: August 22
 Soil Tests: pH = 6.5, O.M. = 2.0%, P = 26 ppm, K = 346 ppm,
 Zn = 0.4 ppm. Depth NO₃-N NH₄-N Cl SO₄-S
 ft. -----lb/a-----
 0-1 22.4 16.2 5 284
 0-2 35.9 31.0 20 1193
 0-3 43.3 49.2 28 1275
 0-4 45.8 68.8 36 1330

Comments: Good yield response to N, but no P, K, or Cl response.
 This location needed about 100 N for 14 % protein.

TABLE 47. EFFECT OF N, P, K, and Cl. ON SPRING WHEAT.
 Experiment located east of Ethridge. Western Triangle
 Ag. Research Center, Conrad. 1994.

TREATMENT	GRAIN	TEST	GRAIN	SPAD
NO. N-P ₂ O ₅ -K-Cl	YIELD	WT.	PROTEIN	READING
lb/acre	bu/ac	lb/bu	%	#
6 30-20-20-18	28.65	53.97	14.43	45.27
11 60-40-20-18	28.45	53.92	15.65	47.10
12 90-40-20-18	28.40	55.60	15.17	46.67
10 30-40-20-18	27.98	55.38	14.30	44.45
14 60-20-20-0	27.85	55.25	15.88	46.10
2 30-0-20-18	27.75	55.47	14.63	45.60
7 60-20-20-18	27.63	54.97	15.10	46.00
8 90-20-20-18	27.57	55.92	15.27	45.50
5 0-20-20-18	26.68	56.38	12.98	42.78
13 60-20-0-18	26.50	55.55	15.17	45.92
1 0-0-20-18	26.15	56.53	12.82	42.90
3 60-0-20-18	25.32	53.55	16.00	47.17
4 90-0-20-18	25.30	55.15	15.65	46.93
9 0-40-20-18	24.67	54.05	13.85	45.25

STATISTICAL TABLE

EXPERIMENTAL MEANS	27.06	55.12	14.78	45.55
ERROR MEAN SQUARE	6.030	4.126	.3278	3.847
P-VALUE FOR TREAT.	.3754	.6301	.0000	.0447
STANDARD ERROR	2.456	2.031	.5725	1.961
STANDARD ERROR OF THE MEAN	1.228	1.016	.2863	.9807
C.V. 1: (S/MEAN)*100	9.074	3.685	3.874	4.306
LSD (0.05)	NS	NS	0.82	2.81

NITROGEN SUMMARY

0	25.83	55.65	13.22	43.64
30	28.13	54.94	14.45	45.11
60	27.13	54.15	15.58	46.76
90	27.09	55.56	15.37	46.37
LSD (0.05)	2.02	NS	0.47	1.62

PHOSPHORUS SUMMARY

0	26.13	55.17	14.77	45.65
20	27.63	55.31	14.44	44.89
40	27.38	54.74	14.74	45.87
LSD (0.05)	NS	NS	NS	NS

Grain yields based on 60 lb/bu.

Variety: Amidon Previous crop: Fallow
 Growing Season ppt. = 3.10" Depth of Moist Soil = > 3'
 Seeding Date: April 18 Harvest Date: August 22
 Soil Tests: pH = 8.0, O.M. = 2.1%, P = 7 ppm, K = 401 ppm,
 Zn = 0.4 ppm. Depth NO₃-N NH₄-N Cl SO₄-S
 ft. -----lb/a-----
 0-1 25.3 10.9 38 105
 0-2 36.3 20.9 79 246
 0-3 44.4 30.5 116 5081

Comments: Grain yield response to 30 N. Needed the 30 N for 14 % protein also. No response to P, K, or Cl.

TABLE 48. EFFECT OF N, P, K, and Cl ON SPRING WHEAT.
 Experiment located north of Lothair. Western Triangle
 Ag. Research Center, Conrad. 1994.

NO.	TREATMENT	GRAIN YIELD	TEST WT.	GRAIN PROTEIN	SPAD READING
	N-P ₂ O ₅ -K-Cl lb/acre	bu/ac	lb/bu	%	#
14	60-20-20-0	34.78	57.80	15.25	41.47
5	0-20-20-18	34.00	58.17	13.25	42.60
10	30-40-20-18	33.78	57.60	14.55	42.60
2	30-0-20-18	33.55	58.60	14.17	40.18
13	60-20-0-18	33.20	57.57	15.32	43.75
11	60-40-20-18	32.97	57.53	15.07	42.73
4	90-0-20-18	32.95	57.35	15.27	40.65
3	60-0-20-18	32.95	58.13	14.95	43.70
6	30-20-20-18	32.70	57.47	14.60	43.80
8	90-20-20-18	32.67	57.10	15.65	41.75
7	60-20-20-18	32.58	57.20	15.40	41.53
9	0-40-20-18	31.98	58.67	13.40	42.25
12	90-40-20-18	31.28	56.92	15.87	43.63
1	0-0-20-18	30.40	58.50	13.38	38.45

STATISTICAL TABLE

EXPERIMENTAL MEANS	32.84	57.76	14.72	42.08
ERROR MEAN SQUARE	4.331	.5161	.2458	9.384
P-VALUE FOR TREAT.	.3641	.0119	.0000	.4471
STANDARD ERROR	2.081	.7184	.4958	3.063
STANDARD ERROR OF THE MEAN	1.041	.3592	.2479	1.532
C.V. 1: (S/MEAN)*100	6.337	1.244	3.367	7.280
LSD (0.05)	NS	1.03	0.71	NS

NITROGEN SUMMARY

0	32.13	58.45	13.34	41.10
30	33.34	57.89	14.44	42.19
60	32.83	57.62	15.14	42.65
90	32.30	57.13	15.60	42.01
LSD (0.05)	NS	0.59	0.41	NS

PHOSPHORUS SUMMARY

0	32.46	58.14	14.44	40.74
20	32.99	57.49	14.72	42.42
40	32.50	57.68	14.72	42.80
LSD (0.05)	NS	0.51	NS	NS

Grain yields based on 60 lb/bu.

Variety: Amidon Previous crop: Fallow
 Growing Season ppt. = 3.25" Depth of Moist Soil = > 3'
 Seeding Date: April 18 Harvest Date: August 17
 Soil Tests: pH = 6.9, O.M. = 1.7%, P = 26 ppm, K = 646 ppm,
 Zn = 0.6 ppm. Depth NO₃-N NH₄-N Cl SO₄-S

ft.	-----lb/a-----			
0-1	44.8	7.5	2	35
0-2	60.5	11.6	22	115
0-3	85.8	14.6	70	208
0-4	111.2	18.0	179	316

Comments: No grain yield response to any applied nutrient, but needed 30 N for 14 % protein. About 10% of the area was infected with dryland root rot.

TABLE 49. EFFECT OF N, P, K, and Cl ON SPRING WHEAT.
 Experiment located north of Joplin. Western Triangle
 Ag. Research Center, Conrad. 1994.

TREATMENT		GRAIN	TEST	GRAIN
NO.	N-P ₂ O ₅ -K-Cl	YIELD	WT.	PROTEIN
	lbs/acre	bu/ac	lb/bu	%
10	50-50-30-27	43.70	58.35	13.45
11	100-50-30-27	41.20	59.30	14.35
7	100-25-30-27	40.70	58.35	14.70
12	150-50-30-27	39.15	57.90	14.55
8	150-25-30-27	37.90	57.95	14.65
6	50-25-30-27	37.35	59.65	13.65
13	100-25-0-27	36.15	59.15	14.65
14	100-25-30-0	35.85	59.10	14.95
2	50-0-30-27	32.75	58.70	14.30
9	0-50-30-27	31.25	59.35	10.35
3	100-0-30-27	30.85	57.60	14.80
4	150-0-30-27	29.65	58.80	14.70
5	0-25-30-27	26.55	59.80	10.15
1	0-0-30-27	26.25	58.45	10.05
STATISTICAL TABLE				
EXPERIMENTAL MEANS		34.95	58.75	13.52
ERROR MEAN SQUARE		6.068	.5532	.0880
P-VALUE FOR VAR.		.0000	.1851	.0000
STANDARD ERROR		2.463	.7438	.2967
STANDARD ERROR OF THE MEAN		1.742	.5259	.2098
C.V. 1: (S/MEAN)*100		7.048	1.266	2.194
LSD (0.05)		5.322	NS	.6410
NITROGEN SUMMARY				
0		28.02	59.20	10.18
50		37.93	58.90	13.80
100		37.58	58.42	14.62
150		35.57	58.22	14.63
LSD (0.05)		3.07	NS	0.37
PHOSPHORUS SUMMARY				
0		29.88	58.39	13.46
25		35.63	58.94	13.29
50		38.83	58.73	13.17
LSD (0.05)		2.67	NS	NS

Grain yields based on 60 lb/bu.

Variety: Amidon Previous crop: Chemical Fallow
 Growing Season ppt. = 2.75" Depth of Moist Soil = > 3'
 Seeding Date: April 19 Harvest Date: August 18
 Soil Tests: pH = 8.3, O.M. = 1.3%, P = 4 ppm, K = 225 ppm,
 Zn = 0.2 ppm. Depth NO₃-N NH₄-N Cl SO₄-S

ft.	-----lb/a-----			
0-1	18.5	11.0	2	58
0-2	24.4	24.3	5	3521
0-3	30.2	50.7	11	8149
0-4	34.1	78.9	24	14637

Comments: Grain yield response to all applied nutrients. Note
 treats. 7, 13, and 14 for K and Cl responses. Needed about 80 N
 for 14% protein. Two reps were not harvested due to Fargo damage.

TABLE 50. EFFECT OF N, P, K, and Cl ON SPRING WHEAT.
 Experiment located northeast of Inverness. Western
 Triangle Ag. Research Center, Conrad. 1994.

NO.	TREATMENT N-P ₂ O ₅ -K-Cl	GRAIN YIELD	TEST WT.	GRAIN PROTEIN
11	100-50-30-27	59.63	58.73	14.97
12	150-50-30-27	56.37	58.77	15.30
8	150-25-30-27	53.90	57.63	15.03
10	50-50-30-27	52.70	57.93	14.50
6	50-25-30-27	50.77	58.73	14.47
14	100-25-30-0	48.83	58.00	15.43
13	100-25-0-27	48.60	57.40	14.93
5	0-25-30-27	48.57	58.70	12.50
7	100-25-30-27	47.97	56.90	15.20
9	0-50-30-27	46.33	59.47	12.53
3	100-0-30-27	45.67	58.20	14.67
1	0-0-30-27	43.97	57.70	13.83
2	50-0-30-27	38.50	56.97	14.97
4	150-0-30-27	36.60	57.93	15.10

STATISTICAL TABLE

EXPERIMENTAL MEANS	48.46	58.08	14.53
ERROR MEAN SQUARE	87.80	1.135	.4878
P-VALUE FOR VAR.	.2464	.1995	.0000
STANDARD ERROR	9.370	1.065	.6984
STANDARD ERROR OF THE MEAN	5.410	.6151	.4032
C.V. 1: (S/MEAN)*100	19.34	1.834	4.806
LSD (0.05)	NS	NS	1.172

NITROGEN SUMMARY

0	46.29	58.62	12.96
50	47.32	57.88	14.64
100	51.09	57.94	14.94
150	48.96	58.11	15.14
LSD (0.05)	NS	NS	0.68

PHOSPHORUS SUMMARY

0	41.18	57.70	14.64
25	50.30	57.99	14.30
50	53.76	58.73	14.32
LSD (0.05)	7.86	NS	NS

Grain yields based on 60 lb/bu.

Variety: Amidon Previous crop: Fallow
 Growing Season ppt. = 3.15" Depth of Moist Soil = > 3'
 Seeding Date: April 19 Harvest Date: August 18
 Soil Tests: pH = 7.1, O.M. = 1.5%, P = 7 ppm, K = 512 ppm,
 Zn = 0.3 ppm. Depth NO₃-N NH₄-N Cl SO₄-S

ft.	-----lb/a-----			
0-1	41.5	9.7	9	90
0-2	64.4	17.3	18	173
0-3	77.6	26.9	48	438

Comments: Wheat streak mosaic virus caused considerable variability, therefore only the P grain yield response was significant. Fig. 7 shows the N response at the high P rate.

TABLE 51. EFFECT OF N, P, K, and Cl ON NO-TILL SPRING WHEAT.
 Experiment located east of Ledger. Western Triangle
 Ag. Research Center, Conrad. 1994.

NO.	TREATMENT	GRAIN	GRAIN
	N-P ₂ O ₅ -K-Cl lb/acre	YIELD bu/ac	PROTEIN %
11	100-50-30-27	17.30	16.58
10	50-50-30-27	17.05	13.10
13	100-25-0-27	16.42	15.63
12	150-50-30-27	16.20	16.43
7	100-25-30-27	15.78	16.10
6	50-25-30-27	15.72	14.55
4	150-0-30-27	15.63	15.43
14	100-25-30-0	14.75	16.20
3	100-0-30-27	14.55	16.52
2	50-0-30-27	14.50	14.20
8	150-25-30-27	13.18	16.63
1	0-0-30-27	9.15	9.47
5	0-25-30-27	8.88	9.07
9	0-50-30-27	8.82	9.35

STATISTICAL TABLE

EXPERIMENTAL MEANS	14.14	14.23
ERROR MEAN SQUARE	2.592	.5164
P-VALUE FOR TREATS.	.0000	.0000
STANDARD ERROR	1.610	.7186
STANDARD ERROR OF THE MEAN	.8050	.3593
C.V. 1: (S/MEAN)*100	11.39	5.049
LSD (0.05)	2.303	1.028

NITROGEN SUMMARY

0	8.95	9.30
50	15.76	13.95
100	15.87	16.40
150	15.00	16.16
LSD (0.05)	1.33	0.59

PHOSPHORUS SUMMARY

0	13.46	13.91
25	13.39	14.09
50	14.84	13.86
LSD (0.05)	1.15	NS

Grain yields based on 60 lb/bu.

Variety: Amidon Previous crop: Barley
 Growing Season ppt. = 1.25" Depth of Moist Soil = > 3'
 Seeding Date: April 14 Harvest Date: August 3
 Soil Tests: pH = 8.2, O.M. = 1.7%, P = 8 ppm, K = 318 ppm,
 Zn = 0.2 ppm. Depth NO₃-N NH₄-N Cl SO₄-S

ft.	-----lb/a-----			
0-1	6.0	18.4	26	113
0-2	6.8	41.0	44	2611
0-3	8.0	68.1	62	6087
0-4	10.9	97.2	82	10813
0-5	16.7	130.2	116	17847

Comments: Grain samples consisted of about 30 % volunteer barley.
 Significant responses occurred to N and P.

TABLE 52. EFFECT OF N, P, K, and Cl ON NO-TILL SPRING WHEAT.
 Experiment located west of Shonkin. Western Triangle
 Ag. Research Center, Conrad. 1994.

TREATMENT	GRAIN YIELD	TEST WT.	GRAIN PROTEIN	SPAD READING
NO. N-P ₂ O ₅ -K-Cl	bu/ac	lb/bu	%	#
11 100-40-30-27	30.05	57.93	13.88	43.97
8 150-20-30-27	29.08	57.50	14.95	43.90
7 100-20-30-27	28.80	57.80	14.55	44.08
12 150-40-30-27	28.40	57.58	14.97	46.77
6 50-20-30-27	28.13	58.70	12.88	43.78
3 100-0-30-27	27.88	57.90	14.48	43.68
10 50-40-30-27	27.57	57.82	13.07	44.25
2 50-0-30-27	27.22	57.88	13.15	42.30
14 100-20-30-0	26.92	57.42	14.77	44.20
4 150-0-30-27	26.18	57.45	15.05	45.72
13 100-20-0-27	26.05	57.28	14.40	43.45
9 0-40-30-27	22.97	59.35	10.85	34.35
1 0-0-30-27	20.27	59.67	10.70	34.22
5 0-20-30-27	20.20	59.82	10.50	34.10

STATISTICAL TABLE

EXPERIMENTAL MEANS	26.41	58.15	13.44	42.06
ERROR MEAN SQUARE	10.64	.8578	.2829	3.342
P-VALUE FOR TREATS.	.0010	.0012	.0000	.0000
STANDARD ERROR	3.263	.9262	.5319	1.828
STANDARD ERROR OF THE MEAN	1.631	.4631	.2659	.9140
C.V. 1: (S/MEAN)*100	12.35	1.593	3.957	4.347
LSD (0.05)	4.67	1.33	0.76	2.62

NITROGEN SUMMARY

0	21.15	59.61	10.68	34.23
50	27.64	58.13	13.03	43.44
100	28.91	57.87	14.30	43.91
150	27.88	57.50	14.99	45.47
LSD (0.05)	2.69	0.76	0.44	1.51

PHOSPHORUS SUMMARY

0	25.39	58.22	13.34	41.48
20	26.55	58.46	13.22	41.46
40	27.25	58.17	13.19	42.34
LSD (0.05)	NS	NS	NS	NS

Grain yields based on 60 lb/bu.

Variety: Amidon Previous crop: Spring Wheat
 Growing Season ppt. = 4.88" Depth of Moist Soil = > 3'
 Seeding Date: April 13 Harvest Date: August 2
 Soil Tests: pH = 6.1, O.M. = 2.7%, P = 26 ppm, K = 425 ppm,
 Zn = 0.6 ppm. Depth NO₃-N NH₄-N Cl SO₄-S

ft.	-----lb/a-----			
0-1	24.9	13.6	12	52
0-2	29.4	25.0	18	140
0-3	30.2	37.1	20	314
0-4	33.8	54.3	36	9116

Comments: Excellent responses to N. No P response. Almost a significant response to K and Cl (see treats. 7, 13, and 14). Needed about 80 N for 14 % protein.

TABLE 53. EFFECT OF N, P, K, and Cl ON SPRING WHEAT.
 Experiment located northeast of Cut Bank. Western
 Triangle Ag. Research Center, Conrad. 1994.

NO.	TREATMENT	GRAIN	TEST	GRAIN	SPAD
	N-P ₂ O ₅ -K-Cl lb/acre	YIELD bu/ac	WT. lb/bu	PROTEIN %	READING #
10	50-50-30-27	36.30	59.63	13.00	44.28
12	150-50-30-27	34.42	59.15	14.13	47.72
7	100-25-30-27	33.95	59.27	13.60	44.45
11	100-50-30-27	33.92	59.00	14.57	46.45
14	100-25-30-0	32.88	58.75	14.90	46.17
13	100-25-0-27	32.83	59.50	14.45	46.47
8	150-25-30-27	32.40	58.92	14.35	45.40
6	50-25-30-27	32.15	59.05	13.57	44.52
4	150-0-30-27	30.13	58.57	14.77	46.60
5	0-25-30-27	29.75	60.75	9.43	39.58
9	0-50-30-27	28.90	60.60	9.38	39.55
3	100-0-30-27	26.95	58.63	14.63	46.75
2	50-0-30-27	26.92	58.57	13.90	45.83
1	0-0-30-27	25.15	59.92	9.95	40.58
STATISTICAL TABLE					
EXPERIMENTAL MEANS		31.19	59.31	13.19	44.60
ERROR MEAN SQUARE		5.418	.3829	.6032	4.629
P-VALUE FOR VAR.		.0000	.0000	.0000	.0000
STANDARD ERROR		2.328	.6188	.7767	2.151
STANDARD ERROR OF THE MEAN		1.164	.3094	.3883	1.076
C.V. 1: (S/MEAN)*100		7.463	1.043	5.890	4.824
LSD (0.05)		3.329	.8850	1.111	3.077
NITROGEN SUMMARY					
0		27.93	60.42	9.58	39.90
50		31.79	59.08	13.49	44.87
100		31.61	58.97	14.27	45.88
150		32.32	58.88	14.42	46.57
LSD (0.05)		1.92	0.51	0.64	1.78
PHOSPHORUS SUMMARY					
0		27.29	58.93	13.31	44.94
25		32.06	59.50	12.74	43.49
50		33.39	59.59	12.77	44.50
LSD (0.05)		1.67	0.44	0.56	1.54

Grain yields based on 60 lb/bu.

Variety: Amidon

Previous crop: Fallow

Growing Season ppt. = 3.50"

Depth of Moist Soil = > 3'

Seeding Date: May 4

Harvest Date: September 1

Soil Tests: pH = 8.1, O.M. = 1.8%, P = 8 ppm, K = 192 ppm,

Zn = 0.2 ppm. Depth NO₃-N NH₄-N Cl SO₄-S
 ft. -----lb/a-----

0-1	21.8	14.8	2	37
0-2	33.0	22.0	4	91
0-3	37.0	31.2	6	172

Comments: Excellent responses to N and P. Need about 80 N for 14 % protein. Responses were probably affected by Fargo damage.

TABLE 54. EFFECT OF N, P, K, and Cl ON SPRING WHEAT.
 Experiment located north of Loma. Western Triangle Ag.
 Research Center, Conrad. 1994.

TREATMENT		GRAIN	GRAIN	SPAD
NO.	N-P ₂ O ₅ -K-Cl	YIELD	PROTEIN	READING
	lb/acre	bu/ac	%	#
6	30-20-20-18	33.39	15.94	44.47
2	30-0-20-18	32.96	16.32	45.95
1	0-0-20-18	32.70	15.45	41.07
13	60-20-0-18	32.47	16.25	45.40
3	60-0-20-18	31.83	16.73	46.82
8	90-20-20-18	30.72	16.65	45.15
5	0-20-20-18	30.47	15.38	44.45
14	60-20-20-0	29.77	16.63	45.88
11	60-40-20-18	29.24	16.46	45.35
7	60-20-20-18	29.08	16.63	42.75
10	30-40-20-18	28.75	16.47	46.63
9	0-40-20-18	28.52	15.60	46.75
12	90-40-20-18	28.40	16.88	47.83
4	90-0-20-18	28.03	16.38	45.00

STATISTICAL TABLE

EXPERIMENTAL MEANS	30.31	16.27	45.25
ERROR MEAN SQUARE	21.73	.1010	5.977
P-VALUE FOR VAR.	.8558	.0000	.0427
STANDARD ERROR	4.662	.3177	2.445
STANDARD ERROR OF THE MEAN	2.331	.1589	1.222
C.V. 1: (S/MEAN)*100	15.31	1.953	5.403
LSD (0.05)	NS	.4561	3.497

Grain yields based on 60 lb/bu.

Variety: Amidon Previous crop: Fallow
 Growing Season ppt. = 4.40" Depth of Moist Soil = > 3'
 Seeding Date: April 13 Harvest Date: August 2
 Soil Tests: pH = 6.4, O.M. = 1.3%, P = 19 ppm, K = 301 ppm,
 Zn = 0.4 ppm.

Depth	NO ₃ -N	NH ₄ -N	Cl	SO ₄ -S
ft.	-----lb/a-----			
0-1	115.5	12.1	4	786
0-2	173.1	30.7	107	11142
0-3	210.5	49.1	189	20204
0-4	262.5	80.7	357	40307

Comments: Some treatments were lost from poor stands due to opener plugging while seeding, therefore, the factorial analysis of N and P couldn't be performed.

TABLE 55. EFFECT OF N AND P FERTILIZATION ON PLANT N AND P LEVELS. Experiment located near Ledger. Western Triangle Ag. Research Center, Conrad. 1994.

TREATMENT	N	N	P	P
	CONTENT	UPTAKE	CONTENT	UPTAKE
lb N-P ₂ O ₅ -K-Cl/acre	%	lb N/a	%	lb P/a
0-0-30-27	0.80	14.70	0.14	2.27
0-25-30-27	0.77	11.88	0.14	2.05
0-50-30-27	0.77	12.10	0.13	2.00
50-0-30-27	0.84	19.65	0.12	2.55
100-25-0-27	1.11	38.65	0.12	4.38
100-50-30-27	1.05	25.62	0.11	2.62
100-25-30-0	1.08	30.25	0.11	2.67
150-0-30-27	0.84	20.33	0.11	2.58
100-0-30-27	1.08	26.13	0.11	2.67
150-25-30-27	0.91	23.75	0.11	2.58
50-25-30-27	0.93	25.35	0.10	2.65
100-25-30-27	1.07	27.63	0.10	2.50
50-50-30-27	0.91	22.17	0.10	2.40
STATISTICAL SUMMARY				
EXPERIMENTAL MEANS	0.96	24.46	0.11	2.68
VAR. MEAN SQUARE	.9276E-01	336.3	.5699E-03	1.479
ERROR MEAN SQUARE	.3962E-01	54.20	.6168E-03	.7364
F-VALUE FOR VAR.	2.341	6.205	.9240	2.009
P-VALUE FOR VAR.	.0183	.0000	.5426	.0432
STANDARD ERROR	.1991	7.362	.2484E-01	.8581
STANDARD ERROR OF THE MEAN	.9953E-01	3.681	.1242E-01	.4291
C.V. 1: (S/MEAN)*100	20.78	30.10	21.70	32.06
LSD (0.05)	0.28	10.53	NS	1.23
NITROGEN SUMMARY				
0	0.78	12.89	0.13	2.11
50	0.89	22.39	0.11	2.53
100	1.07	26.46	0.11	2.60
150	1.00	29.43	0.11	2.90
LSD (0.05)	0.10	6.08	0.02	0.71
PHOSPHORUS SUMMARY				
0	0.89	20.20	0.12	2.52
25	0.92	22.15	0.11	2.44
50	1.00	26.03	0.11	2.64
LSD (0.05)	0.08	5.27	NS	NS

TABLE 56. EFFECT OF N AND P FERTILIZATION ON PLANT N AND P LEVELS. Experiment located northeast of Cut Bank. Western Triangle Ag. Research Center, Conrad. 1994.

TREATMENT	N CONTENT	N UPTAKE	P CONTENT	P UPTAKE
lb N-P ₂ O ₅ -K-Cl/acre	%	lb N/a	%	lb P/a
0-0-30-27	0.70	34.72	0.09	4.10
100-50-30-27	0.72	39.05	0.08	4.47
100-25-0-27	0.82	50.60	0.08	4.60
50-0-30-27	0.81	44.88	0.07	3.77
0-50-30-27	0.53	21.77	0.07	2.75
0-25-30-27	0.69	31.55	0.07	3.00
150-0-30-27	0.80	46.40	0.07	3.77
100-0-30-27	0.75	38.63	0.07	3.65
150-25-30-27	0.77	40.20	0.07	3.58
50-25-30-27	0.93	37.67	0.06	2.90
100-25-30-0	0.74	48.83	0.06	4.05
100-25-30-27	0.73	55.67	0.06	4.38
50-50-30-27	0.73	37.65	0.06	2.80
150-50-30-27	0.64	36.20	0.06	3.38
STATISTICAL TABLE				
EXPERIMENTAL MEANS	.7409	40.27	.6804E-01	3.657
TREAT. MEAN SQUARE	.3408E-01	295.1	.3430E-03	1.569
ERROR MEAN SQUARE	.3492E-01	122.3	.3309E-03	.9871
P-VALUE FOR TREATS.	.4942	.0152	.4405	.1259
STANDARD ERROR	.1869	11.06	.1819E-01	.9935
STANDARD ERROR OF THE MEAN	.9344E-01	5.529	.9095E-02	.4968
C.V. 1: (S/MEAN)*100	25.22	27.46	26.74	27.17
LSD (0.05)	NS	15.82	NS	NS
NITROGEN SUMMARY				
0	0.64	29.35	0.74	3.28
50	0.82	40.07	0.62	3.16
100	0.73	44.45	0.70	4.17
150	0.74	40.93	0.65	3.58
LSD (0.05)	NS	9.13	NS	0.82
PHOSPHORUS SUMMARY				
0	0.77	41.16	0.73	3.83
25	0.78	41.27	0.64	3.46
50	0.66	33.67	0.67	3.35
LSD (0.05)	NS	7.91	NS	NS

TABLE 57. EFFECT OF N ON N UPTAKE AND N USE EFFICIENCY.
Western Triangle Ag Research Center, Conrad, MT. 1994.

Treat lb N/acre	-----Location-----			
	East of Ledger		Northeast of Cut Bank	
	Nuptake lbN/a	Eff. %	Nuptake lb N/a	Eff. %
0	11.9	45.6	31.6	65.7
50	25.4	35.6	37.7	38.5
100	27.6	29.4	55.7	38.2
150	23.8	16.4	40.2	23.3
*****Statistical Summary*****				
p-value	0.16	0.24	0.46	0.00
CV, %	44	59	24	14
LSD (0.05)	NS	NS	NS	18.4

$$N \text{ use Eff.} = \frac{\text{Nuptake}}{\text{N rate} + \text{Initial N} - \text{Post harvest N}} \times 100$$

TABLE 58. INITIAL SOIL N AND THE EFFECT OF N ON POST-HARVEST SOIL N.
Western Triangle Ag. Research Center, Conrad, MT, 1994.

SOIL N	DEPTH feet	Initial N	North of Cut Bank				MEAN	LSD (0.05)	P-VALUE	C.V. %
			TREATMENT ----- lb N/acre-----							
Nitrate	0-1	22.4	4.0	7.7	7.0	8.9	6.9	NS	0.16	41
Nitrate	1-2	13.5	1.5	4.0	3.7	3.6	3.2	2.0	0.06	39
Ammonium	0-1	16.2	8.4	11.0	10.5	9.9	10.0	1.4	0.01	9
Ammonium	1-2	15.8	9.7	11.9	7.3	9.0	10.0	NS	0.57	30
<u>East of Ledger</u>										
Nitrate	0-1	6.0	4.2	8.5	7.2	9.5	7.4	NS	0.52	70
Nitrate	1-2	0.8	3.0	2.8	5.4	5.2	4.1	NS	0.84	127
Nitrate	2-3	2.8	1.8	5.1	3.0	4.4	3.6	NS	0.17	56
Nitrate	3-4	2.9	5.9	7.6	5.4	6.7	6.4	NS	0.88	64
Nitrate	4-5	5.8	12.3	9.0	7.8	5.9	8.8	NS	0.61	78
Ammonium	0-1	18.4	9.2	8.9	10.7	15.0	11.0	NS	0.14	34
Ammonium	1-2	22.6	14.7	17.5	15.3	19.8	16.8	NS	0.31	24
Ammonium	2-3	27.1	19.4	23.3	21.9	29.6	24.0	NS	0.23	28
Ammonium	3-4	29.1	21.1	27.8	24.5	27.6	25.3	NS	0.48	26
Ammonium	4-5	33.0	19.4	23.3	21.9	29.6	23.6	NS	0.23	28
<u>Northeast of Cut Bank</u>										
Nitrate	0-1	21.8	2.5	5.0	3.3	17.0	7.0	NS	0.13	124
Nitrate	1-2	11.2	0.7	2.6	2.3	4.7	2.6	NS	0.11	78
Nitrate	2-3	4.0	0.7	0.5	0.9	1.2	0.8	NS	0.76	116
Ammonium	0-1	14.8	7.5	6.8	7.4	8.2	7.5	NS	0.68	21
Ammonium	1-2	7.2	5.2	3.8	5.8	7.8	4.9	NS	0.28	28
Ammonium	2-3	9.2	3.2	1.4	2.0	1.9	2.1	NS	0.61	90

Fig. 1. Effect of N on Spring Wheat Yield
Yield Range : 20-35 bu/ac.

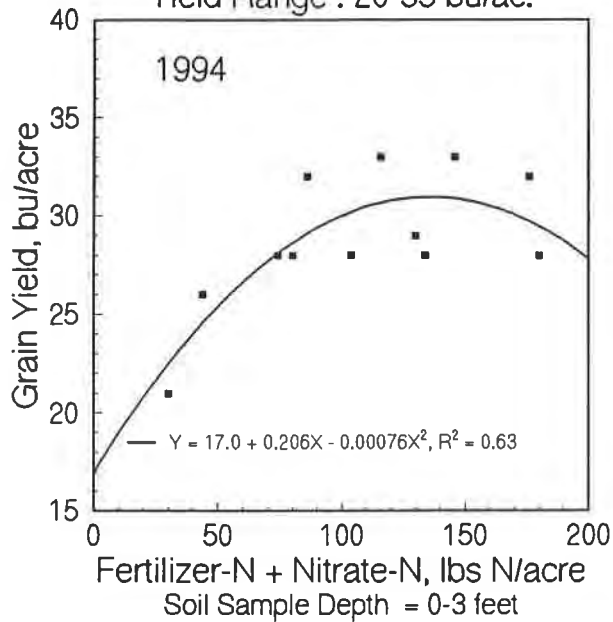


Fig.2. Effect of N on Spring Wheat Yield
Yield Range : 30-60 bu/ac.

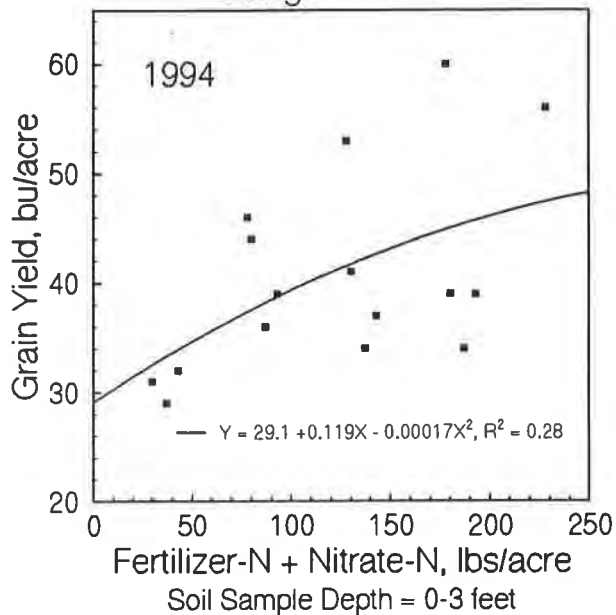


Fig. 3. Effect of N on Spring Wheat Protein
All Locations.

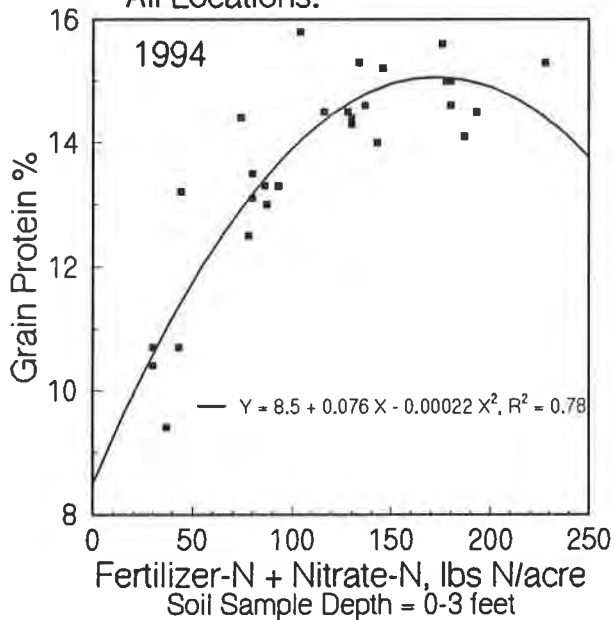


Fig. 4. Effect P Soil Test on Relative
Spring Wheat Yield. 1988-1994

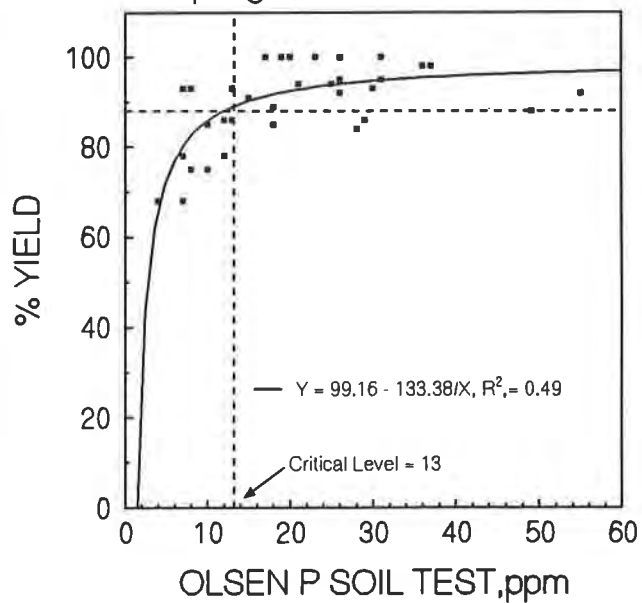


Fig. 5. Effect of N and P on Spring Wheat Yield. 1994

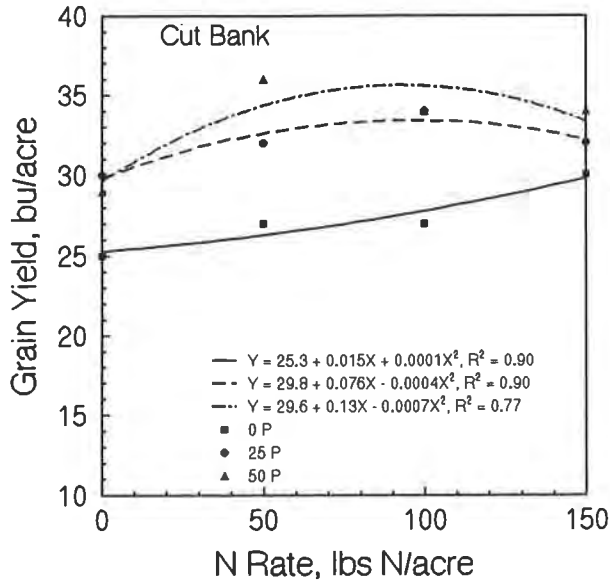


Fig. 6. Effect of N and P on Spring Wheat Yield. 1994

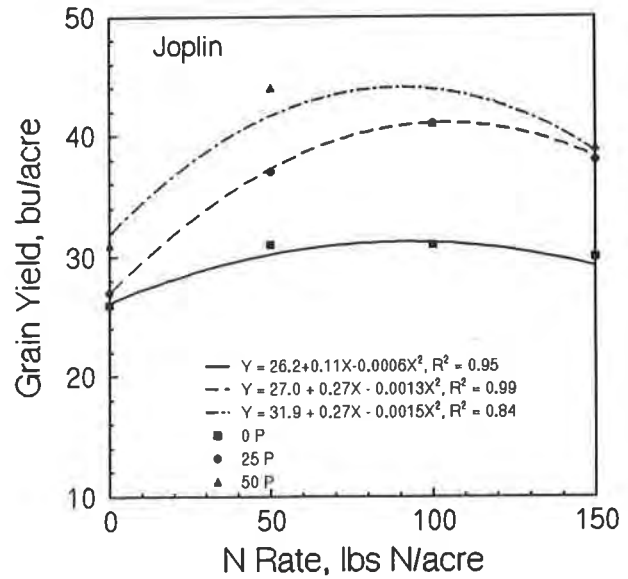
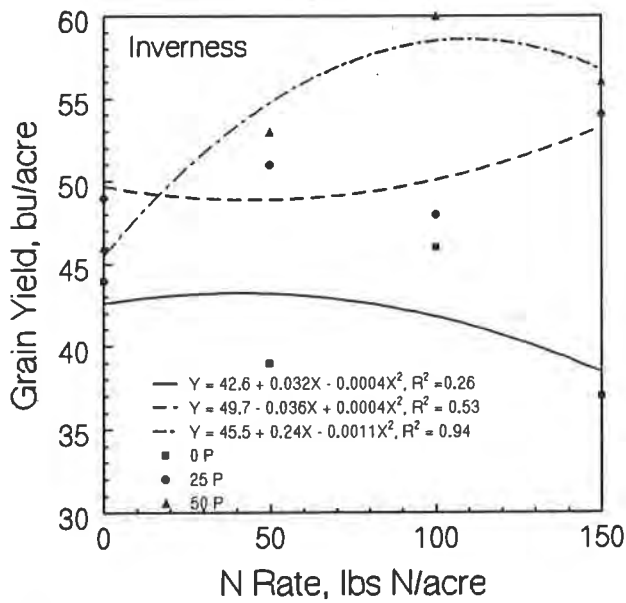


Fig. 7. Effect of N and P on Spring Wheat Yield. 1994.



TITLE: Plant Diagnosis for Protein Management in Spring Wheat

PERSONNEL: Mal Westcott (Principal Investigator), Grant Jackson, and Larry Christiaens.

LOCATION: Western Triangle Ag. Research Center, Conrad.

YEAR: 1994

OBJECTIVES: To develop a system of protein management in spring wheat based on plant diagnosis of flag leaf N and chlorophyll (SPAD) levels.

1. Determine the relationship between protein response to N topdressed at heading and flag leaf N or chlorophyll (SPAD) levels in selected spring wheat varieties.

2. Determine the efficiency of uptake and utilization of N topdressed at heading.

MATERIALS AND METHODS: Three varieties of spring wheat (Len, Highline, and Newana) were planted as treatments in factorial combination with four N fertilizer rates (0, 20, 95, and 170 lbs N/acre as urea applied while planting) in a randomized complete block design with four replications. The research area was fertilized with 45 lbs N/acre in February, and 100 lbs of 11-52-0/acre was applied with the seed. Thus counting the 70 lbs/acre of nitrate-N, 126 lbs of N was added or present at planting time. At heading, 30 flag leaves in each plot was assayed for chlorophyll content with the SPAD meter and then pulled, dried, ground, and analyzed for total N (TKN). Each plot was split into two subplots, one received a topdressing of 40 lbs N/ac as granular urea followed by irrigation. At grain maturity, subplots was subsampled for total plant N determination, and when ripe, grain was mechanically harvested for grain yield and protein determination. The Newana plots was soil sampled for post-harvest N.

RESULTS: All of the agronomic data, except N concentration of the leaf tissue, are tabulated in Table 59. Len yielded much lower than the other two varieties. The overall yields of Newana and Highline were almost the same, except Highline had higher yields than Newana at the highest N rates. As shown in Table 59, the area was infected with wheat streak mosaic virus (WSMV) which may have affected the varieties differently, though Highline showed the most symptoms. Grain yields of Newana and Highline relative to fertilizer treatment are shown graphically in Figures 8 and 12, respectively. Figure 10 depicts Newana yield versus total N, and Figure 14 shows a similar situation with Highline. Both varieties show the classical yield response to N regardless of the time of N application. Note the amount of N needed for optimum yields.

Protein response curves (Fig. 9 for Newana and Fig. 13 for Highline) show the dramatic protein increases of both varieties to fertilizer N. Figs. 11 and 15 show the protein response to total N.

The protein response to N applied at heading was spectacular, especially with Highline.

Nitrogen utilization is an important part of a N management program. Total, above ground, plant N concentration and N uptake data at maturity are presented in Table 59. Changes in soil nitrate and ammonium-N from the Newana plots are shown in Figs. 16 and 17. The 40 N treatment at flowering increased N uptake beyond the 40 N level added. At the highest N rates, Newana removed 87% of the soil nitrate-N plus fertilizer-N.

Fig. 18 shows the relationship between the chlorophyll meter reading (SPAD) of the flag leaf and grain protein content. The readings were taken at heading. At least in 1994, the SPAD readings did not predict protein accurate enough to be a useful tool. We tried to select leaves free from WSMV for the SPAD readings, but the disease may have affected the results.

TABLE 59. EFFECT OF N APPLIED AT PLANTING AND FLOWERING ON THREE IRRIGATED SPRING WHEAT VARIETIES. Western Triangle Ag Research Center, Conrad. 1994.

VARIETY	N RATE	FLOWERING N RATE	GRAIN YIELD	PROTEIN	TEST WEIGHT	WSMV RATING ¹	TISSUE N	N UPTAKE	SPAD READING
Highline	0	0	51.1	10.1	62.4	2.75	0.63	53	32
Highline	0	40	58.7	14.5	62.5	2.75	0.99	99	40
Highline	20	0	62.9	10.2	62.6	2.25	0.74	75	34
Highline	20	40	68.0	12.4	62.5	2.25	1.01	95	39
Highline	95	0	74.2	11.7	62.5	2.50	0.92	110	40
Highline	95	40	80.3	14.1	62.3	1.75	1.25	160	43
Highline	170	0	87.5	14.2	62.1	2.00	1.36	175	40
Highline	170	40	87.1	14.8	61.7	1.50	1.46	186	44
Newana	0	0	58.5	8.7	62.5	2.00	0.69	68	33
Newana	0	40	58.0	12.1	63.2	2.00	0.98	94	34
Newana	20	0	59.9	8.9	62.5	1.50	0.73	93	33
Newana	20	40	70.3	12.5	63.0	1.75	1.16	154	36
Newana	95	0	75.3	11.1	62.6	1.25	1.05	127	41
Newana	95	40	77.5	13.4	62.4	1.25	1.36	193	44
Newana	170	0	82.6	13.4	61.7	1.00	1.51	198	46
Newana	170	40	84.8	14.0	62.0	1.00	1.76	293	44
Len	0	0	46.3	11.5	61.2	2.25	0.75	64	36
Len	0	40	49.4	15.2	61.2	2.50	1.12	115	38
Len	20	0	49.9	11.9	61.7	2.25	0.78	83	38
Len	20	40	54.3	15.2	61.2	2.25	1.06	113	40
Len	95	0	64.0	14.0	61.2	2.00	0.96	115	44
Len	95	40	64.8	15.3	61.3	1.75	1.37	177	45
Len	170	0	61.4	14.2	61.4	1.25	1.20	158	42
Len	170	40	69.2	15.4	61.4	1.25	1.58	229	44
Summary									
Highline			71.2	12.8	62.3	2.22	1.05	119	39
Newana			70.9	11.8	62.5	1.47	1.15	153	39
Len			57.4	14.1	61.3	1.94	1.10	132	41
LSD (0.05)			7.2	0.6	0.7	0.63	0.07	NS	NS
	0		53.7	12.0	62.2	2.38	0.86	82	36
	20		60.9	11.9	62.3	2.04	0.91	102	37
	95		72.7	13.3	62.1	1.75	1.15	147	43
	170		78.7	14.3	61.7	1.33	1.48	206	43
LSD (0.05)			4.6	0.7	0.3	0.28	0.08	20	2
	0		64.5	11.7	62.0	1.92	0.94	110	38
	40		68.5	14.1	62.1	1.83	1.26	159	41
LSD (0.05)			2.1	0.4	NS	NS	0.05	13	1
Interaction p-values									
Variety x N Rate			0.30	0.17	0.18	0.78	0.08	0.21	0.01
Var x Flowering N Rate			0.92	0.97	0.13	0.16	0.32	0.18	0.02
Var x N Rate Flow N Rate			0.27	0.56	0.58	0.84	0.45	0.44	0.48
N Rate x Flow N Rate			0.56	0.00	0.41	0.23	0.47	0.51	0.53

Grain Yield based on 60 lb/bu as standard test weight.

Planting Date: April 14. Harvest Date: Sept. 1.

Flowering fertilization Date: July 11.

¹Wheat Streak Mosaic Virus Rating (0=healthy, 3=severe symptoms).

Hail and wind damage on June 6 and June 26.

Grow season rainfall= 5.4". Irrigation dates: June 20, June 30, July 11, and

July 22, 2" per irrigation. 45 lbs N/acre as urea applied in Feb., 100 lbs

11-52-0 applied with the seed, and main N treatments applied while planting.

Planting rate: 22 seeds/ft. SPAD reading date: July 11.

Soil test results: pH= 7.6, O.M.= 2.5%, Depth NH₄-N NO₃-N

P = 30 ppm, K= 470 ppm	ft	lb N/acre	
	0-1	16	37
	0-2	30	48
	0-3	50	56
	0-4	68	70

Fig. 8. Effect of N on Newana Spring Wheat Yield. 1994.

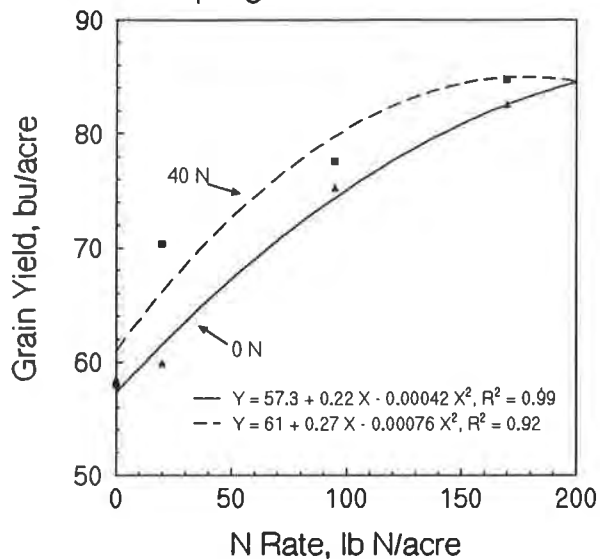


Fig. 9. Effect of N on Newana Spring Wheat Protein. 1994.

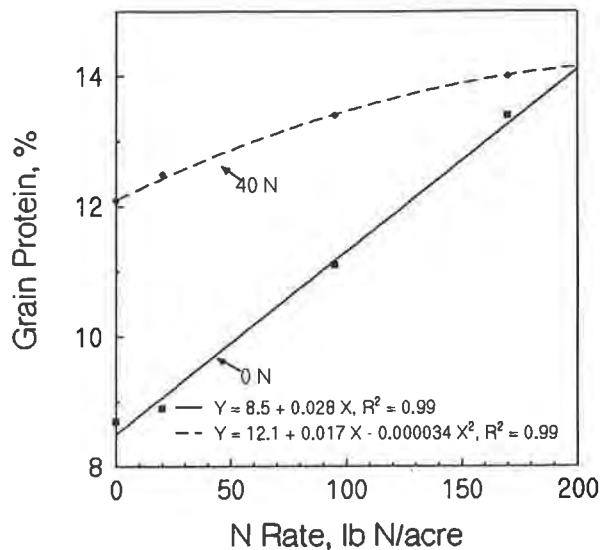


Fig. 10. Effect of Fertilizer and Soil N on Newana Spring Wheat. 1994.

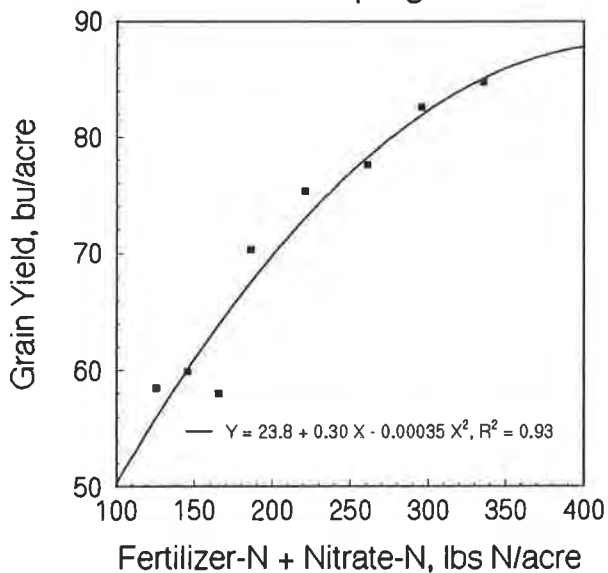


Fig. 11. Effect of Fertilizer and Soil N on Newana Spring Wheat Protein. 1994.

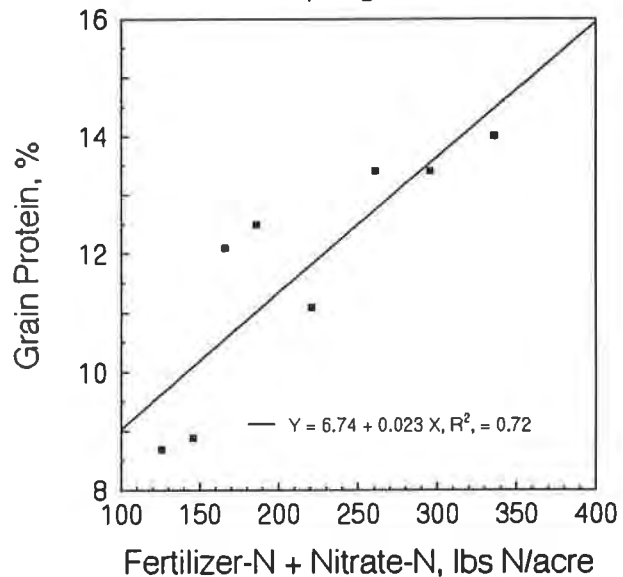


Fig. 12. Effect of N on Highline Spring Wheat Yield. 1994.

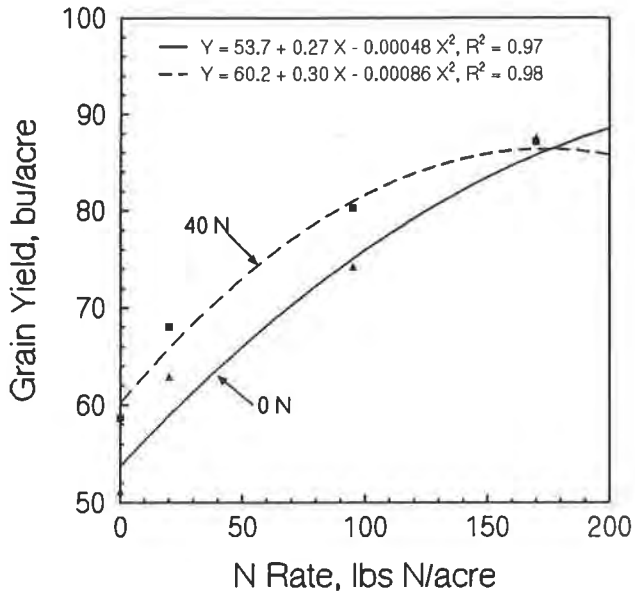


Fig. 13. Effect of N on Highline Spring Wheat Protein. 1994.

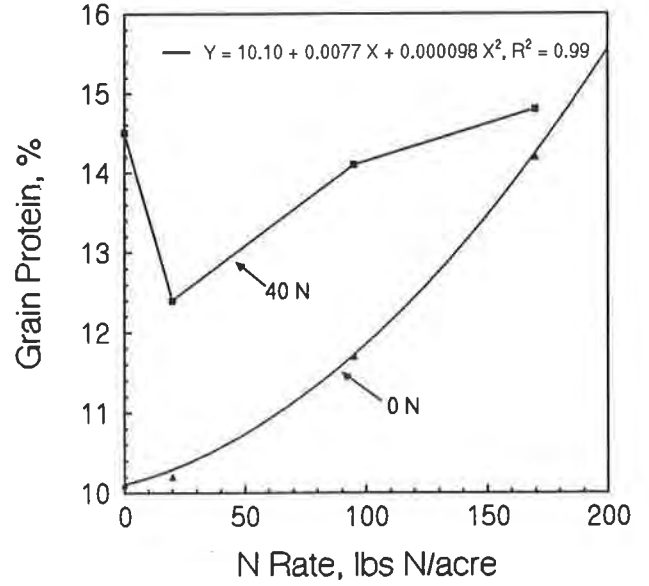


Fig. 14. Effect of Fertilizer N and Soil-N on Highline Spring Wheat. 1994.

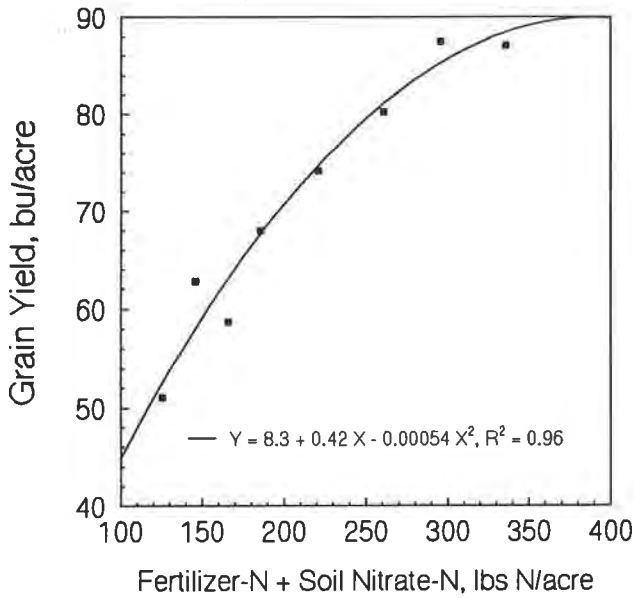


Fig. 15. Effect of Fertilizer and Soil N on Highline Spring Wheat Protein. 1994.

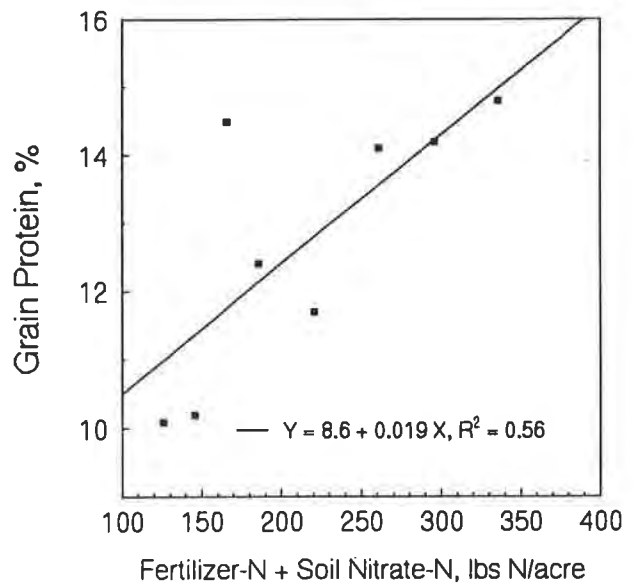


Fig. 16. Preplant and Post Harvest Soil Nitrate-N, Irr. Spring Wheat. 1994.

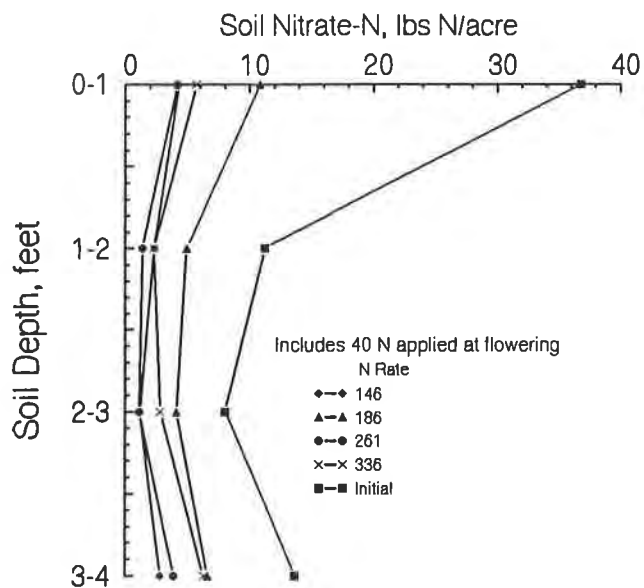


Fig. 17. Preplant and Post Harvest Soil Nitrate-N, Irr. Spring Wheat. 1994.

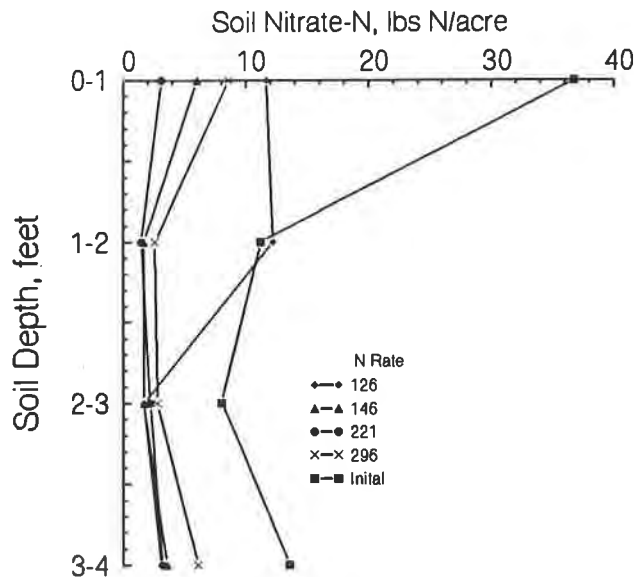


Fig. 18. Calibration of Chlorophyll Meter.

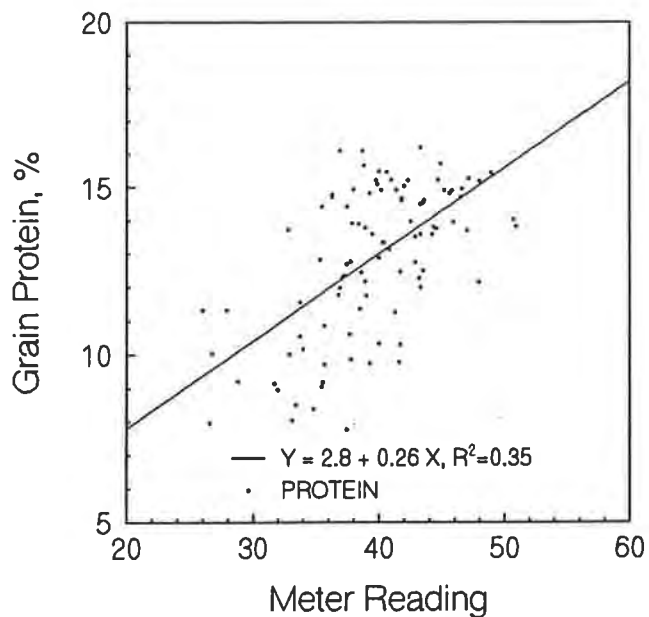
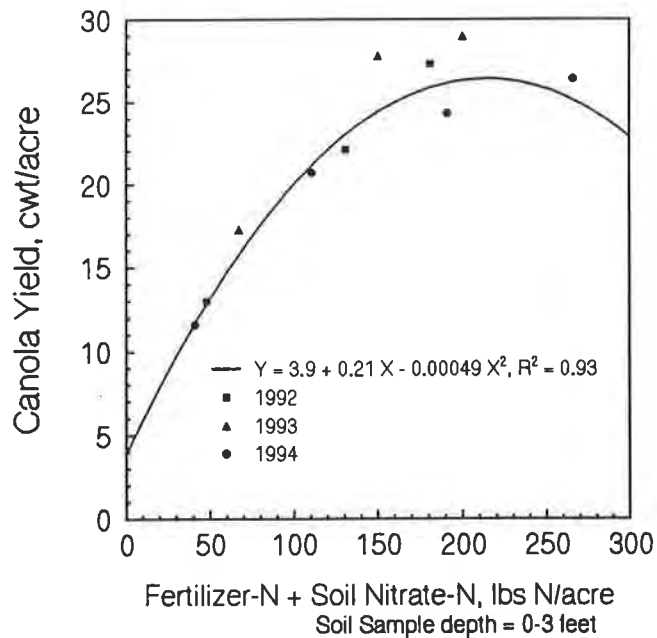


Fig. 19. Effect of N on Canola Yield.



TITLE: Canola Response to N, P, and S Fertilizers.

YEAR: 1994

LOCATION: Allan and Ross Peace Farm, Fairfield, MT.

PERSONNEL: Grant Jackson, Larry Christiaens, and Greg Popove.

OBJECTIVES: Determine the response of canola to N, P, and S fertilization and correlate response with respective soil tests.

MATERIALS AND METHODS: Small plots (5 x 20 feet) were planted on April 21, 1992, April 29, 1993, and April 20, 1994. A 10" spaced double disc plot drill was used to seed the plots in 1992 and 1993, and fertilizer was broadcast while seeding (P fertilizer was placed with the seed). In 1994 the planter was set to plant a 6 x 14" paired row with fertilizer placed between the paired rows, P fertilizer was placed with the seed. Treatments are shown in Table 60. Fertilizer sources were urea, ammonium sulfate, and treble super phosphate in 1992, ammonium nitrate, ammonium sulfate, and treble super phosphate in 1993, and urea, potassium sulfate, and ammonium sulfate in 1994. Potassium chloride (30 lbs K/acre) was broadcast over the plot area in 1992-94, and 30 lbs P₂O₅/acre as treble super phosphate was used on all plots in 1994. Plots were irrigated four times in 1992 (includes an initial irrigation for germination), and three times in 1993 and 1994. When mature, plots were swathed by hand, allowed to dry (usually about a week), and threshed with a small plot combine.

RESULTS: The results from 1992, 1993, and 1994 are tabulated in Table 60. A significant N response was measured all three years and is shown graphically in Fig. 19. Note the excellent response curve when yield is plotted versus soil nitrate-N plus fertilizer-N. Canola did not respond to P in 1992 and 1993, so the P treatments were dropped in 1994. Locations with low P soil tests will be needed to calibrate P soil tests, and these locations will be difficult to find in the Fairfield area. A S response was measured only in 1992. This response is probably related to the S soil test. More locations are needed to calibrate the S soil test.

TABLE 60. EFFECT OF N, P, AND S ON IRRIGATED CANOLA YIELD.
Experiments located near Fairfield, MT. Western
Triangle Ag. Research Center, Conrad, MT. 1992-94.

TREATMENT	Year		
	1992	1993	1994
lbs/acre	cwt/acre		
N 0	13.0	17.3	11.6
75	-	-	20.7
100	22.1	27.8	-
150	27.3	29.0	24.3
225	-	-	26.4
P ₂ O ₅ 0	24.1	25.5	-
30	22.1	27.8	-
60	24.2	27.0	-
S 0	19.5	26.2	28.4
20	22.1	27.8	27.2
40	25.8	25.5	26.2
LSD (0.05)	3.6	5.4	2.6

Variety: Westar

Soil Test Results

1992

pH= 7.5, O.M.= 16.%, P= 21 ppm, K= 243 ppm, Zn= 1.4 ppm

Depth	NO ₃ -N	NH ₄ -N	Cl	SO ₄ -S
feet	lbs/acre			
0-1	15	-	33	49
0-2	23	-	45	85
0-3	31	-	54	117
0-4	37	-	64	141

1993

pH= 7.9, O.M.= 22%, P= 27 ppm, K= 429 ppm, Zn= 0.6 ppm

Depth	NO ₃ -N	NH ₄ -N	Cl	SO ₄ -S
feet	lbs/acre			
0-1	21	42	31	64
0-2	39	71	60	158
0-3	50	97	104	268
0-4	62	121	133	364

1994

pH= 7.6, O.M.= 2.4%, p= 34 ppm, K= 392 ppm, Zn= 0.7 ppm

Depth	NO ₃ -N	NH ₄ -N	Cl	SO ₄ -S
feet	lbs/acre			
0-1	36	124	39	70
0-2	40	137	63	161
0-3	41	146	72	256
0-4	45	168	80	338