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The 15th

ANNUAL REPORT

of the

WESTERN TRIANGLE AGRICULTURAL RESEARCH CENTER

Montana Agricultural Experiment Station

Conrad, Montana

1992

Submitted by

Dr. Gregory D. Kushnak, Superintendent & Crop Scientist

and

Dr. Grant Jackson, Soil Scientist

MSU-MAES Research Report

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TABLE OF CONTENTS

	Page
Weather Summary	1-2
Research Results	
Winter Wheat Variety Investigations	3
Hybrid wheat-1st & 2nd generation comparison, Table 1	3
Comments on winter wheat varieties	4-7
Spring Wheat & Durum Variety Investigations	8
Comments on Varieties	9-14
Conrad dryland wheat (AY), (Hailed out)	
Conrad irrigated wheat, (Hailed out)	
Cut Bank wheat, Table 2	15
Cut Bank, 5-year summary, Table 3	16
Oilmont wheat, Table 4	17
Oilmont, 5-year summary, Table 5	18
Choteau wheat, Table 6	19
Choteau, 5-year summary, Table 7	20
Sun River wheat, Table 8	21
Sun River, 5-year summary, Table 9	22
Dryland Durum, Conrad, (Hailed out)	
Irrigated Durum, Conrad, (Hailed out)	
Regional Durum, (Hailed out)	
Barley Variety Investigations	23
Comments on barley varieties	24-26
Conrad dryland intrastate, (Hailed out)	
Conrad irrigated intrastate, (Hailed out)	
Cut Bank, Table 10	27
Cut Bank, 5-year summary, Table 11	28
Oilmont, Table 12	29
Oilmont, 4-year summary, Table 13	30
Choteau, (Hailed out)	
Sun River, Table 14	31
Sun River, 5-year summary, Table 15	32
No-till recrop grain Varieties (failed from drought)	
Sawfly Study	33
Seed rate and date sawfly, Table 16	34
Oilseed & Pulse Crops, no-till recrop (failed from drought)	
Soils Research Report	35
Effect of N on spring wheat	35
Tables 17 - 20	36-39
Effect of P on spring wheat	40
Table 21	41
Effect of potassium and chlorine on dryland wheat	42
Tables 22 - 24	43-45
Effect of N, P, K & S on spring canola	46
Tables 25 - 34	47-56
Effect of N, P & irrigation water on spring barley	57-58
Figs. 1 - 12 & Tables 35 - 37	59-73

Climatic summary for the 1992 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	0.11	0.08	0.00	0.67	0.69	2.22	2.83	1.12	0.39	1.75	0.26	0.32	10.44
Average	0.25	0.22	0.60	0.88	1.89	2.30	1.45	1.75	1.74	0.54	0.30	0.17	12.09
Mean Temperature (^{0}F)													
Current Year	32.7	31.2	43.6	47.2	57.4	64.5	60.4	64.1	55.5	47.0	32.9	16.5	46.1
Average	25.9	23.4	35.2	44.9	53.6	61.9	66.0	65.3	57.4	45.9	32.5	24.1	44.7

Last killing frost in Spring
1992----------May 26 (31^0)
Average----------May 18

First killing frost in Fall
1992----------Aug 24 (31^0)
Average----------Sep 19

Frost free period (days)
1992----------90
Average----------124

Maximum summer temperature-----94^0 (Aug 17)

Minimum winter temperature----- -25^0 (Dec 30)

Hail storm : Aug 1

Summary of climatic data by month for the 1991-92 crop year (September thru August) at the Western Triangle Agricultural Research Center, Conrad, MT.

	Sep 1991	Oct 1991	Nov 1991	Dec 1991	Jan 1992	Feb 1992	Mar 1992	Apr 1992	May 1992	Jun 1992	Jul 1992	Aug 1992	Total or Average
Precipitation (inches)													
Current year	0.42	0.50	0.31	0.00	0.11	0.08	0.00	0.67	0.69	2.22	2.83	1.12	8.95
Average	1.94	0.37	0.30	0.15	0.25	0.22	0.60	0.88	1.89	2.30	1.45	1.75	12.10
Mean Temperature (^{0}F)													
Current year	58.0	41.5	31.9	30.9	32.7	31.2	43.6	47.2	57.4	64.5	60.4	64.1	47.0
Average	57.7	45.8	32.4	25.3	25.9	23.4	35.2	44.9	53.6	61.9	66.0	65.3	44.7

Last killing frost in Spring
1992----------May 26 (31^0)
Average----------May 18

First killing frost in Fall
1992----------Aug 24 (31^0)
Average----------Sept 19

Frost free period (days)
1992----------90
Average----------124

Maximum summer temperature------94^0 (Aug 17)

Minimum winter temperature----- -11^0 (Nov 4, 1991)

Hail storm : Aug 1

TITLE: Winter Wheat Variety Investigations.

YEAR: 1992

PERSONNEL: Gregory D. Kushnak, Ron Thaut, and Larry Christiaens, Research Center; and Dr. Phil Bruckner, MSU, Bozeman.

Approximately 160 experimental lines of winter wheat were screened for sawfly resistance, winter hardiness and milling quality. The combination of these 3 desired traits narrowed the selected group of lines considerably for advanced yield testing in 1993. Another 1700 of potential sawfly resistant lines were planted in the fall of 1992 for preliminary testing in 1993.

Winter wheat nurseries on station were hail damaged in 1992, but fortunately not before sawfly and winterhardiness data were collected. Enough seed was harvested for milling and baking tests on the sawfly lines, but yield data were not obtained.

Off-station winter wheat plots at Chester, Sun River and the Knees were completely lost to drought. The plots at Dutton and Eden were partially damaged by drought, with Dutton also suffering from grasshopper and Russian aphid damage. Therefore, no yield data are reported for winter wheat this year, with the exception of a special trial involving Quantum 542 hybrid wheat comparing yield performance from planting 1st and 2nd generation seed (Table 1).

Comments on winter wheat varieties, based primarily on observations in Triangle Area trials, are presented on the following pages.

Table 1. Quantum 542 hybrid wheat yield comparison from first and second generation seed, 1992. Mont. Agr. Expt. Sta., Western Triangle, Central, and Southern Agr. Research Centers.

	Conrad	Moccasin	Huntley
	Yield (bu/a)		
Quantum 542	32.0	33.4	93.1
Quantum 542-2nd generation	27.4	24.2	86.0
Yield reduction from 2nd gen.	14.4%	27.5%	7.6%

VARIETY NOTES

WINTER WHEAT

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?? Heterozygons (mixed) resistance to Great Plains strain of Hessian fly.

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 winter-hardiness 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 fairly high.

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 -(NAPB) Winterhardiness 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, winter-hardiness 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; winterhardiness higher than Rocky and Cheyenne, and equal to Redwin. Medium shatter resistance.

Three problems:

1) Test wight 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.

Kestrel (Sask.,Can)-Supposedly winterhardy and high yielding in Canada. Leaf spots at Conrad 1992.

Lamar(Colorado)-Medium height with long coleoptile. Adapted to severe low moisture conditions of Colorado.

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

Meridian(Idaho)- Derived from Neeley. Currently under test, 1993.

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 winterhardiness (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.

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. Pseudumonas 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.

Quantum 542 (Hybritech- Seed Intl. Inc.) - An F_1 hybrid; needs new seed each year. Planting F_2 (second generation) seed may result in yield reduction and developement of ergot due to sterility in a small percentage of florets (ms ratio less than 3:1). F_1 vs F_2 tests in 1992 indicated a 12% yield reduction from planting 2nd generation seed. 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. Dryland and 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.

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. Presumably will be higher yield than 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, thus eliminating marketing problems for Canadian markets. Had similar leaf spot problems as Redwin at Conrad 1992.

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

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.

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) - Moderate resistance to wheat curl mite infestation, and thus able to escape wheat streak mosaic virus. Winterhardiness ??.

Thunderbird(NAPB) - 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.

Vona(Colorado)-Winterkilled fairly often in Triangle area tests, but yields high if it survives without injury. Very early maturity if not winter-injured. Stiff straw. Good 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.

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

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) Winterhardiness less than Centurk. Sister to Vona, but a little more winterhardiness. 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. Winterhardiness (2) medium, better than Centurk but less than Cheyenne. Good shatter resistance. For dwarf smut areas.

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).

TITLE: Spring Wheat Variety investigations.

YEAR: 1992

LOCATION: Western Triangle Research Center, Conrad, MT.

PERSONNEL: Gregory D. Kushnak, Ron Thaut, and Larry Christiaens, Research Center, Conrad; and Dr. Luther Talbert, MSU Dept. of Plant & Soil Science.

Off-station dryland spring wheat variety trials were grown near Cut Bank, Oilmont, Choteau, and Sun River. All Trials were grown on fallow. All trials on station at Conrad were hail damaged, and a no-till recrop trial at Conrad failed due to drought conditions early in the growing season.

Data for the 1992 spring wheat tests at the various locations are presented in Tables 2-9. Five-year averages are included among the data tables. (Emphasis should be placed more on the five-year averages when predicting which varieties are best suited for a given area. The 1992 tables reflect performance under the conditions of only one year, and therefore should not be relied on too heavily). Performance varied among varieties depending on moisture, sawflys, and other conditions at the different locations. Sawfly damage was heavy at Choteau, but harvest was accomplished before lodging was severe. The Cut Bank location experieced some frost damage in 1992.

The variety 'Hi-Line' (MT 8402), recently developed by MSU, generally produced a combination of high yield and protein at most locations. Hi-Line is susceptible to sawfly and would not be suitable for growers meeding a variety with sawfly resistance. However, in areas where hollow stemmed varieties have been grown successfully, Hi-Line showed some advantages over Newana and Pondera. When averaged over several Western Triangle locations during the last five years, Hi-Line was slightly higher in yield, nearly one percent higher in protein, and four days earlier to ripen than Newana. Hi-Line was similar to Pondera for protein, ripening date, and dryland yield; but yielded three bu/a higher than Pondera on irrigated. Test weight and plant height of Hi-Line were slightly less than for Pondera.

Among sawfly resistant varieties, Glenman yielded the highest when averaged over all locations during the five-year period, but averaged low in protein and test weight. Rambo and Amidon also ranked high for yield, but both showed only partial resistance to sawfly. In addition, Amidon was tall (like Lew and Fortuna) and would not be suitable for irrigated conditions. At some of the dryland locations, Lew and Fortuna yielded nearly as much as Glenman, and yet had much higher protein. Proteins, when averaged over the 4 locations for 5 years, were 15.6% for Amidon, 15.5% for Lew and Fortuna, 15.0% for Rambo, and 14.8% for Glenman.

See following pages for comments on spring wheat varieties.

SPRING WHEAT

Far-Go herbicide tolerance:

Spring wheat varieties reported to have the highest tolerance to Far-Go are Fortuna, Bronze Chief, Kodiak, NK 751, Len, Oslo, Butte, Marshall, Success and Rambo. Lew, Newana, Alex, Erik, Pondera, Fremont and Amidon are the least tolerant, while Westbred 906R, McKay and Glenman are somewhere in between. 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. 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:

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).

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.

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).

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

3)Hollow Stem varieties:

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.

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.

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.

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.

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

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

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

Table: 2. Dryland **Spring Wheat** variety trial grown north of **Cut Bank,** 1992. 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)	48.67	58.06	29	9.5
MT 8849		46.16	56.37	33	10.3
GLENMAN	*	43.10	55.59	30	9.7
WESTBRED 926		40.74	57.71	32	11.2
OWENS	(s. white)	40.37	55.59	30	10.2
RAMBO	*	40.17	57.85	27	10.2
AMIDON	*	38.34	55.45	35	10.1
LEW	*	38.30	57.00	34	10.0
FORTUNA	*	37.99	59.83	34	11.7
HI-LINE		36.73	61.31	29	11.7
GRANDIN		35.80	58.84	33	10.6
PONDERA		34.13	60.60	29	11.8
NEWANA		33.88	57.43	27	10.2
CUTLESS	*	33.84	58.84	33	11.7
LANCER	*	33.59	59.12	36	11.6
LEN		33.20	57.15	28	11.0
GUS		32.65	58.63	31	11.2
STOA		30.73	58.06	33	11.0
KLASIC	(h. white)	29.77	61.24	23	12.1
OLAF		29.68	57.36	29	11.7

Cooperator : Don Bradley
Location : Fifteen miles north of Cut Bank, Glacier County.
Fertilizer : 100# 11-51-0 with the seed.
Previous crop : Fallow
Date seeded : April 15, 1992.
Date harvested : September 1, 1992.
Rainfall : From seeding to harvest, 7 + inches.
* = Sawfly resistant varieties. (Amidon and Rambo partial resistance)
Yield experimental mean : 36.89
Error degrees of freedom : 38.00
F test for var. : 11.22
C.V. 2 : 4.22
LSD (0.05) : 4.46

Table: 3. **Five-year** summary for **Spring Wheat** varieties grown north of **Cut Bank**, MT. 1988 - 1989 - 1990 - 1991 - 1992. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety		5 - year comparable average			
		Yield Bu\ac	Test wt. lbs\bu.	Plant hgt. inches	% Protein
PENAWAWA	(s. white)	42.40	59.47	26.62	10.71
OWENS	(s. white)	40.04	57.63	28.20	10.98
AMIDON	*	37.73	58.13	34.93	12.71
GLENMAN	*	36.94	57.89	28.20	12.22
HI-LINE		36.71	60.11	27.40	13.04
RAMBO	*	36.15	58.77	26.80	11.94
WESTBRED 926		35.72	58.77	27.59	12.85
PONDERA		35.52	60.70	27.80	13.22
LEN		34.89	58.80	27.00	12.88
LEW	*	34.61	58.97	33.00	12.84
GRANDIN		34.28	60.40	29.54	13.64
OLAF		34.24	58.77	27.00	13.14
STOA		34.21	58.65	31.00	12.76
FORTUNA	*	33.53	60.67	33.40	13.20
LANCER	*	33.25	59.95	34.00	13.04
CUTLESS	*	32.70	60.15	30.40	13.18
GUS		32.30	59.66	28.57	13.13
NEWANA		32.23	58.49	26.60	12.84

Cooperator : Don Bradley
Location : Fifteen miles north of Cut Bank, Glacier County.
* = Sawfly resistant varieties. (Rambo and Amidon have partial resistance.)

Table: 4. Dryland **Spring Wheat** variety trial grown east of **Oilmont,** 1992. Mont. Agr. Expt. Sta., Western Triangle Research Center, Conrad, Mt.

Variety		Yield bu\ac	Test wt. lbs/bu.	Plant hgt. inches	% Protein
PENAWAWA	(s. white)	41.56	63.07	21	15.02
GLENMAN	*	40.76	62.72	23	15.39
MT 8849		39.42	61.66	23	18.27
OWENS	(s. white)	39.07	62.86	20	14.85
LEW	*	36.57	63.99	25	16.21
LANCER	*	36.44	62.51	24	17.13
RAMBO	*	36.07	64.34	22	15.65
GRANDIN		34.31	64.55	23	16.52
OLAF		32.97	63.28	23	16.15
LEN		32.56	63.21	25	16.73
HI-LINE		31.39	63.21	22	17.45
KLASIC	(h. white)	30.76	62.23	16	16.32
STOA		30.70	62.72	24	17.20
CUTLESS	*	29.93	63.21	21	16.70
AMIDON	*	29.91	62.51	24	15.88
PONDERA		29.08	63.57	22	17.43
NEWANA		28.79	61.73	21	16.66
FORTUNA	*	28.40	59.97	25	16.46
GUS		27.93	63.14	22	17.19
WESTBRED 926		26.90	63.00	19	16.77

Cooperator : Terry Alme
Location : Eight miles east of Oilmont, Toole County.
Fertilizer : 100# 11-51-0 with the seed.
Previous crop : Fallow
Date seeded : March 30, 1992.
Date harvested : August 10, 1992.
Rainfall : From seeding to harvest was 7 + inches.
* = Sawfly resistant varieties. (Amidon and Rambo partial resistance)
Yield experimental mean : 33.18
Error degrees of freedom : 38.00
F test for var. : 3.49
C.V. 2 : 6.07
LSD (0.05) : 5.77

Table: 5 **Five-year** summary for **Spring Wheat** varieties grown east of **Oilmont, MT.** 1988 - 1989 - 1990 - 1991 - 1992. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety		5 - year comparable average			
		Yield Bu\ac	Test wt. lbs\bu.	Plant hgt. inches	% Protein
PENAWAWA	(s. white)	30.55	55.27	23.35	15.63
GLENMAN	*	29.97	56.13	26.20	15.88
WESTBRED 926		27.63	56.65	23.71	18.32
AMIDON	*	27.39	57.89	29.70	17.03
GRANDIN		27.33	55.34	26.41	18.07
OLAF		26.95	56.33	25.80	16.97
HI-LINE		26.74	56.16	25.00	17.79
LEN		26.74	55.26	27.00	16.73
FORTUNA	*	26.52	57.63	29.60	16.99
LEW	*	26.18	57.50	29.60	16.84
PONDERA		26.15	57.35	25.80	17.67
RAMBO	*	25.94	57.96	23.44	16.97
STOA		25.94	55.95	29.40	18.02
NEWANA		25.90	55.76	24.00	17.11
OWENS	(s. white)	25.68	54.23	24.20	16.13
LANCER	*	24.73	56.93	29.60	17.11
GUS		24.00	55.62	25.21	18.97
CUTLESS	*	22.68	57.42	25.40	17.96

Cooperator : Terry Alme
Location : Eight miles east of Oilmont, Toole County.
* = Sawfly resistant varieties. (Rambo and Amidon have partial resistance.)

Table: 6. Dryland **Spring Wheat** variety trial grown east of **Choteau,** 1992. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety		Yield bu/a	Test wt. lbs/bu.	Plant hgt. inches	% Protein
GLENMAN	*	25.62	57.35	27	16.56
FORTUNA	*	23.83	59.89	29	16.59
MT 8849		22.99	57.70	26	17.09
LEW	*	22.82	59.18	29	16.37
LANCER	*	22.06	58.62	34	17.26
CUTLESS	*	21.63	57.91	30	17.35
RAMBO	*	21.56	56.51	26	15.64
AMIDON	*	21.23	56.71	32	17.23
HI-LINE		20.60	58.13	26	16.68
PONDERA		20.59	58.97	26	17.18
PENAWAWA	(s. white)	19.83	58.76	25	16.33
WESTBRED 926		19.22	56.51	26	15.35
OWENS	(s. white)	19.00	57.49	28	16.50
NEWANA		17.03	57.00	26	16.67
GRANDIN		16.71	56.86	25	17.94
GUS		16.49	56.22	25	16.84
KLASIC	(h. white)	15.57	57.98	18	17.40
OLAF		15.11	55.16	27	16.69
STOA		14.23	54.95	30	17.71
LEN		14.23	54.53	26	17.44

Cooperator : Rick Corey
Location : Northeast of Choteau, Teton County.
Fertilizer : 100# 11-51-0 with the seed, + 75# AA-N.
Previous crop : Fallow
Date seeded : March 31, 1992.
Date harvested : August 10, 1992.
Rainfall : From seeding to harvest was 7 + inches.
* = Sawfly resistant varieties. (Amidon and Rambo partial resistance)
Yield experimental mean : 19.52
Error degrees of freedom : 38.00
F test for var. : 3.19
C.V. 2 : 9.62
LSD (0.05) : 5.38

Table: 7. **Five-year** summary for dryland **Spring Wheat** varieties grown northeast of **Choteau, MT.** 1988 - 1989 - 1990 1991 - 1992. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety		5 - year comparable average			
		Yield Bu\ac	Test wt. lbs\bu.	Plant hgt. inches	% Protein
GLENMAN	*	33.25	57.21	28.60	14.33
HI-LINE		32.21	60.33	26.60	15.00
FORTUNA	*	32.15	60.04	33.80	15.14
LANCER	*	31.11	59.98	34.60	15.67
PENAWAWA	(s. white)	31.03	59.75	26.60	12.99
OWENS	(s. white)	30.72	57.83	28.60	12.74
LEN		30.37	58.68	27.40	14.39
RAMBO	*	30.29	56.64	26.20	14.07
LEW	*	30.17	58.33	33.60	14.89
WESTBRED 926		30.04	59.17	27.13	14.33
AMIDON	*	29.30	57.47	33.25	15.49
PONDERA		28.77	60.04	27.80	14.74
CUTLESS	*	28.44	60.29	29.80	15.73
STOA		27.99	57.86	32.20	14.94
GRANDIN		26.37	59.11	28.41	15.68
NEWANA		25.39	57.32	26.00	14.55
GUS		25.03	58.87	27.45	15.38
OLAF		24.17	57.95	28.00	14.84

Cooperator : Rick Corey
Location : Northeast of Choteau, Teton County.
* = Sawfly resistant varieties. (Rambo and Amidon have partial resistance.)

Table: 8. Dryland **Spring Wheat** variety trial grown southeast of **Sun River,** 1992. 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)	54.24	61.73	26	13.79
HI-LINE		53.07	62.44	23	15.40
OWENS	(s. white)	48.14	59.54	27	14.40
GRANDIN		47.81	62.23	32	16.71
KLASIC	(h. white)	46.27	62.72	20	16.54
WESTBRED 926		46.08	60.81	24	14.94
STOA		45.47	59.90	33	16.05
PONDERA		44.79	60.11	27	15.43
MT 8849		44.38	55.66	28	16.03
FORTUNA	*	42.47	60.39	31	15.33
LEW	*	42.13	58.27	35	15.02
LANCER	*	41.57	58.84	35	15.40
GUS		41.01	58.34	29	15.59
NEWANA		40.67	55.95	27	15.27
GLENMAN	*	40.34	52.14	28	14.03
AMIDON	*	39.77	58.77	31	14.88
CUTLESS	*	38.25	59.76	27	16.21
OLAF		37.84	59.05	27	15.68
LEN		37.36	60.18	27	15.54
RAMBO	*	34.36	56.44	30	14.52

Cooperator : Chuck Merja
Location : Three miles southeast of Sun River, Cascade County.
Fertilizer : 100# 11-51-0 with the seed + 40# N actual topdressed.
Previous crop : Fallow
Date seeded : March 31, 1992.
Date harvested : July 30, 1992.
Rainfall : From seeding to harvest was 7 + inches.
* = Sawfly resistant varieties. (Amidon and Rambo partial resistance)

Yield experimental mean : 43.30
Error degrees of freedom : 38.00
F test for var. : 4.63
C.V. 2 : 5.47
LSD (0.05) : 6.78

Table: 9. **Five-year** summary for dryland **Spring Wheat** varieties grown east of **Sun River, MT.** 1988 - 1989 - 1990 - 1991 - 1992. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Variety		5 - year comparable average			
		Yield Bu\ac	Test wt. lbs\bu.	Plant hgt. inches	% Protein
WESTBRED 926		29.99	58.30	24.13	17.88
HI-LINE		29.63	57.34	24.41	18.24
PENAWAWA	(s. white)	29.33	58.18	23.72	15.06
GRANDIN		28.98	57.90	28.66	18.60
OWENS	(s. white)	28.54	56.22	25.60	15.46
PONDERA		28.06	58.12	26.80	17.83
GUS		27.78	56.77	25.92	18.63
NEWANA		27.41	55.43	25.20	16.99
AMIDON	*	27.01	57.59	30.20	17.08
STOA		26.60	57.01	30.60	18.05
LEN		26.30	57.04	26.40	17.69
FORTUNA	*	24.80	59.27	31.00	16.81
OLAF		24.53	56.69	26.28	17.96
CUTLESS	*	23.83	58.46	26.40	18.42
GLENMAN	*	23.82	54.34	26.80	16.57
RAMBO	*	23.70	57.09	26.00	17.04
LANCER	*	23.29	57.38	30.93	18.04
LEW	*	23.12	57.61	30.80	17.44

Cooperator : Chuck Merja
Location : Three miles southeast of Sun River, Cascade County.
* = Sawfly resistant varieties. (Rambo and Amidon have partial resistance.)

TITLE: Barley Variety Investigations

YEAR: 1992

LOCATION: Western Triangle Research Center, Conrad.

PERSONNEL: Gregory D. Kushnak, Ron Thaut, & Larry Christiaens, Research Center, Conrad, MT; Dr. Tom Blake MSU,Bozeman

Dryland barley variety trials were grown near Cut Bank, Oilmont, Choteau, Sun River and the Research Center at Conrad; in addition to irrigated at Conrad. All trials were grown on fallow. A seperate no-till recrop trial was planted at Conrad, but failed due to drought conditions early in the growing season. The other on-station trials at Conrad were lost to hail, as well as the barley trial at Choteau.

Data for 1992, as well as 5-year averages, are presented in Tables (10-15). Moisture conditions were unusually dry early in the growing season, but mid-summer rains brought the yields up suprisingly well.

The unusual distribution of moisture resulted in varied performance among varieties at the three locations. Baronesse was the top yielder at Cut Bank, but ranked only mid-level at the other two harvested sites. Moisture conditions at Cut Bank were considerably more favorable than the other sites in 1992. Baronesse was fairly late to mature (similar to Harrington), and therefore may be more vulnerable to moisture stress than earlier maturing varieties. Baronesse is a stiff-strawed 2-row from Europe. It is not known at this time if Baronesse will be considered a malt variety. Medallion, a 6-row feed barley from Western Plant Breeders, was grown only at the Research Center and no data was obtained due to hail. However, Medallion ranked high at some of the other Research Centers in Montana during 1992. Other comments about barley varieties, based on observations in Triangle Area trials, are presented in the following pages.

BARLEY

Montana Malt List according to AMBA (Amer. Malt. Bly. Assoc.) Clark, Klages, Moravian III, Premier, Morex, Harrington; although other varieties may be contracted.

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.

BA 1215 (Busch Ag) 2-row malt. Very high irrigated yields, and very good lodging resistance. Maturity approx same as 1202. Tested as BA8529 prior to 1990.

BA 5113 & 5133 (Busch Ag)- experimental 2-row types. 5133 earlier maturity than 1202.

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

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. 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 Piroline 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. Most likely will be approved by AMBA (should know by summer of 92). Better malt and agronomics than Clark, Klages, and Harrington. 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 too 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). Malt status pending flavor test. Supposedly has higher quality than Harrington. Malts as good or better than a 6-row! Very high extract. 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/Piroline/Zephyr parentage).

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

Colter (Id/Ore/Wash) 6-row feed. Higher yield and test weight than Steptoe, but test weight may still be too low on dryland. Tested as ID 71966 in Western Regional (79Ab10719-66).

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). May qualify for Montana AMBA in 1991. (Klages cross). 5% greater yielder than Klages but 2% less than Clark; same height and head date as Klages, but better lodging resistance. Good tolerance to Pseudomonas Kernel Blight; thus better than Klages.

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.

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.

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.

Medallion (Western Pl. Breeders) 6-row feed. Very high dryland yield in Central Montana in 1992 (no Triangle area data for 1992).

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.

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. (AB needs Morex).

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.

Shonkin (MSU)- 2-row hulless. 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.

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.

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. '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).

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.

Table: 10. Dryland **Barley** variety trial grown north of **Cut Bank**, 1992. Mont. Agr. Expt. Sta., Western Triangle Ag. Research Center, Conrad, MT.

Variety	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Plump	% Thin	% Protein
Baronesse	81.20	49.17	26	94	2	7.8
Steptoe	67.77	45.72	24	89	3	8.8
MT 81161	62.04	49.39	30	92	3	8.9
Clark	61.58	50.09	29	91	3	8.4
Harrington	61.38	52.00	27	95	1	8.2
MT 860756	61.17	52.42	28	92	3	8.8
Hector	60.81	49.95	28	91	3	9.0
MT 140523	60.60	51.22	28	96	1	8.8
Bearpaw	59.19	51.08	30	94	2	8.6
Lewis	58.88	51.64	26	94	2	8.5
Gallatin	58.31	50.94	28	92	3	8.7
Piroline	57.48	50.30	26	93	2	9.1
Bowman	52.90	50.94	25	95	1	10.3
Excel	50.86	48.68	29	94	2	8.8
Stark	50.46	50.94	29	95	1	9.0

Cooperator : Don Bradley
Location : Fifteen miles north of Cut Bank, Glacier County.
Fertilizer : 100# 11-51-0 with the seed.
Previous crop : Fallow
Date seeded : April 15, 1992.
Date harvested : September 1, 1992.
Rainfall : From seeding to harvest was 7 + inches.
Yield experimental mean : 60.31
Error degrees of freedom : 28.00
F test for var. : 3.14
C.V. 2 : 6.87
LSD (0.05) : 12.01

Table: 11. **Five-year** summary for dryland **Barley** varieties grown **north of Cut Bank, MT.** 1988 - 1989 - 1990 - 1991 - 1992. Mont. Agr. Expt. Station, Western Triangle Agr. Research Center, Conrad, MT.

Variety	5 - year comparable average					
	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Plump	% Thin	% Protein
BARONESSE	68.43	48.31	25.12	91.06	2.67	9.04
STEPTOE	56.51	44.73	25.60	87.40	3.60	9.30
HECTOR	55.97	49.94	27.80	89.00	3.00	9.82
MT 81161	54.22	49.08	26.82	87.26	4.06	10.04
PIROLINE	53.28	51.15	26.20	88.20	2.20	10.84
BEARPAW	53.11	49.87	26.80	89.00	3.00	10.24
GALLATIN	52.89	50.76	27.20	89.40	3.00	10.08
LEWIS	52.70	50.63	26.80	87.60	4.20	9.84
CLARK	52.28	49.49	27.00	85.20	4.40	10.00
MT 140523	51.91	50.59	26.40	89.40	2.60	10.10
EXCEL	51.61	47.01	28.12	85.92	4.27	10.37
HARRINGTON	51.18	49.73	26.20	90.00	2.40	10.26
BOWMAN	47.28	50.60	26.00	94.80	1.31	10.50
STARK	46.95	50.89	28.76	95.54	.99	10.06

Cooperator : Don Bradley.
Location : Fifteen miles northeast of Cut Bank, Glacier County.

Table: 12. Dryland **Barley** variety trial grown east of **Oilmont**, 1992. 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
Hector	66.50	49.03	22	77	21	12.37
Bowman	62.04	45.22	20	93	5	12.50
MT 140523	61.08	47.97	19	93	5	12.84
Lewis	60.08	45.65	20	79	19	12.54
MT 860756	59.21	43.46	19	88	10	12.38
Gallatin	58.33	47.20	20	86	11	11.69
Stark	58.06	45.86	23	88	10	12.62
Piroline	56.79	47.48	21	74	21	12.48
Baronesse	55.98	44.52	18	75	21	12.36
Harrington	55.13	44.94	21	84	14	12.49
Bearpaw	54.81	45.58	20	89	8	12.28
MT 81161	52.77	45.79	18	78	16	12.49
Clark	49.15	46.99	19	87	12	12.37
Steptoe	49.02	43.88	19	92	5	11.37
Excel	44.28	45.50	18	82	10	12.64

Cooperator : Terry Alme
Location : Eight miles east of Oilmont, Toole County.
Fertilizer : 100# 11-51-0 with the seed.
Previous crop : Fallow
Date seeded : March 30, 1992.
Date harvested : August 10, 1992.
Rainfall : From planting to harvest was 7 + inches.
Yield experimental mean : 56.21
Error degrees of freedom : 28
F test for var. : 1.59
C.V. 2 : 8.05
LSD (0.05) : 13.10

Table: 13. **Five-year** summary for dryland **Barley** varieties grown north of **Oilmont, MT.** 1988 - 1989 - 1990 - 1991 - 1992. Mont. Agr. Expt. Station, Western Triangle Agr. Research Center, Conrad, MT.

Variety	5 - year comparable average					
	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	% Plump	% Thin	% Protein
BOWMAN	49.30	47.47	25.80	53.40	23.00	14.14
LEWIS	48.86	47.51	25.80	46.00	31.60	14.95
STARK	48.62	47.05	28.24	44.63	28.67	14.29
MT 140523	48.27	46.84	26.40	41.40	44.00	15.41
HECTOR	47.07	47.40	27.60	34.60	45.20	14.57
GALLATIN	46.63	47.71	25.80	39.00	35.80	14.64
PIROLINE	46.20	46.60	26.40	33.40	53.00	14.80
MT 81161	43.99	46.41	24.86	44.04	34.96	14.21
STEPTOE	43.95	40.45	25.20	41.80	37.60	12.11
BARONESSE	43.51	44.48	23.99	30.50	71.76	14.83
CLARK	43.14	46.21	25.80	44.00	32.00	14.85
BEARPAW	40.32	45.93	25.00	38.80	34.40	15.80
HARRINGTON	37.28	46.58	26.00	46.20	30.40	15.28
EXCEL	37.07	43.48	24.88	35.72	40.56	14.40

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

Table: 14. Dryland **Barley** variety trial grown southeast of **Sun River,** 1992. 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
Steptoe	79.39	48.82	26	94	2	13.18
Excel	75.70	50.80	30	97	2	14.14
Stark	71.27	51.50	29	81	8	15.55
Piroline	63.52	51.85	29	72	11	15.09
Lewis	61.04	50.73	29	79	9	15.57
Baronesse	58.23	48.82	26	74	9	16.01
MT 860756	58.17	50.09	28	84	5	13.75
Gallatin	56.04	50.37	29	87	8	13.99
MT 81161	54.34	47.48	28	79	8	15.19
Bowman	54.09	49.60	30	81	5	16.76
MT 140523	53.27	49.31	30	87	13	18.16
Clark	50.34	48.04	29	70	12	16.54
Harrington	50.05	47.48	27	75	10	16.50
Hector	47.38	47.76	32	70	12	16.29
Bearpaw	47.23	47.13	29	73	9	16.80

Cooperator : Chuck Merja
Location : Three miles southeast of Sun River, Cascade County.
Fertilizer : 100# 11-51-0 with the seed + 40# N actual topdressed.
Previous crop : Fallow.
Date seeded : March 31, 1992.
Date harvested : July 30, 1992.
Rainfall : From seeding to harvest was 7 + inches.
Yield experimental mean : 58.67
Error degrees of freedom : 28.00
F test for var. : 5.04
C.V. 2 : 7.55
LSD (0.05) : 12.84

Table: 15. **Five-year** summary for dryland **Barley** varieties grown east of **Sun River, MT.** 1987 - 1989 - 1990 - 1991 - 1992. 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	% Plump	% Thin	% Protein
STARK	66.03	51.13	29.33	80.26	9.97	14.41
EXCEL	60.95	48.60	28.96	82.23	3.17	13.56
STEPTOE	57.69	44.75	28.60	68.80	12.40	12.34
BARONESSE	55.62	47.94	25.01	65.14	12.66	14.71
BOWMAN	55.31	50.01	30.40	81.20	6.40	14.73
GALLATIN	54.78	49.95	29.20	70.60	13.20	14.56
HECTOR	54.51	48.97	31.00	67.40	14.40	15.00
MT 140523	54.08	49.35	28.44	66.60	18.15	15.53
LEWIS	53.88	49.77	29.00	67.60	14.00	15.33
PIROLINE	52.32	50.32	29.80	52.20	20.60	15.10
MT 81161	51.87	47.82	28.08	63.55	14.59	14.42
BEARPAW	50.41	47.94	27.80	64.00	14.40	15.50
CLARK	50.38	48.15	29.80	63.80	14.40	15.09
HARRINGTON	46.33	47.77	27.80	66.60	11.60	14.78

Cooperator : Chuck Merja.
Location : Three miles east of Sun River, Cascade County.

Title: Sawfly/spring planting date & rate study.

Year: 1992

Location: Western Triangle Research Center, Conrad, MT.

Personnel Greg Kushnak (WTRC), & Wendell Morrill (MSU Entomology Dept.).

Our field observations in previous years indicated that sawfly prefer to select larger-diameter stems for laying eggs. One of the objectives of this study was to induce smaller stem-diameter in spring wheat by increasing seeding rate, and determine if this strategy would decrease sawfly-larvae infestation. The infestation data in Table 16 indicates that high seeding rate had no effect on controlling sawfly infestation. This was also the case in 1991, when the study was initiated.

Another objective of this study was to determine the effect of planting date on sawfly infestation. The April 13 planting date had the highest infestation at 51%, followed by the April 28 planting at 27%, and May 19 at 5% (Table 16). This was consistent with the previous year's data. Although the May 19 planting date had only 5% infestation, grain yield from that date was 22% lower than from the earliest date; which offset the benefit of reduced infestation.

Table 16. Seeding Rate and Seeding Date study on Spring Wheat grown north of Conrad, MT. 1992. Mont. Agr. Expt. Station, Western Triangle Ag. Research Center, Conrad, MT.

Seeding date	Seeding rate	Yield bu/ac	Test wt. lbs/bu.	Plant hgt. inches	Head date *	% Sawfly infest.
	20 seeds/ft.	37.0	60.4	25	169	52
April 13	40 seeds/ft.	37.2	60.7	26	169	53
	80 seeds/ft.	33.2	60.9	26	169	48
	average	35.8	60.7	26	169	51
	20 seeds/ft.	34.5	58.8	27	177	33
April 28	40 seeds/ft.	34.4	58.9	25	177	40
	80 seeds/ft.	35.6	59.2	28	177	39
	average	34.8	59.0	27	177	37
	20 seeds/ft.	24.3	55.8	30	195	7
May 19	40 seeds/ft.	32.2	55.7	29	195	4
	80 seeds/ft.	31.6	56.2	31	195	3
	average	29.4	55.9	29	195	5

Location : Western Triangle Ag. Research Center, ten miles north of Conrad, Pondera County.
Variety : Copper.
Fertilizer : 100 # 11-51-0 with the seed + 40 lbs. N actual topdressed.
Previous crop : Fallow.
Rainfall : From April 13 to harvest was 6.79 inches.
From April 28 to harvest was 6.20 inches.
From May 19 to harvest was 6.86 inches.
Dates of adult sawfly activity : May 23 to July 1.
*Head dates : 169=June 18; 177=June 26; 195=July 14.
Date of growth stage (Feekes scale):
April 13 planting : stage 5 June 2; stage 10.3 June 18.
April 28 planting : stage 3 June 2; stage 8 June 18.
May 19 planting : stage 2 June 2; stage 5 June 18.
(Feekes 2=start of tillering; 3=full tillering; 5=start of shooting; 8=last leaf; 10.3=heading).

TITLE: Effect of nitrogen on grain yield and quality of spring wheat.

YEAR: 1992

LOCATIONS:
1. Bruce Bradley Farm, North of Cut Bank;
2. Bill Eney Farm, North of Cut Bank;
3. Don Bradley Farm, North of Cut Bank;
4. Mike Koepke Farm, Northeast of Cut Bank.

PERSONNEL: Grant Jackson, Larry Christiaens, and Robert Kirby-Glacier County Agent.

OBJECTIVES: Determine the response of spring wheat to N fertilizer, and calibrate nitrate-N soil test to spring wheat response.

PROCEDURES: Seven fertilizer treatments, described in each data table, were applied broadcast prior to seeding. Plot size was 10 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. Previous crop was fallow.

RESULTS: Data are summarized in Tables 17 through 20. Results were affected by a extremely dry spring which delayed germination, an August freeze, and snow storm which caused frost damage, lower test weights, and probably affected the protein analysis. Significant grain yields due to N were measured at two locations with the lowest nitrate-N soil tests (Tables 18 and 19). The same two locations also responded to the KCl treatment. None of the locations responded to S or the additional P. Grain protein was also increased by N, however, the protein levels may not be accurate and are being checked by chemical analysis.

TABLE 17. Effect of nitrogen on spring wheat - Don Bradley Loc. Western Triangle Ag. Research Center, Conrad, MT 1992

TREATMENT	GRAIN YIELD	GRAIN PROTEIN	TEST WT.
lb/a of N-P_2O_5-K_2O-S	bu/a	%	lb/bu
30-0-25-0	48.80	11.31	50.61
60-50-25-20	47.70	11.58	49.20
60-50-0-0	45.60	11.68	48.51
60-0-25-0	45.33	11.88	49.76
90-0-25-0	44.93	12.45	48.70
60-50-25-0	42.27	11.56	48.99
0-0-25-0	40.17	10.81	50.40
EXPERIMENTAL MEANS	44.97	11.61	49.45
TOTAL OBSERVATIONS	21.00	21.00	21.00
NO. OF REPLICATIONS	3.00	3.00	3.00
NO. OF TREATMENTS	7.00	7.00	7.00
REP. MEAN SQUARE	81.69	.10	1.40
TRT. MEAN SQUARE	26.52	.76	2.02
ERROR MEAN SQUARE	17.11	.09	1.45
ERROR DEGREES OF FREEDOM	12.00	12.00	12.00
F TEST FOR REPS.	4.77	1.08	.96
F TEST FOR TRT.	1.55	8.13	1.40
STANDARD ERROR	4.14	.30	1.20
STANDARD ERROR OF THE MEAN	2.39	.18	.69
C.V. 1: (S/MEAN)*100	9.20	2.63	2.43
C.V. 2: (S OF MEAN/MEAN)*100	5.31	1.52	1.40
LSD (0.05	NS	.54	NS

Grain yields based on 60 lb/bu.
Variety: Amidon
Seeding Date: April 25
Harvest Date: September 18
Fertilizer with Seed: 50 lbs of 18-46-0
Fertilizer sources were urea, monoammonium phosphate, potassium chloride, and ammonium sulfate applied broadcast prior to planting.
Soil Test Results: pH = 7.9, O.M. = 1.7 %, P = 13 ppm, K = 254 ppm, S = 15 ppm, NO_3-N (0-2') = 49 lb/a, NO_3-N (0-4') = 82 lb/a.

TABLE 18. Effect of nitrogen on spring wheat - Bill Eney Loc. Western Triangle Ag. Research Center, Conrad, MT 1992

TREATMENT	GRAIN YIELD	GRAIN PROTEIN	TEST WT.
lb/a, N-P_2O_5-K_2O-S	bu/a	%	lb/bu
90-0-25-0	64.95	9.52	57.39
60-50-25-0	64.15	9.44	57.92
60-0-25-0	61.10	9.71	57.89
60-50-25-20	59.05	9.48	58.52
60-50-0-0	58.00	9.19	57.99
30-0-25-0	55.48	8.58	57.90
0-0-25-0	52.83	8.52	58.50
EXPERIMENTAL MEANS	59.32	9.20	58.02
TOTAL OBSERVATIONS	28.00	28.00	28.00
NO. OF REPLICATIONS	4.00	4.00	4.00
NO. OF TREATMENTS	7.00	7.00	7.00
REP. MEAN SQUARE	103.48	1.40	.09
TRT. MEAN SQUARE	80.64	.90	.61
ERROR MEAN SQUARE	17.79	.25	.62
ERROR DEGREES OF FREEDOM	18.00	18.00	18.00
F TEST FOR REPS.	5.82	5.61	.15
F TEST FOR TRT.	4.53	3.62	1.00
STANDARD ERROR	4.22	.50	.79
STANDARD ERROR OF THE MEAN	2.11	.25	.39
C.V. 1: (S/MEAN)*100	7.11	5.42	1.35
C.V. 2: (S OF MEAN/MEAN)*100	3.55	2.71	.68
LSD (0.05)	6.27	.74	NS

Grain yields based on 60 lb/bu.
Variety: Rambo
Seeding Date: April 15
Harvest Date: September 1
Fertilizer with Seed: 65 lbs of 22-36-0
Fertilizer sources were urea, monoammonium phosphate, potassium chloride, and ammonium sulfate applied broadcast prior to planting.
Soil Test Results: pH = 7.8, O.M. = 2.2 %, P = 23 ppm, K = 578 ppm, S = 16 ppm, NO_3-N (0-2') = 28 lb/a, NO_3-N (0-4') = 47 lb/a.

TABLE 19. Effect of nitrogen on spring wheat - B. Bradley, Loc. Western Triangle Ag. Research Center, Conrad, MT 1992

TREATMENT	GRAIN YIELD	GRAIN PROTEIN	TEST WT.
lb/a, $N-P_2O_5-K_2O-S$	bu/a	%	lb/bu
60-50-25-0	56.30	11.13	55.15
90-0-25-0	55.43	11.56	53.48
60-50-25-20	55.43	11.22	55.63
60-0-25-0	52.97	11.23	54.29
60-50-0-0	52.23	11.22	54.68
30-0-25-0	51.95	10.66	55.06
0-0-25-0	47.23	10.38	56.53
EXPERIMENTAL MEANS	53.08	11.06	54.97
TOTAL OBSERVATIONS	28.00	28.00	28.00
NO. OF REPLICATIONS	4.00	4.00	4.00
NO. OF TREATMENTS	7.00	7.00	7.00
REP. MEAN SQUARE	27.23	.17	.85
TRT. MEAN SQUARE	38.44	.63	3.79
ERROR MEAN SQUARE	10.45	.09	.74
ERROR DEGREES OF FREEDOM	18.00	18.00	18.00
F TEST FOR REPS.	2.61	1.96	1.15
F TEST FOR TRT.	3.68	7.44	5.13
STANDARD ERROR	3.23	.29	.86
STANDARD ERROR OF THE MEAN	1.62	.15	.43
C.V. 1: (S/MEAN)*100	6.09	2.64	1.56
C.V. 2: (S OF MEAN/MEAN)*100	3.04	1.32	.78
LSD (0.05)	4.80	.43	1.28

Grain yields based on 60 lb/bu.
Variety: Amidon
Seeding Date: April 24
Harvest Date: September 18
Fertilizer with Seed: 50 lb/a 18-46-0
Fertilizer sources were urea, monoammonium phosphate, potassium chloride, and ammonium sulfate applied broadcast prior to planting.
Soil Test Results: pH = 6.9, O.M. = 1.5 %, P = 16 ppm, K = 211 ppm, S = 10 ppm, NO_3-N (0-2') = 35 lb/a, NO_3-N (0-4') = 56 lb/a.

TABLE 20. Effect of nitrogen on spring wheat - M. Koepke Loc.
Western Triangle Ag. Research Center, Conrad, MT 1992

TREATMENT	GRAIN YIELD	GRAIN PROTEIN	TEST WT.
lb/a, N-P_2O_5-K_2O-S	bu/a	%	lb/bu
60-50-25-0	57.40	10.15	57.09
0-0-25-0	56.88	9.63	57.64
60-0-25-0	56.23	10.29	56.07
60-50-0-0	56.03	10.33	56.35
90-0-25-0	55.83	10.54	56.33
60-50-25-20	53.28	10.51	58.12
30-0-25-0	50.90	9.18	57.36
EXPERIMENTAL MEANS	55.22	10.09	56.99
TOTAL OBSERVATIONS	28.00	28.00	28.00
NO. OF REPLICATIONS	4.00	4.00	4.00
NO. OF TREATMNENTS	7.00	7.00	7.00
REP. MEAN SQUARE	12.07	.69	16.68
TRT. MEAN SQUARE	21.31	1.01	2.35
ERROR MEAN SQUARE	34.18	.63	2.11
ERROR DEGREES OF FREEDOM	18.00	18.00	18.00
F TEST FOR REPS.	.35	1.08	7.91
F TEST FOR TRT.	.62	1.59	1.11
STANDARD ERROR	5.85	.80	1.45
STANDARD ERROR OF THE MEAN	2.92	.40	.73
C.V. 1: (S/MEAN)*100	10.59	7.89	2.55
C.V. 2: (S OF MEAN/MEAN)*100	5.29	3.95	1.27
LSD (0.05)	NS	NS	NS

Grain yields based on 60 lb/bu.
Variety: Rambo
Seeding Date: April 25
Harvest Date: September 2
Fertilizer with Seed: None
Fertilizer sources were urea, monoammonium phosphate, potassium chloride, and ammonium sulfate applied broadcast prior to planting.
Soil Test Results: pH = 7.4, O.M. = 1.3 %, P = 14 ppm, K = 387 ppm, S = 18 ppm, NO_3-N (0-2') = 89 lb/a, NO_3-N (0-4') = 133 lb/a.

TITLE: Effect phosphorus (P) fertilizers on spring wheat production.

YEAR: 1992

LOCATIONS: 1. Don Bradley, Cooperator, North of Cut Bank.

PERSONNEL: Grant Jackson, Greg Kushnak, Ron Thaut, and Larry Christiaens.

OBJECTIVES: To calibrate the Olsen P soil test for spring wheat grown on fallow in northcentral Montana.

PROCEDURES: Phosphorus rates of 0, 10, 20, 30, 40, and 50 lbs P_2O_5 per acre were applied with the seed on land previously in fallow. Plot size was 4 x 10 feet with three replications. Other location information is included in the data table.

RESULTS: Data are tabulated in Table 21. Only the Cut Bank location survived the drought conditions, poor seed quality, and hail storms this year. A small yield increase was measured at this location. Several more years of data with varying soil tests are needed before a reliable calibration curve can be determined. Central and Northern Ag. Research Centers are cooperating by conducting similar experiments.

TABLE 21. Effect of phosphorus on spring wheat - D. Bradley Loc. Western Triangle Ag. Research Center, Conrad, MT 1992

TREATEMENT	GRAIN YIELD	GRAIN PROTEIN	NIR	TEST WT.
lb/a P_2O_5	bu/a	%	%	lb/bu
20	33.27	8.79	10.37	56.35
50	32.37	9.13	10.53	56.86
10	31.87	9.42	10.80	56.58
30	30.70	9.02	10.67	55.41
40	29.40	9.47	11.00	55.41
0	26.00	9.18	10.87	53.38
EXPERIMENTAL MEANS	30.60	9.17	10.71	55.66
TOTAL OBSERVATIONS	18.00	18.00	18.00	18.00
NO. OF REPLICATIONS	3.00	3.00	3.00	3.00
NO. OF TREATMENTS	6.00	6.00	6.00	6.00
REP. MEAN SQUARE	1.12	.06	.02	4.60
TRT. MEAN SQUARE	20.67	.19	.16	4.85
ERROR MEAN SQUARE	7.73	.07	.12	1.92
ERROR DEGREES OF FREEDOM	10.00	10.00	10.00	10.00
F TEST FOR REPS.	.15	.79	.19	2.39
F TEST FOR TRT.	2.68	2.60	1.30	2.52
STANDARD ERROR	2.78	.27	.35	1.39
STANDARD ERROR OF THE MEAN	1.60	.16	.20	.80
C.V. 1: (S/MEAN)*100	9.08	2.98	3.29	2.49
C.V. 2: (S OF MEAN/MEAN)*100	5.24	1.72	1.90	1.44
LSD (0.05)	NS	NS	NS	NS

Grain yields based on 60 lb/bu.
Variety: Lew
Planting Date: April 15
Harvest Date: September 18
Fertilizer: Monoammonium phosphate applied with the seed.
P soil test: 12 ppm

TITLE: Effect of potassium and chlorine on wheat stem sawfly damage and disease incidence in dryland wheat production.

YEAR: 1992

LOCATIONS:
1. Dryland spring wheat-Roy Imbody, Cooperator, north-east of Choteau;
2. Dryland spring wheat-Bruce Bradley, Cooperator, north of Cut Bank;
3. Dryland spring wheat-Bill Eney, Cooperator, north of Cut Bank.

PERSONNEL: Grant Jackson and Larry Christiaens

OBJECTIVES: (1) To evaluate the effect of K and Cl on (dryland root rot, take all, etc.) incidence and grain yield of dryland winter and spring wheat, and (2) To determine if wheat stem sawfly damage is affected by K and Cl fertilizers in dryland winter wheat and spring wheat and irrigated spring wheat.

PROCEDURES: Potassium fertilizers were applied topdress to existing stands of spring wheat just before tillering. Plot size was 10 x 20 feet with four replications. Fertilizer treatments and specific site information are included with each data table. Plant samples from three feet of row were collected at maturity for K and Cl analysis. The B. Bradley location was not sampled. Previous crop for all locations was fallow.

RESULTS: Specific results from each location are tabulated in tables 22 through 24. Grain yields were excellent this year at the Cut Bank locations (Tables 23 and 24). Results from the Cut Bank locations were affected by an August freeze and snow storm which caused frost damage and lower test weights. All three locations suffered from severe spring drought which delayed germination. Potassium did not increase yields at the Choteau location (Table 22), but increased yields slightly at both Cut Bank locations. An interaction is evident at the Cut Bank locations (Tables 23 and 24); KNO_3 lowered grain yields while KCl increased yields. Potassium chloride increased plant Cl conc. at the Eney location (Table 24), and all K treatments increased plant Cl content at the Choteau location (Table 22). Plant K conc. was not increased significantly by K at any location. Since plant K conc. was unaffected, differential sawfly damage would not be expected. At the Choteau location, 40 to 50 % of the stems were invested with sawflys, but the location was harvested before lodging occurred. Sawfly infestation was not evident at Cut Bank. Plant disease was not detected this year at any location.

TABLE 22. Effect of Potassium on Spring Wheat - Roy Embody Location
Western Triangle Ag. Research Center, Conrad, MT. 1992.

TREATMENT	GRAIN YIELD	GRAIN PROTEIN	TEST WT.	PLANT K	PLANT Cl	K UPTAKE	Cl UPTAKE
0K	48.48	14.77	60.00	1.24	0.35	32.77	9.35
60K AS KCL	46.53	15.10	60.83	1.19	0.53	31.56	13.90
60K AS KNO3	46.25	15.08	61.03	1.00	0.41	31.90	12.90
15K AS KNO3	45.48	15.13	60.53	1.24	0.46	45.33	16.40
30K AS KCL	45.35	14.80	59.26	1.20	0.46	38.46	14.80
30K AS KNO3	45.28	14.82	60.16	1.11	0.44	37.96	15.05
15K AS KCL	43.80	14.98	60.73	1.23	0.45	37.17	17.05
EXPERIMENTAL MEANS	45.88	14.95	60.36	1.17	0.45	37.17	14.21
TOTAL OBSERVATIONS	28.00	28.00	28.00	28.00	28.00	28.00	28.00
NO. OF REPLICATIONS	4.00	4.00	4.00	4.00	4.00	4.00	4.00
NO. OF TREATMENTS	7.00	7.00	7.00	7.00	7.00	7.00	7.00
REP. MEAN SQUARE	113.33	0.28	6.62	0.02	0.00	183.70	32.20
TRT. MEAN SQUARE	8.28	0.09	1.47	0.03	0.01	115.20	26.23
ERROR MEAN SQUARE	9.54	0.05	2.42	0.03	0.00	127.70	14.60
ERROR D OF F	18.00	18.00	18.00	18.00	18.00	18.00	18.00
F TEST FOR REPS.	11.88	5.18	2.73	0.71	0.90	3.23	2.21
F TEST FOR TRT.	.87	1.71	.61	1.08	4.59	0.90	1.80
STANDARD ERROR	3.09	0.23	1.56	0.17	0.06	11.30	3.82
SE OF THE MEAN	1.54	0.12	.78	0.08	0.03	5.65	1.91
C.V. 1: (S/MEAN)*100	6.73	1.56	2.58	14.37	12.48	30.40	26.89
CV2(S OF MEAN/MEAN)	3.37	0.78	1.29	7.18	6.24	15.20	13.45
LSD (0.05)	NS	NS	NS	NS	0.08	NS	NS

Grain yields based on 60 lb/bu.
Variety: Rambo
Seeding Date: April 15; Fertilizer application date: May 8
Harvest Date: August 19
Fertilizer preplant: 60 lbs/a of N as anhydrous ammonia
Fertilizer with Seed: 60 lbs/a of 11-53-0
Potassium fertilizer sources were KCl and KNO_3. Ammonium nitrate was topdressed on each plot at the rate required for 20 lbs N/a.
Soil Test Results: pH = 7.2, O.M. = 1.9 %, P = 31 ppm, K = 834 ppm, S = 11 ppm, NO_3-N (0-2') = 141 lb/a, Cl (0-2') = 58 lb/a.

TABLE 23. Effect of potassium on spring wheat-B. Bradley Location Western Triangle Ag. Research Center, Conrad, MT. 1992.

TREATMENT	GRAIN YIELD	GRAIN PROTEIN	TEST WT.
lb K/a	bu/a	%	lb/bu
15K AS KCL	56.57	11.62	53.71
30K AS KCL	56.57	11.66	54.08
60K AS KCL	54.62	11.42	54.73
0K	54.18	11.66	53.92
15K AS KNO3	53.95	11.62	54.13
30K AS KNO3	53.55	11.65	53.74
60K AS KNO3	48.08	11.27	53.19
EXPERIMENTAL MEANS	53.93	11.56	53.93
TOTAL OBSERVATIONS	28.00	28.00	28.00
NO. OF REPLICATIONS	4.00	4.00	4.00
NO. OF TREATMENTS	7.00	7.00	7.00
REP. MEAN SQUARE	68.44	.35	4.91
TRT. MEAN SQUARE	32.64	.09	.88
ERROR MEAN SQUARE	10.51	.02	.97
ERROR DEGREES OF FREEDOM	18.00	18.00	18.00
F TEST FOR REPS.	6.51	16.35	5.07
F TEST FOR TRT.	3.11	4.39	.91
STANDARD ERROR	3.24	.15	.98
STANDARD ERROR OF THE MEAN	1.62	.07	.49
C.V. 1: (S/MEAN)*100	6.01	1.26	1.82
C.V. 2: (S OF MEAN/MEAN)*100	3.01	.63	.91
LSD (0.05)	4.82	0.22	NS

Grain yields based on 60 lb/bu.
Variety: Amidon
Seeding Date: April 24 Fertilizer Application Date: May 7
Harvest Date: September 18
Fertilizer with Seed: 50 lb/a 18-46-0
Potassium fertilizer sources were KCl and KNO_3. Ammonium nitrate was topdressed on each plot at the rate required for 60 lbs N/a.
Soil Test Results: pH = 6.9, O.M. = 1.5 %, P = 16 ppm, K = 211 ppm, S = 10 ppm, NO_3-N (0-2') = 35 lb/a, NO_3-N (0-4') = 56 lb/a, Cl (0-2') = 26 lb/a, Cl (0-4') = 57 lb/a.

TABLE 24. Effect of Potassium on Spring Wheat - Bill Eney Location
Western Triangle Ag. Research Center, Conrad, MT 1992.

TREATMENT	GRAIN YIELD	GRAIN PROTEIN	TEST WT.	PLANT K	PLANT Cl	K UPTAKE	Cl UPTAKE
lb K/a	bu/a	%	lb/bu	%	%	lb/a	lb/a
30K AS KCL	61.85	9.23	56.05	0.46	0.17	15.22	5.58
0K	56.62	9.66	57.04	0.49	0.08	21.19	3.39
15K AS KCL	56.13	9.25	58.50	0.56	0.19	22.14	7.69
60K AS KNO3	55.95	9.00	57.37	0.47	0.07	20.07	2.78
60K AS KCL	53.20	9.14	57.46	0.46	0.19	16.52	6.75
30K AS KNO3	50.72	9.02	56.02	0.51	0.09	19.91	3.16
15K AS KNO3	48.93	9.15	55.77	0.49	0.13	16.48	4.62
EXPERIMENTAL MEANS	54.77	9.21	56.89	0.49	0.13	18.79	4.62
TOTAL OBSERVATIONS	28.00	28.00	28.00	28.00	28.00	28.00	28.00
NO. OF REPLICATIONS	4.00	4.00	4.00	4.00	4.00	4.00	4.00
NO. OF TREATMENTS	7.00	7.00	7.00	7.00	7.00	7.00	7.00
REP. MEAN SQUARE	177.20	1.67	4.12	0.03	0.00	147.07	4.62
TRT. MEAN SQUARE	73.19	0.20	3.94	0.00	0.01	28.70	16.35
ERROR MEAN SQUARE	27.74	0.09	2.18	0.00	0.00	16.32	1.68
ERROR D OF F	18.00	18.00	18.00	18.00	18.00	18.00	18.00
F TEST FOR REPS.	6.39	18.53	1.89	13.84	2.14	9.01	2.75
F TEST FOR TRT.	2.64	2.19	1.81	2.37	21.23	1.76	9.73
STANDARD ERROR	5.27	0.30	1.48	0.05	0.02	4.04	1.30
SE OF THE MEAN	2.63	0.15	0.74	0.02	0.01	2.02	0.65
CV1:(S/MEAN)*100	9.62	3.26	2.59	9.29	19.30	21.50	28.05
CV2:(S OF MEAN/MEAN)	4.81	1.63	1.30	4.64	9.65	10.75	14.03
LSD (0.05)	7.82	NS	NS	NS	0.04	NS	1.93

Grain yields based on 60 lb/bu.
Variety: Rambo
Seeding Date: April 15; Fertilizer application date: May 7
Harvest Date: September 1
Fertilizer with Seed: 65 lbs of 22-36-0
Potassium fertilizer sources were KCl and KNO_3. Ammonium nitrate was topdressed on each plot at the rate required for 40 lbs N/a.
Soil Test Results: pH = 7.8, O.M. = 2.2 %, P = 23 ppm, K = 578 ppm, S = 16 ppm, NO_3-N (0-2') = 28 lb/a, NO_3-N (0-4') = 47 lb/a, Cl (0-2') = 36 lb/a, Cl (0-4') = 86 lb/a.

TITLE: Nitrogen (N), phosphorus (P), potassium (K), sulfur (S), and irrigation water effects on no-till spring canola.

YEAR: 1991

LOCATION: Western Triangle Ag. Research Center, 10 miles north of Conrad, Pondera Co.

PERSONNEL: Grant Jackson, Ron Thaut, and Larry Christiaens

OBJECTIVES: (1) To determine the response of spring canola to differential irrigation water applications; (2) to evaluate spring canola response to and calibrate soil tests for N, P, K, and S; and (3) to measure N effects on spring canola water use and nitrate-N movement below the root zone.

PROCEDURES: Line source irrigation experiments were conducted with three irrigation treatments plus dryland and four replications on canola. Details are included with each table.

RESULTS: The 1992 experiments were hailed out. Data in this year's report was not available for inclusion in the 1991 report. Total dry matter canola yields are shown in Table 25. These responses were similar to the grain yield response reported last year.

Nitrogen, P, K, and S analysis and uptake results are shown in Tables 26 through 31. Nitrogen uptake increased with increasing N fertilizer, and the total amount of N uptake indicates canola is an excellent scavenger of residual soil nitrate-N. The other nutrient data also indicate canola is an excellent rotation crop because it cycles nutrients so effectively.

The post-harvest nitrate-N data are shown in Table 32. These data are further indication that canola is an excellent scavenger of indigenous soil nitrate-N. Nitrate-N levels are very similar or lower than the initial soil nitrate-N levels.

Table 33 shows the N transport and plant N data summary for 0, 50, 100, and 150 lbs N/ac treatments for 1990 and 1991. Two years of data also indicate that canola is an efficient N user with no indication of nitrate leaching below the root zone with optimum N rates.

Total water use and water use efficiency (wue) data are shown in Table 34. Canola water use is slightly less than barley (see Table 35).

TABLE 25. EFFECT OF FERTILIZER AND IRRIGATION RATE ON **TOTAL DRY Matter YIELD** NO-TILL CANOLA. Western Triangle Ag. Research Center, Conrad, MT. 1991.

Fertilizer Treatment[1]	Irrigation Treatment				Overall Mean
	Dryland	W-1[2]	W-2[3]	W-3[4]	
	lbs/ac				
0-45-0-0	2285	2256	3269	3616	2856
0-0-0-0	3124	3153	4107	3384	3442
100-0-0-0	6971	8186	10090	9111	8591
100-45-0-20	8967	8851	7868	10120	8952
50-30-0-0	8186	5785	7434	10240	7911
50-60-0-0	7029	9632	8938	5988	7897
150-60-0-0	12090	10070	10070	9603	10460
100-45-0-0	9401	9314	7578	8157	8612
150-30-0-0	8215	9141	9256	9227	8960
100-45-50-0	7867	9979	8012	12150	9502
Mean	7413	7636	7662	8160	7718
LSD (.05)	3685	3400	3867	4665	
CV %	34.3	30.7	34.8	39.4	

Total forage yield at maturity, oven dry basis.
1 Lbs per ac of N, P_2O_5, K_2O, and S
2 Less than optimum irrigation
3 Optimum irrigation
4 Greater than optimum irrigation
Growing season ppt. = 11.2" W-1 = 11.62" W-2 = 13.06" W-3 = 13.65"
Seeding date : April 23, 1991
Variety : 'Wester' (fungicide: Vita Vax)
Previous crop : Barley (3500 lbs residue)
Fertilizers applied with seeding, P with seed, all others broadcast between rows every other row.
Drill : Station built double disc set at 10 inch row space
Harvest date : August 15, 1991
Irrigation date : July 10 W-1=0.20"; W-2=0.72"; W-3=0.92"
July 19 W-1=0.12"; W-2=1.14"; W-3=1.53"
Soil Series : Scobey Cl
Soil Test : pH=7.3; o.m.=1.8%; K=360 ppm; P=20 ppm

Depth in	NO_3-N lb N/ac	SO_4-S ppm
0-6	4	16
6-12	12	18
12-24	12	
24-36	20	
36-48	20	

TABLE 26. EFFECT OF FERTILIZERS AND IRRIGATION RATE ON THE **NITROGEN CONTENT** OF NO-TILL CANOLA. Western Triangle Ag. Research Center, Conrad, MT. 1991.

Fertilizer Treatment[1]	Irrigation Treatment				Overall Mean
	Dryland	W-1[2]	W-2[3]	W-3[4]	
	%				
0-45-0-0	1.41	1.27	1.31	1.26	1.31
0-0-0-0	1.53	1.34	1.27	1.41	1.39
100-0-0-0	1.46	1.40	1.51	1.28	1.41
100-45-0-20	1.29	1.78	1.54	1.55	1.54
50-30-0-0	1.63	1.11	1.29	1.39	1.35
50-60-0-0	1.50	1.24	1.32	1.30	1.34
150-60-0-0	1.67	1.70	1.39	1.85	1.65
100-45-0-0	1.68	1.41	1.53	1.65	1.49
150-30-0-0	1.52	1.55	1.67	1.65	1.60
100-45-50-0	1.68	1.30	1.39	1.56	1.48
Mean	1.54	1.41	1.42	1.46	1.46
LSD (.05)	NS	0.40	NS	0.32	
CV %	14.8	20.7	13.7	15.3	

Samples taken at plant maturity.
1 Lbs per ac of N, P_2O_5, K_2O, and S
2 Less than optimum irrigation
3 Optimum irrigation
4 Greater than optimum irrigation
Growing season ppt. = 11.2" W-1 = 11.62" W-2 = 13.06" W-3 = 13.65"
Seeding date: April 23, 1991
Variety: 'Wester' (fungicide: Vita Vax)
Previous crop: Barley (3500 lbs residue)
Fertilizers applied with seeding, P with seed, all others broadcast between rows every other row.
Drill: Station built double disc set at 10 inch row space
Harvest date: August 15, 1991
Irrigation date: July 10 W-1=0.20"; W-2=0.72"; W-3=0.92"
July 19 W-1=0.12"; W-2=1.14"; W-3=1.53"
Soil Series: Scobey Cl
Soil Test: pH=7.3; o.m.=1.8%; K=360 ppm; P=20 ppm;

Depth in	NO_3-N lb N/ac	SO_4-S ppm
0-6	4	16
6-12	12	18
12-24	12	
24-36	20	
36-48	20	

TABLE 27. EFFECT OF FERTILIZERS AND IRRIGATION RATE ON **NITROGEN UPTAKE** OF NO-TILL CANOLA. Western Triangle Ag. Research Center, Conrad, MT. 1991.

Fertilizer Treatment[1]	Irrigation Treatment				Overall Mean
	Dryland	W-1[2]	W-2[3]	W-3[4]	
	lbs N/ac				
0-45-0-0	32.5	29.2	44.0	45.3	37.7
0-0-0-0	47.1	42.7	56.1	48.0	48.5
100-0-0-0	102.6	113.4	152.8	116.0	121.2
100-45-0-20	118.3	152.6	121.5	156.9	137.3
50-30-0-0	139.3	70.3	96.4	143.5	112.4
50-60-0-0	105.5	126.1	121.0	71.1	105.9
150-60-0-0	202.8	169.4	144.5	168.8	171.4
100-45-0-0	158.1	135.8	106.3	111.5	127.9
150-30-0-0	123.5	140.1	152.4	153.2	142.3
100-45-50-0	129.1	126.0	111.4	184.7	137.8
Mean	115.9	110.6	110.6	119.9	114.2
LSD (.05)	71.9	61.0	58.2	72.1	
CV %	42.8	38.0	36.3	41.5	

Calculated from N content and total forage yield.
1 Lbs per ac of N, P_2O_5, K_2O, and S
2 Less than optimum irrigation
3 Optimum irrigation
4 Greater than optimum irrigation
Growing season ppt. = 11.2" W-1 = 11.62" W-2 = 13.06" W-3 = 13.65"
Seeding date: April 23, 1991
Variety: 'Wester' (fungicide: Vita Vax)
Previous crop: Barley (3500 lbs residue)
Fertilizers applied with seeding, P with seed, all others broadcast between rows every other row.
Drill: Station built double disc set at 10 inch row space
Harvest date: August 15, 1991
Irrigation date: July 10 W-1=0.20"; W-2=0.72"; W-3=0.92"
July 19 W-1=0.12"; W-2=1.14"; W-3=1.53"
Soil Series: Scobey Cl
Soil Test: pH=7.3; o.m.=1.8%; K=360 ppm; P=20 ppm

Depth in	NO_3-N lb N/ac	SO_4-S ppm
0-6	4	16
6-12	12	18
12-24	12	
24-36	20	
36-48	20	

TABLE 28. EFFECT OF FERTILIZERS AND IRRIGATION RATE ON THE **PHOSPHORUS CONTENT** OF NO-TILL CANOLA. Western Triangle Ag. Research Center, Conrad, MT. 1991.

Fertilizer Treatment[1]	Irrigation Treatment				Overall Mean
	Dryland	W-1[2]	W-2[3]	W-3[4]	
	%				
0-45-0-0	0.31	0.29	0.27	0.31	0.29
0-0-0-0	0.28	0.27	0.28	0.31	0.29
100-0-0-0	0.23	0.26	0.26	0.30	0.26
100-45-0-20	0.23	0.26	0.29	0.31	0.27
50-30-0-0	0.29	0.26	0.30	0.28	0.28
50-60-0-0	0.27	0.22	0.27	0.29	0.26
150-60-0-0	0.28	0.26	0.29	0.30	0.28
100-45-0-0	0.27	0.30	0.33	0.28	0.29
150-30-0-0	0.29	0.28	0.30	0.30	0.29
100-45-50-0	0.29	0.26	0.30	0.28	0.28
Mean	0.27	0.27	0.29	0.29	0.28
LSD (.05)	NS	NS	NS	NS	
CV %	15.8	15.9	12.1	16.6	

Determined from total forage samples taken at plant maturity.
1 Lbs per ac of N, P_2O_5, K_2O, and S
2 Less than optimum irrigation
3 Optimum irrigation
4 Greater than optimum irrigation
Growing season ppt. = 11.2" W-1 = 11.62" W-2 = 13.06" W-3 = 13.65"
Seeding date: April 23, 1991
Variety: 'Wester' (fungicide: Vita Vax)
Previous crop: Barley (3500 lbs residue)
Fertilizers applied with seeding, P with seed, all others broadcast between rows every other row.
Drill: Station built double disc set at 10 inch row space
Harvest date: August 15, 1991
Irrigation date: July 10 W-1=0.20"; W-2=0.72"; W-3=0.92"
July 19 W-1=0.12"; W-2=1.14"; W-3=1.53"
Soil Series: Scobey Cl
Soil Test: pH=7.3; o.m.=1.8%; K=360 ppm; P=20 ppm;

Depth in	NO_3-N lb N/ac	SO_4-S ppm
0-6	4	16
6-12	12	18
12-24	12	
24-36	20	
36-48	20	

TABLE 29. EFFECT OF FERTILIZERS AND IRRIGATION RATE ON THE **PHOSPHORUS UPTAKE** OF NO-TILL CANOLA. Western Triangle Ag. Research Center, Conrad, MT. 1991.

Fertilizer Treatment[1]	Irrigation Treatment				Overall Mean
	Dryland	W-1[2]	W-2[3]	W-3[4]	
	lbs P/ac				
0-45-0-0	6.7	6.5	8.6	11.1	8.2
0-0-0-0	8.9	8.6	11.9	10.9	10.1
100-0-0-0	16.0	21.1	25.9	27.0	22.5
100-45-0-20	21.3	22.2	22.8	31.0	24.3
50-30-0-0	24.1	16.3	22.7	28.5	22.9
50-60-0-0	19.1	21.9	24.4	17.1	20.6
150-60-0-0	34.1	26.4	28.9	28.0	29.3
100-45-0-0	25.2	26.5	23.9	23.1	24.7
150-30-0-0	23.8	24.3	27.3	27.4	25.7
100-45-50-0	23.4	25.5	22.9	35.2	26.7
Mean	20.3	19.9	21.9	23.9	21.5
LSD (.05)	12.4	9.1	11.1	15.1	
CV %	42.1	31.7	34.8	43.6	

Calculated from total forage yield and P content.
1 Lbs per ac of N, P_2O_5, K_2O, and S
2 Less than optimum irrigation
3 Optimum irrigation
4 Greater than optimum irrigation
Growing season ppt. = 11.2" W-1 = 11.62" W-2 = 13.06" W-3 = 13.65"
Seeding date: April 23, 1991
Variety: 'Wester' (fungicide: Vita Vax)
Previous crop: Barley (3500 lbs residue)
Fertilizers applied with seeding, P with seed, all others broadcast between rows every other row.
Drill: Station built double disc set at 10 inch row space
Harvest date: August 15, 1991
Irrigation date: July 10 W-1=0.20"; W-2=0.72"; W-3=0.92"
July 19 W-1=0.12"; W-2=1.14"; W-3=1.53"
Soil Series: Scobey Cl
Soil Test: pH=7.3; o.m.=1.8%; K=360 ppm; P=20 ppm;

Depth in	NO_3-N lb N/ac	SO_4-S ppm
0-6	4	16
6-12	12	18
12-24	12	
24-36	20	
36-48	20	

TABLE 30. EFFECT OF POTASSIUM AND IRRIGATION RATE ON YIELD, POTASSIUM CONTENT, AND POTASSIUM UPTAKE OF NO-TILL SPRING CANOLA. Western Triangle Ag. Research Center, Conrad, MT. 1991.

Fertilizer Treatment[1]	Irrigation Treatment: Dryland	W-1[2]	W-2[3]	W-3[3]	Overall Mean
	grain yield, lbs/ac				
100-45-0-0	1993	1822	2050	2207	2018
100-45-50-0	2724	1530	2106	2074	2108
p-value	0.09	0.62	0.98	0.94	
CV (%)	17.5	32.7	24.5	17.5	
	K content				
100-45-0-0	1.67	1.43	1.55	1.47	1.53
100-45-50-0	1.65	1.57	1.54	1.59	1.59
p-value	0.98	0.55	0.99	0.05	
CV (%)	11.4	16.3	12.5	3.38	
	K uptake				
100-45-0-0	155.3	139.3	116.3	121.7	133.1
100-45-50-0	131.1	154.7	128.7	190.0	151.1
p-value	0.74	0.89	0.86	0.49	
CV (%)	41.3	43.1	36.4	65.2	

1 Lbs/ac of N, P_2O_5, K_2O, and S.
2 Less than optimum irrigation.
3 Optimum irrigation.
4 Greater than optimum irrigation.
Growing season ppt: = 11.2"; W-1 = 11.62"; W-2 = 13.06"; W-3 = 13.65".
Seeding date: April 23, 1991
Variety: 'Wester' (fungicide: Vita Vax)
Previous crop: Barley (3500 lbs residue)
Fertilizers applied with seeding, P with seed, all others broadcast between rows every other row.
Drill: Station built double disc set at 10 inch row space
Harvest date: August 15, 1991
Irrigation date: July 10 W-1=0.20"; W-2=0.72"; W-3=0.92"
July 19 W-1=0.12"; W-2=1.14"; W-3=1.53"
Soil Series: Scobey Cl
Soil Test: pH=7.3; o.m.=1.8%; P = 20 ppm; K = 360 ppm

Depth in	NO_3-N lb N/ac	SO_4-S ppm
0-6	4	16
6-12	12	18
12-24	12	
24-36	20	
36-48	20	

TABLE 31. EFFECT OF SULFUR AND IRRIGATION RATE ON YIELD, SULFUR CONTENT, SULFUR UPTAKE, AND NITROGEN:SULFUR RATIO OF NO-TILL SPRING CANOLA. Western Triangle Ag. Research Center, Conrad, MT. 1991.

Fertilizer Treatment[1]	Irrigation Treatment: Dryland	W-1[2]	W-2[3]	W-3[3]	Overall Mean
	grain yield, lbs/ac				
100-45-0-0	1993	1822	2050	2207	2018
100-45-0-20	1447	2012	1919	2246	1906
p-value	0.27	0.85	0.92	0.96	
CV (%)	31.1	34.3	32.7	12.9	
	S content, %				
100-45-0-0	0.60	0.56	0.60	0.55	0.58
100-45-0-20	0.49	0.53	0.57	0.54	0.53
p-value	0.27	0.77	0.64	0.96	
CV (%)	13.8	12.1	10.0	10.3	
	S uptake, lbs S/ac				
100-45-0-0	57.7	52.0	44.0	44.3	49.5
100-45-0-20	45.5	47.3	45.3	55.6	48.4
p-value	0.06	0.93	0.99	0.41	
CV (%)	11.8	49.9	40.4	49.9	
	N:S ratio				
100-45-0-0	2.96	2.53	2.50	2.43	2.61
100-45-0-20	2.69	3.41	2.67	2.93	2.92
p-value	0.33	0.28	0.37	0.17	
CV (%)	10.7	29.6	7.67	14.2	

1 Lbs/ac of N, P_2O_5, K_2O, and S.
2 Less than optimum irrigation.
3 Optimum irrigation.
4 Greater than optimum irrigation.
Growing season ppt: = 11.2"; W-1 = 11.62"; W-2 = 13.06"; W-3 = 13.65".
Seeding date: April 23, 1991
Variety: 'Wester' (fungicide: Vita Vax)
Previous crop: Barley (3500 lbs residue)
Fertilizers applied with seeding, P with seed, all others broadcast between rows every other row.
Drill: Station built double disc set at 10 inch row space
Harvest date: August 15, 1991
Irrigation date: July 10 W-1=0.20"; W-2=0.72"; W-3=0.92"
July 19 W-1=0.12"; W-2=1.14"; W-3=1.53"
Soil Series: Scobey Cl
Soil Test: pH=7.3; o.m.=1.8%; P = 20 ppm; K = 360 ppm

Depth in	NO_3-N lb N/ac	SO_4-S ppm
0-6	4	16
6-12	12	18
12-24	12	
24-36	20	
36-48	20	

TABLE 32. EFFECT OF NITROGEN AND IRRIGATION RATE ON NO-TILL SPRING CANOLA-**POST HARVEST NITRATE-NITROGEN.** Western Triangle Ag. Research Center, Conrad, MT. 1991.

	NITRATE-N				
TREATMENT	0-1'	0-2'	0-3'	0-4'	0-5'
	lbs N/ac				
	Dryland				
0	6	10	14	18	26
50	5	11	15	21	36
100	7	13	18	29	44
150	5	9	13	17	24
p-value	0.80	0.57	0.48	0.03	0.01
LSD (0.05)	NS	NS	NS	8	10
CV (%)	52.2	36.3	29.5	23.3	19.9
	Less than optimum irrigation				
0	10	19	27	34	44
50	10	20	29	40	53
100	12	22	30	40	53
150	10	19	27	35	44
p-value	0.46	0.70	0.91	0.76	0.66
CV (%)	19.0	18.9	21.9	25.3	27.3
	Optimum irrigation				
0	8	15	21	26	34
50	7	12	16	21	32
100	10	17	23	28	37
150	7	12	16	26	39
p-value	0.47	0.49	0.44	0.58	0.73
CV (%)	37.6	33.1	34.9	27.1	22.3
	Greater than optimum irrigation				
0	8	14	19	24	33
50	6	11	15	19	27
100	6	11	17	24	36
150	7	12	17	24	34
p-value	0.19	0.21	0.33	0.61	0.67
CV (%)	20.4	17.6	16.6	26.3	30.8

Growing season ppt. = 11.2" W-1 = 11.62" W-2 = 13.06" W-3 = 13.65". Seeding date: April 23, 1991
Variety: 'Wester' (fungicide: Vita Vax)
Previous crop: Barley (3500 lbs residue)
Irrigation date: July 10 W-1=0.20"; W-2=0.72"; W-3=0.92"
July 19 W-1=0.12"; W-2=1.14"; W-3=1.53"
Soil Series: Scobey Cl
Soil Test: pH=7.3; o.m.=1.8%; K=360 ppm; p=20 ppm

Depth in	NO_3-N lb N/ac	SO_4-S ppm
0-6	4	16
6-12	12	18
12-24	12	
24-36	20	
36-48	20	

TABLE 33. NITROGEN TRANSPORT IN IRRIGATED NO-TILL CANOLA FOLLOWING BARLEY. Western Triangle Ag. Research Center, Conrad, MT.

	---Treatment, lbs N/ac---				
	0	50	100	150	LSD[1]
	1990				
Initial Nitrate-N, lbs N/ac	23	23	23	23	NA
Plant N Uptake, lbs N/ac	35	90	96	188	52
Residual Nitrate-N, lbs N/ac	21	22	17	41	15
Plant N Content, %	1.10	1.23	1.40	2.12	0.27
	1991				
	High Irrigation Rate				
Initial Nitrate-N, lbs N/ac	68	68	68	68	NA
Plant N Uptake, lbs N/ac	48	144	112	169	72
Residual Nitrate-N, lbs N/ac	24	19	24	24	NS
Plant N Content, %	1.41	1.39	1.65	1.85	0.32

[1]Least Significant Difference at P=0.05.
NA=Not applicable
Initial nitrate-N soil samples representing 0-4' taken at planting time. Residual nitrate-N soil samples representing 0-4' taken in October, 1990 and 1991.

Table 34. Effect of nitrogen and irrigation rate on no-till spring canola - total water use and water use efficiency. Western Triangle Ag Research Center, Conrad, MT. 1991.

Treatment	0-1'	0-2'	0-3'	0-4'	0-5'	WUE
	- - - - - - -soil depth - - - - - - -					
lbs N/A	- - - - - - - - - - - - in - - - - - - - - - - - -					lbs/in
			Dryland			
0	11.5	11.3	11.2	10.8	10.2	58.5
50	11.3	11.2	10.9	10.4	9.5	137.9
100	11.3	11.3	11.3	11.0	10.3	176.3
150	11.6	11.7	11.8	11.8	11.2	152.5
p-value	0.21	0.08	0.09	0.15	0.14	0.00
LSD (0.05)	NS	NS	NS	NS	NS	47.3
CV (%)	1.8	2.1	3.6	7.2	9.1	22.5
			W - 1			
0	11.5	11.2	10.7	10.0	9.2	70.9
50	11.9	11.9	11.5	10.9	10.3	132.1
100	11.7	11.6	11.3	11.0	10.3	157.6
150	11.9	11.7	11.4	11.0	10.5	212.7
p-value	0.00	0.02	0.10	0.12	0.23	0.02
LSD (0.05)	0.2	0.40	NS	NS	NS	81.6
CV (%)	1.0	2.2	4.2	5.9	9.2	35.6
			W - 2			
0	13.2	12.9	12.4	12.0	10.7	52.7
50	13.2	13.0	12.7	12.4	11.6	155.3
100	13.3	13.5	13.4	13.3	12.8	154.2
150	13.3	13.3	13.3	13.0	12.3	180.7
p-value	0.51	0.26	0.19	0.38	0.03	0.00
LSD (0.05)	NS	NS	NS	NS	1.3	58.1
CV (%)	1.4	3.2	5.3	8.4	7.3	26.8
			W - 3			
0	13.9	13.5	12.9	12.3	11.6	67.1
50	13.9	13.7	13.1	12.7	12.0	128.1
100	13.9	13.8	13.4	13.0	12.1	164.9
150	13.9	13.8	13.7	13.3	12.7	194.8
p-value	0.97	0.23	0.05	0.09	0.24	0.00
LSD (0.05)	NS	NS	0.5	NS	NS	57.3
CV (%)	1.3	1.7	2.5	3.7	5.7	25.8

Growing season ppt: = 11.2"; W-1 = 11.62"; W-2 = 13.06"; W-3 = 13.65". Seeding date: April 23, 1991. Variety: 'Westar'
Previous crop: Barley (3500 lbs residue)
Harvest date: August 15, 1991. Soil Series: Scobey Cl
Irrigation date: July 10 W-1=0.20"; W-2=0.72"; W-3=0.92"
July 19 W-1=0.12"; W-2=1.14"; W-3=1.53"
Soil Test: pH=7.3; o.m.=1.8%; P = 20 ppm; K = 360 ppm

Depth in	NO_3-N lb N/ac	SO_4-S ppm
0-6	4	16
6-12	12	18
12-24	12	
24-36	20	
36-48	20	

TITLE: Nitrogen (N), phosphorus (P), and irrigation water effects on no-till spring barley.

YEAR: 1991

LOCATION: Western Triangle Ag. Research Center, 10 miles north of Conrad, Pondera Co.

PERSONNEL: Grant Jackson, Ron Thaut, and Larry Christiaens

OBJECTIVES: (1) To determine the response of spring barley to differential irrigation water applications; (2) to evaluate spring barley response to three soil series, and N and P fertilizers; and (3) to measure N effects on spring barley water use and nitrate-N movement below the root zone.

PROCEDURES: Line source irrigation experiments were conducted on spring barley with three irrigation treatments (W-1=less than optimum, W-2=optimum, and W-3=greater than optimum) plus dryland, three soil series: Scobey clay loam (cl), Kevin cl, and Hillon cl, four N rates (0, 50, 100, and 150 lbs N/a, and four P_2O_5 rates (0, 30, 45, and 60 lbs P_2O_5/a). Soils (each 12' x 12'plot) in the experimental area were classified into Scobey, Kevin, or Hillon series. Fertilizer treatments were randomized in each soil series and water treatment. Soil water use and nitrate-N data were collected on the Kevin cl. Data analysis was accomplished by completely random, ANOVA and multiple regression. Plots were seeded with a custom built no-till drill, and fertilizer sources were urea and treble super phosphate. Additional details are included with each Tables 35 through 37. A total plant sample from three feet of row was collected at crop maturity for total N and P analysis.

RESULTS: The 1992 experiments were hailed out. Data in this year's report was not available for inclusion in the 1991 report.

Barley grain yields, expressed as regression equations, are shown in Fig. 1. As expected, barley had a tremendous response to N. Response to irrigation was not as dramatic since the growing season precipitation was over 11 inches. Barley yields were reduced by spot and net blotch.

The protein response curves to N and irrigation are shown in Fig. 3. Irrigation rate decreased protein while N increased protein. A similar pattern exists with percent thin kernels; N increases thin kernels while irrigation rate decreases thin kernels as shown in Fig. 12.

The effect of N and irrigation rate on N uptake characteristics of barley are shown in Figs. 4 through 6. Increased irrigation and N increase the total uptake of N in the plant (see Fig. 4). However, the amount of N accumulated in the grain decreases with irrigation rate (Fig. 5). Thus N rate and irrigation rate increase the amount

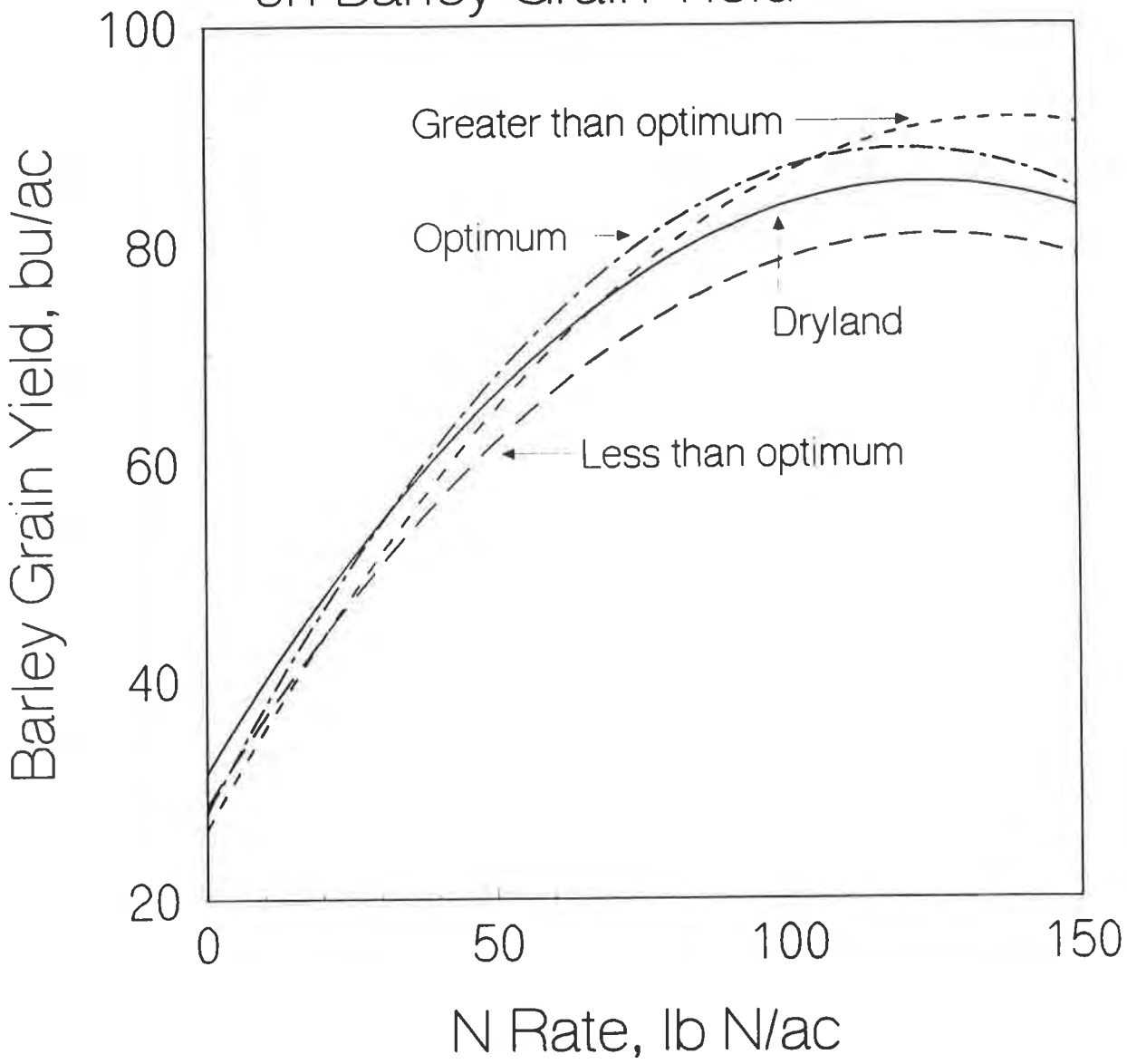
of N accumulated in the straw. This is significant because N accumulated in the straw means it is not in protein or leached and is available for recycling. The effect of N and irrigation on post-harvest soil nitrate-N are shown in Table 37. These data indicate very little soil nitrate-N available for leaching with realistic N fertilization levels.

The effect of N and irrigation rate on total water use and water use efficiency (wue) are summarized in Tables 35 and 36, respectively. The wue values for the 0-5' water measurement are plotted in Fig. 11 which shows that maximum water use occurs at about 100 N rate. In 1991, very little supplemental irrigation water was needed for maximum yields, therefore, maximum wue occurred with dryland. If grain quality factors such as thin kernels are considered, than the result would probably be different.

The response of barley to P rates applied with the seed was non-significant (yield equations are shown in Fig. 10, P uptake not shown). However, P uptake was affected by N and irrigation rate as shown in Fig. 7.

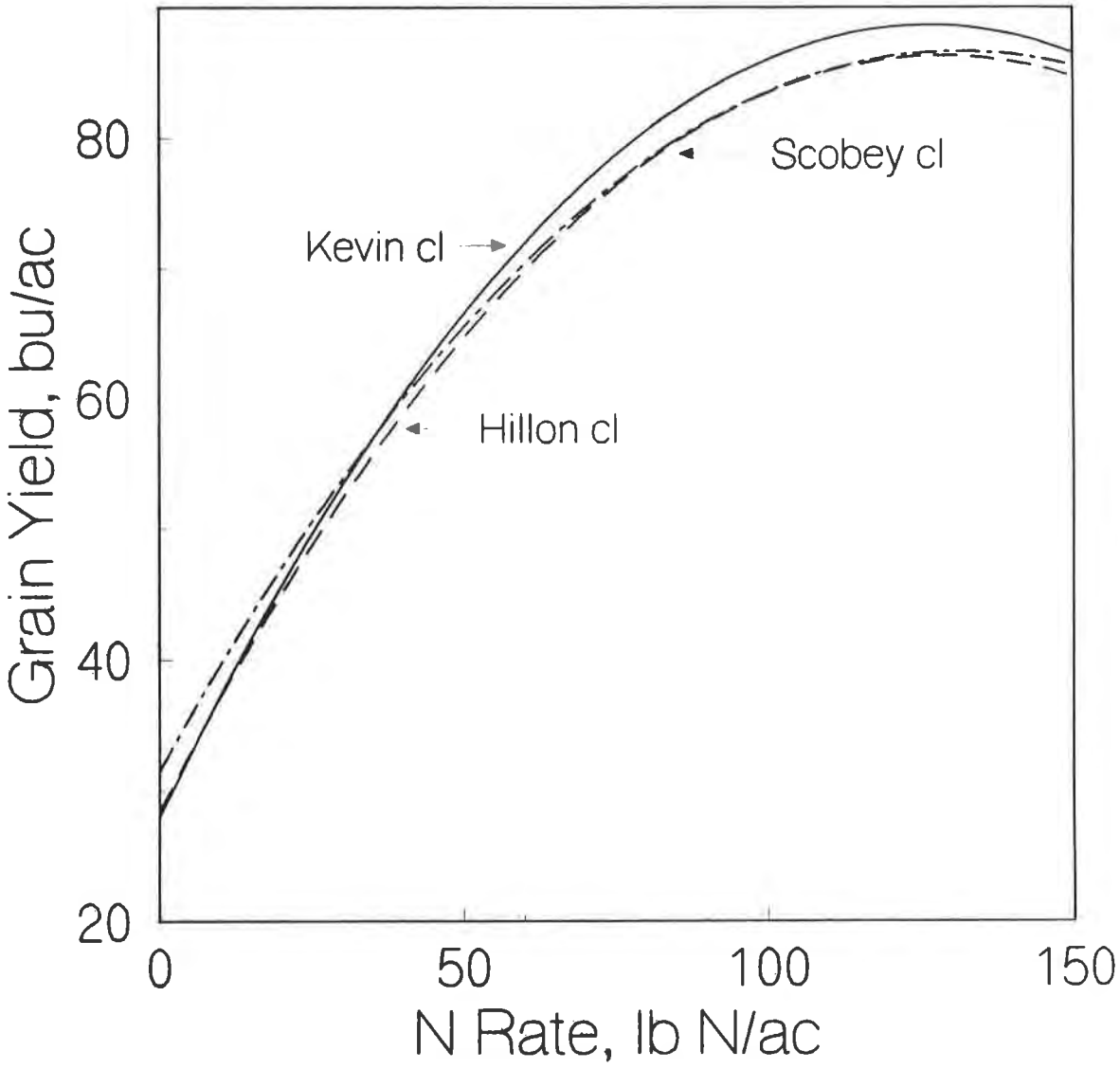
All of the water treatments were used to generate the response curves shown in Fig. 2, 8, and 9. Fig. 2 indicates the effect of soil and N on barley yield. All of the soils had about the same yield curve. However the expected soil productivity differences are evident in Figs. 8 and 9 with the N and P uptake equations.

Fig. 1. Effect of N and Irrigation Rate on Barley Grain Yield



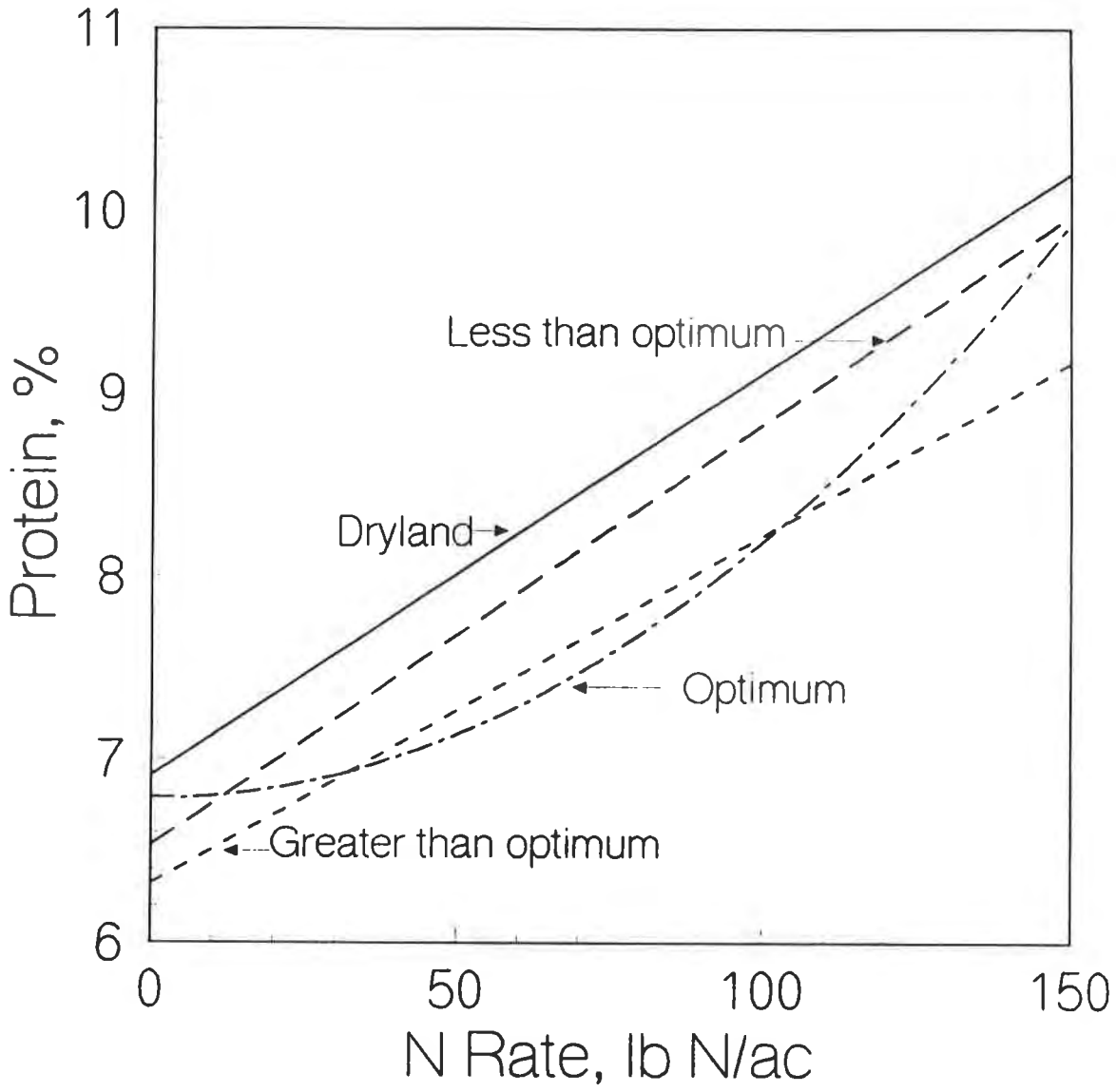
— $Y = 31.56 + 0.87\ X - 0.0035\ X^2$, $R^2 = 0.87$
— - $Y = 28.62 + 0.83\ X - 0.0033\ X^2$, $R^2 = 0.93$
—·· $Y = 27.93 + 1.01\ X - 0.0042\ X^2$, $R^2 = 0.92$
- - $Y = 26.43 + 0.94\ X - 0.0034\ X^2$, $R^2 = 0.96$

Fig. 2. Effect of Nitrogen and Soil on Barley Grain Yield.



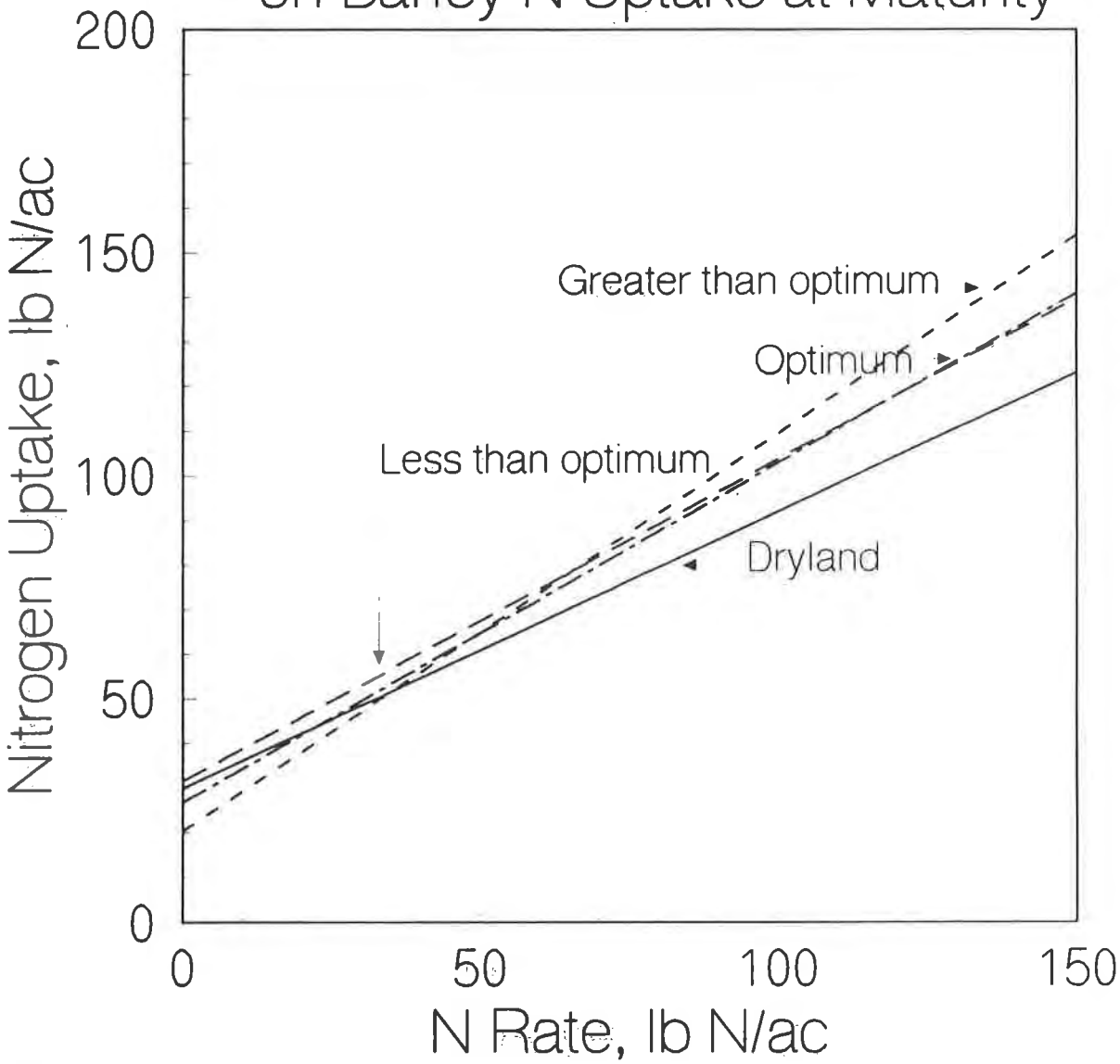
— $Y = 28.02 + 0.96\ X - 0.0038\ X^2$, $R^2 = 0.91$
— - $Y = 28.45 + 0.90\ X - 0.0035\ X^2$, $R^2 = 0.92$
—·· $Y = 31.52 + 0.84\ X - 0.0032\ X^2$, $R^2 = 0.86$

Fig. 3. Effect of N and Irrigation Rate on Barley Grain Protein



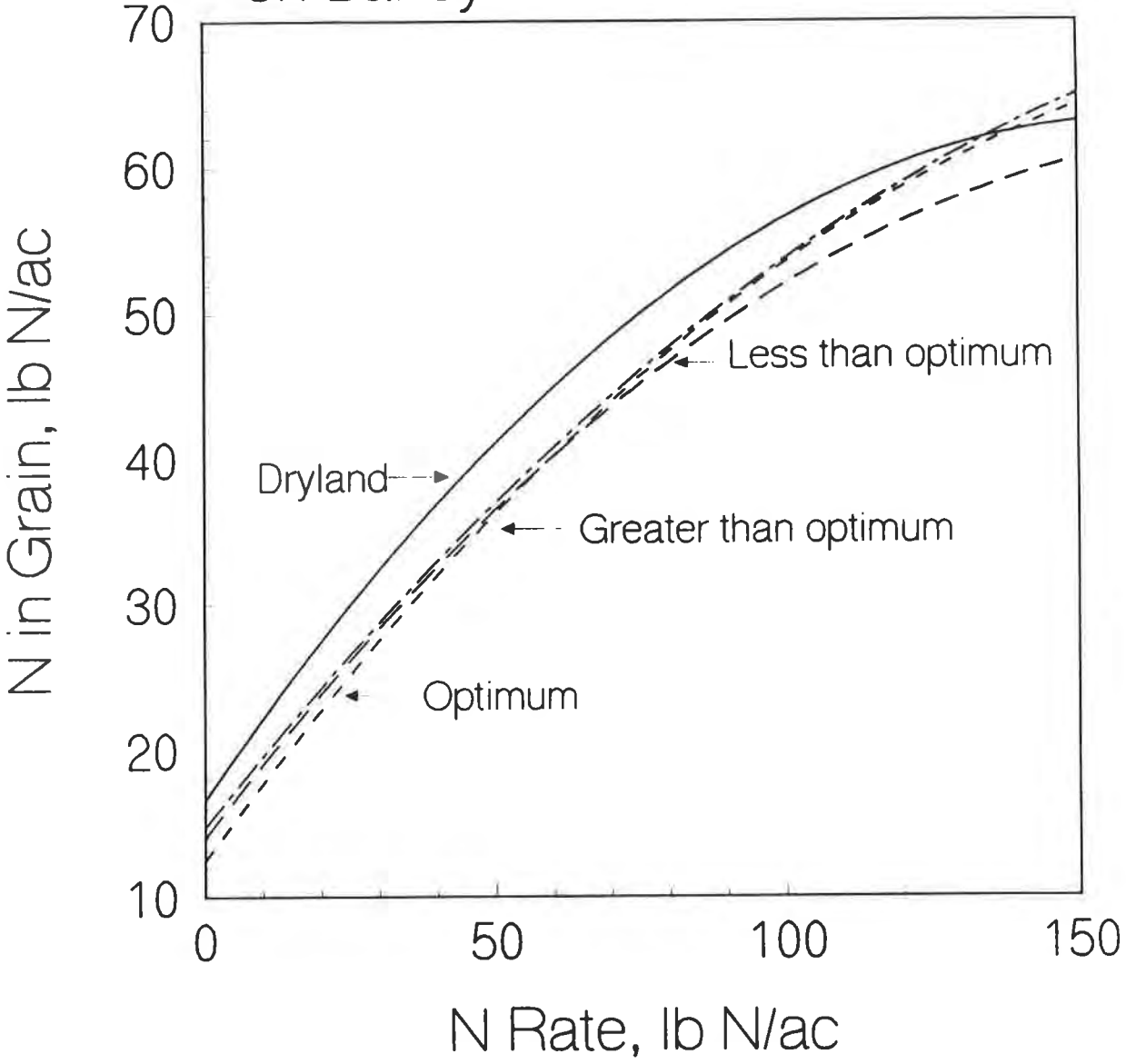
— $Y = 6.91 + 0.022\ X$, $R^2 = 0.48$
— - $Y = 6.53 + 0.023\ X$, $R^2 = 0.46$
—·· $Y = 6.79 + 0.00014\ X^2$, $R^2 = 0.66$
- - $Y = 6.32 + 0.019\ X$, $R^2 = 0.41$

Fig. 4. Effect of N and Irrigation Rate on Barley N Uptake at Maturity



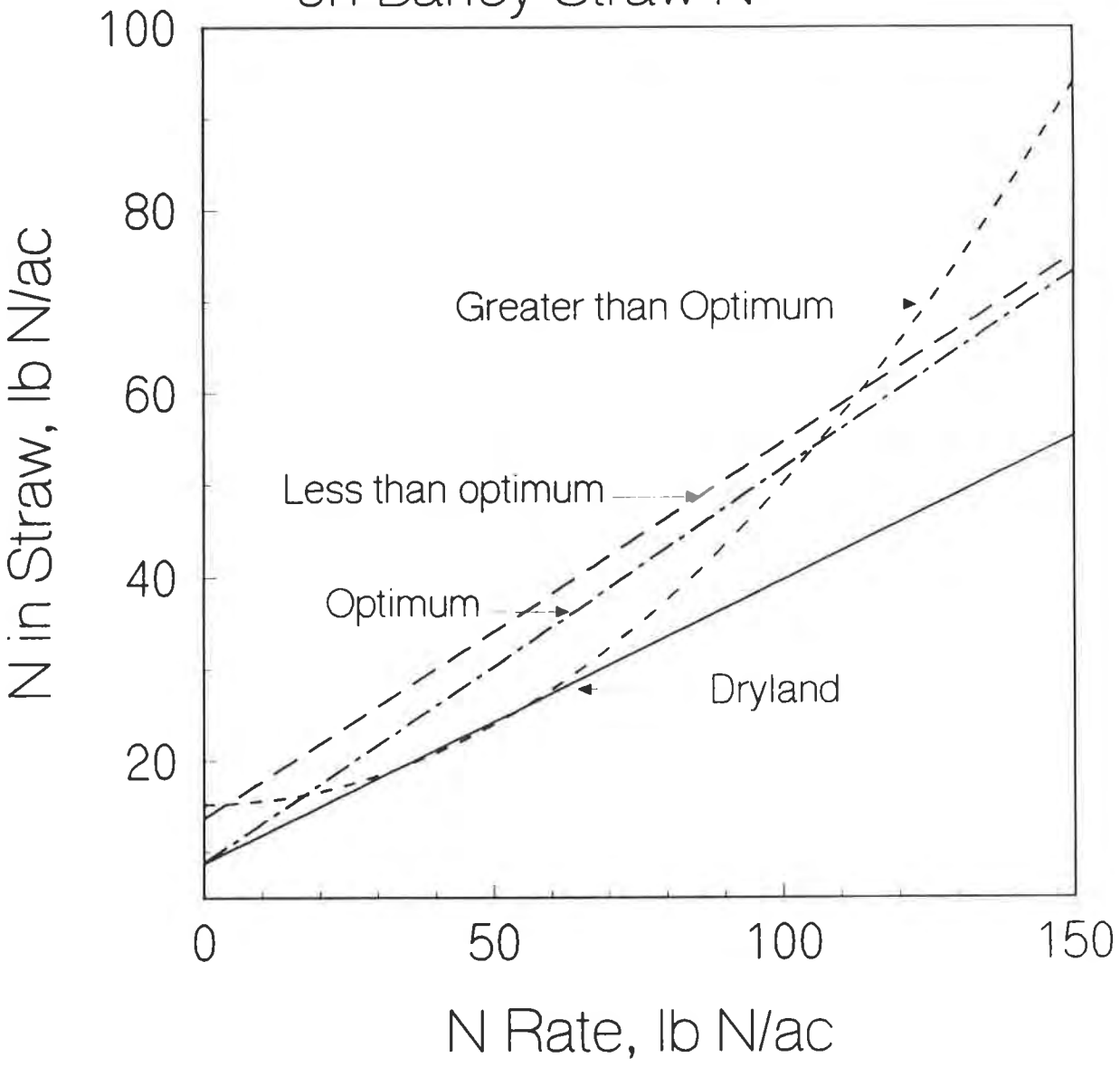
— Y = 29.9 + 0.62 X, R^2 = 0.65
– – Y = 31.52 + 0.72 X, R^2 = 0.60
— · Y = 26.72 + 0.76 X, R^2 = 0.75
– – Y = 20.35 + 0.89 X, R^2 = 0.82

Fig. 5. Effect of N and Irrigation Rate on Barley Grain N



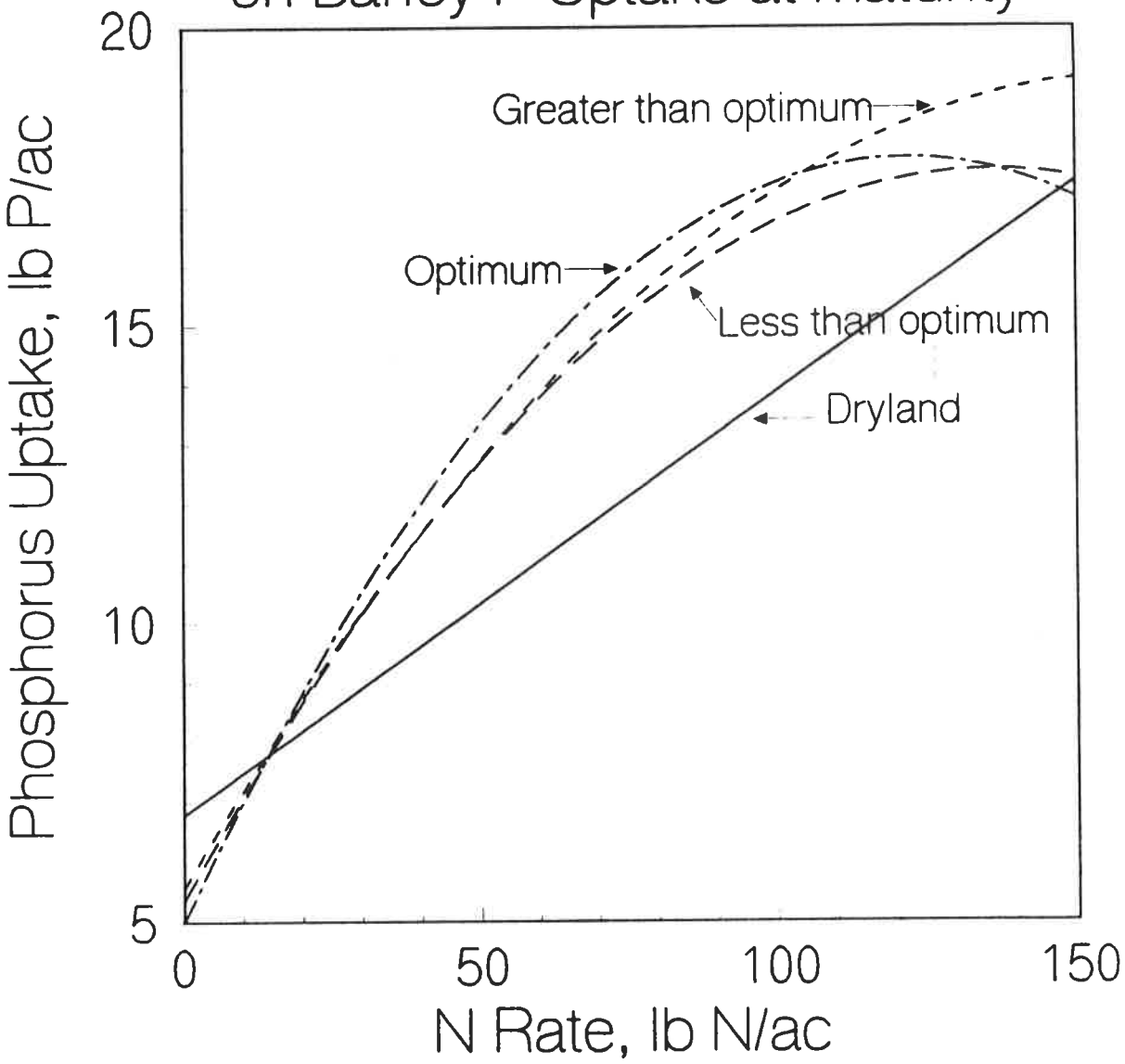
— $Y = 16.6 + 0.58\ X - 0.0018\ X^2$, $R^2 = 0.87$
— - $Y = 14.02 + 0.52\ X - 0.0014\ X^2$, $R^2 = 0.86$
—·· $Y = 14.74 + 0.50\ X - 0.0011\ X^2$, $R^2 = 0.93$
- - $Y = 12.5 + 0.54\ X - 0.0013\ X^2$, $R^2 = 0.85$

Fig. 6. Effect of N and Irrigation Rate on Barley Straw N



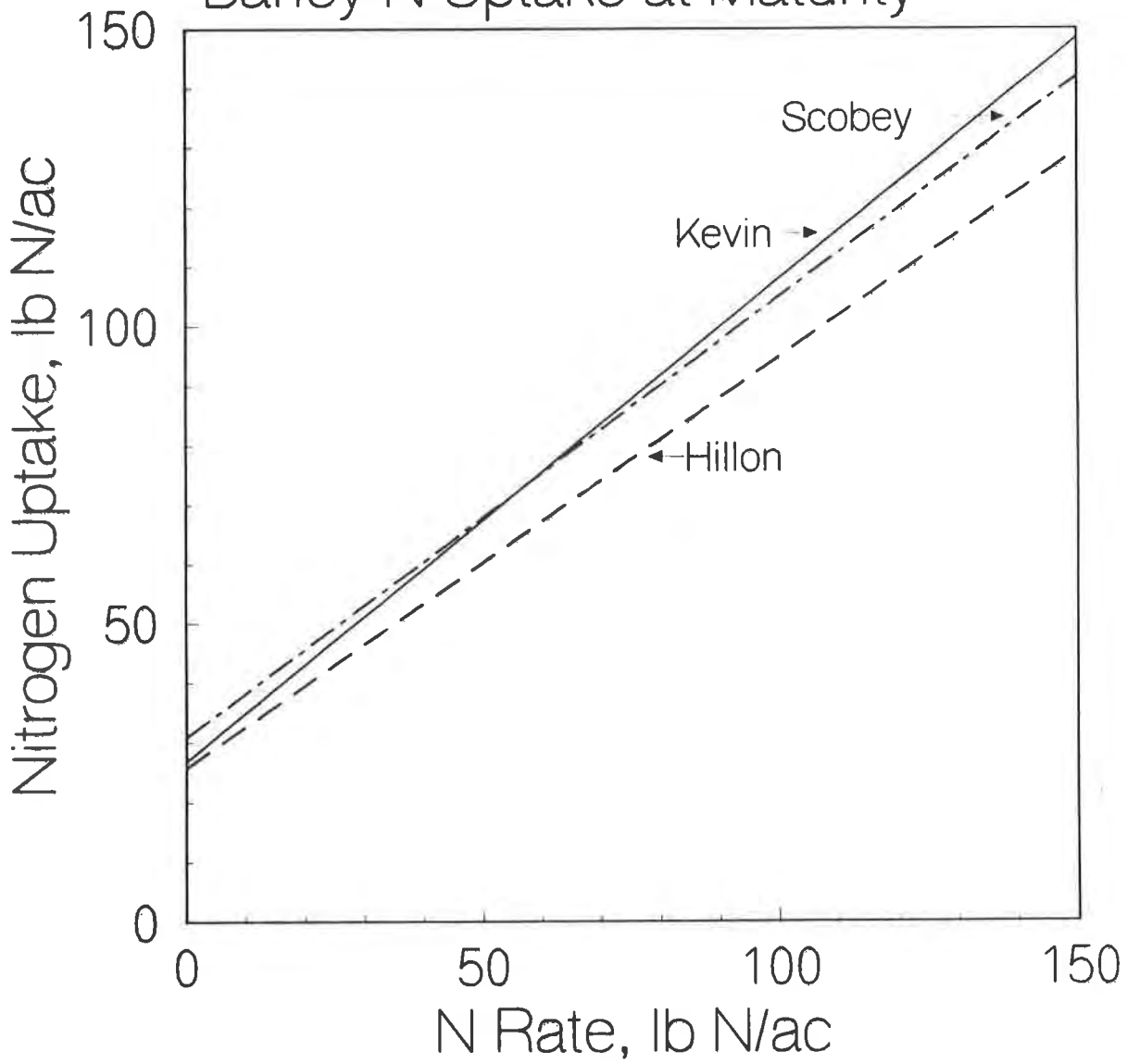
— $Y = 8.71 + 0.31\ X$, $R^2 = 0.32$
— - $Y = 13.6 + 0.41\ X$, $R^2 = 0.32$
—·· $Y = 8.78 + 0.43\ X$, $R^2 = 0.50$
- - $Y = 15.17 + 0.0035\ X^2$, $R^2 = 0.61$

Fig. 7. Effect of N and Irrigation Rate on Barley P Uptake at Maturity



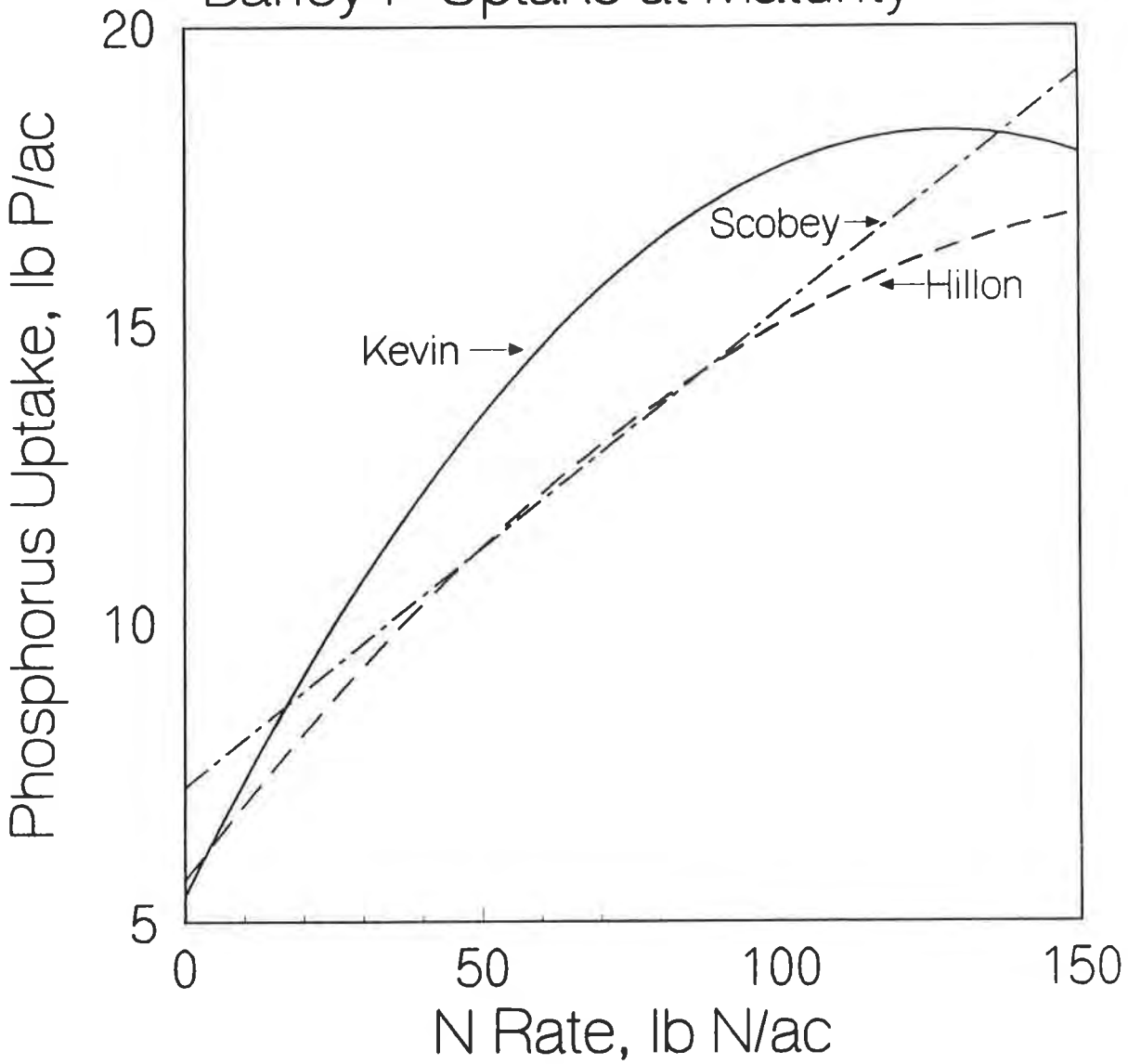
— $Y = 6.78 + 0.071\ X$, $R^2 = 0.59$
— - $Y = 5.35 + 0.18\ X - 0.00066\ X^2$, $R^2 = 0.57$
—·· $Y = 5.00 + 0.21\ X - 0.00086\ X^2$, $R^2 = 0.79$
- - $Y = 5.56 + 0.17\ X - 0.00053\ X^2$, $R^2 = 0.70$

Fig. 8. Effect of Nitrogen and Soil on Barley N Uptake at Maturity



— Y = 26.86 + 0.81 X, R^2 = 0.73
– - Y = 25.71 + 0.69 X, R^2 = 0.71
—·· Y = 30.82 + 0.74 X, R^2 = 0.65

Fig. 9. Effect of Nitrogen and Soil on Barley P Uptake at Maturity

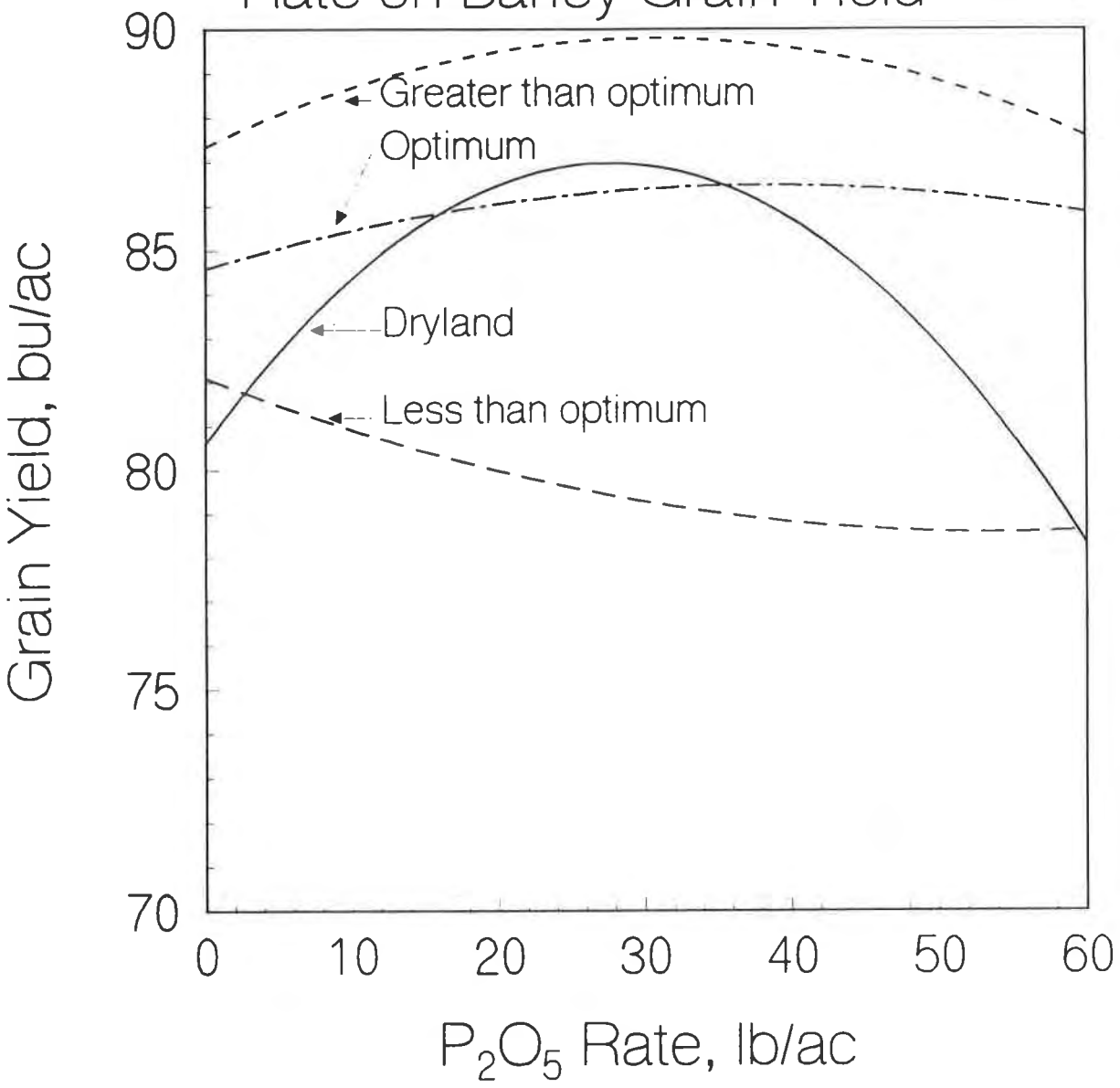


— $Y = 5.44 + 0.20\ X - 0.00078\ X^2$, $R^2 = 0.69$

– – $Y = 5.70 + 0.13\ X - 0.00037\ X^2$, $R^2 = 0.64$

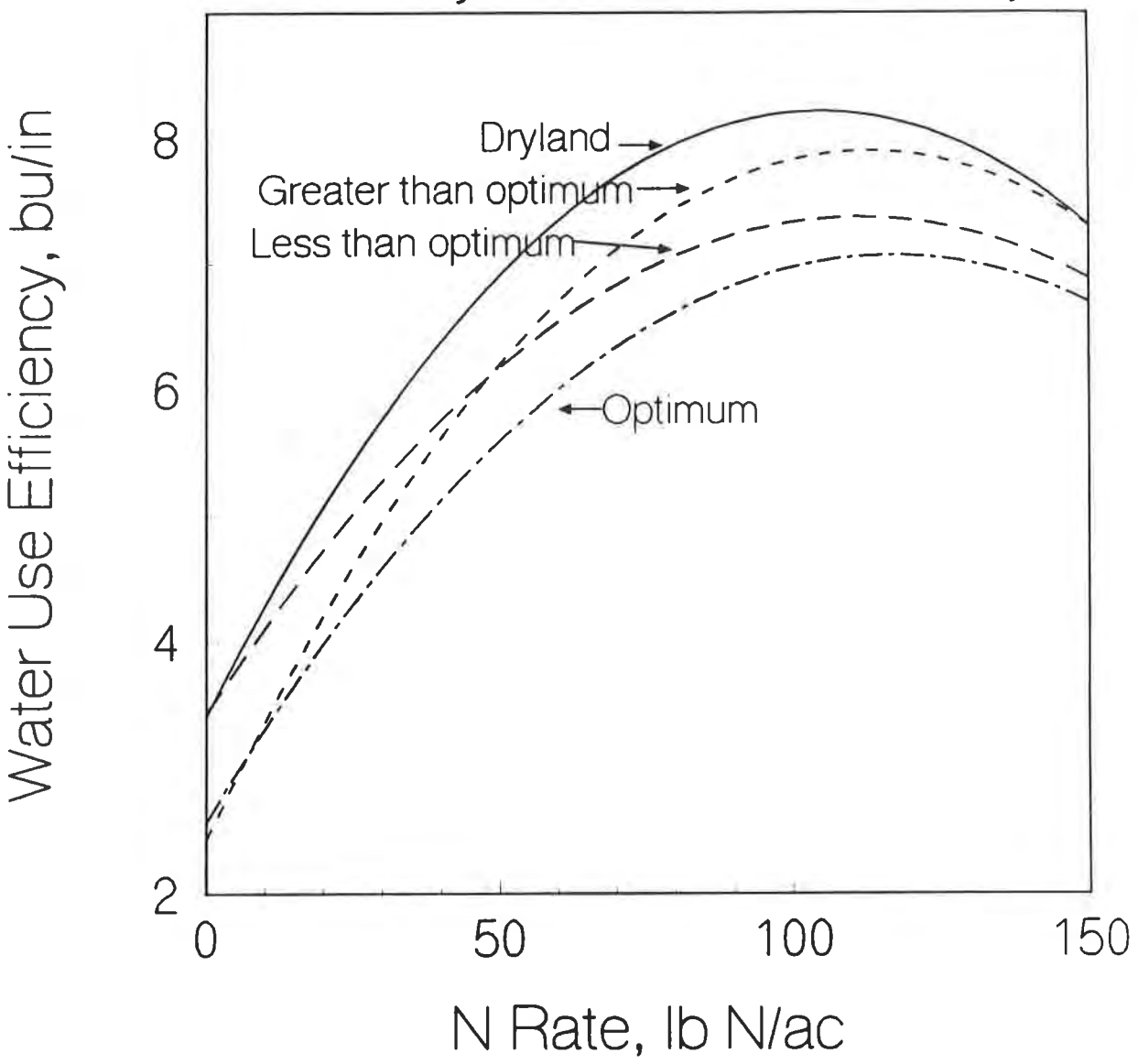
—·· $Y = 7.25 + 0.08\ X$, $R^2 = 0.56$

Fig. 10. Effect of Phosphorus and Irrigation Rate on Barley Grain Yield



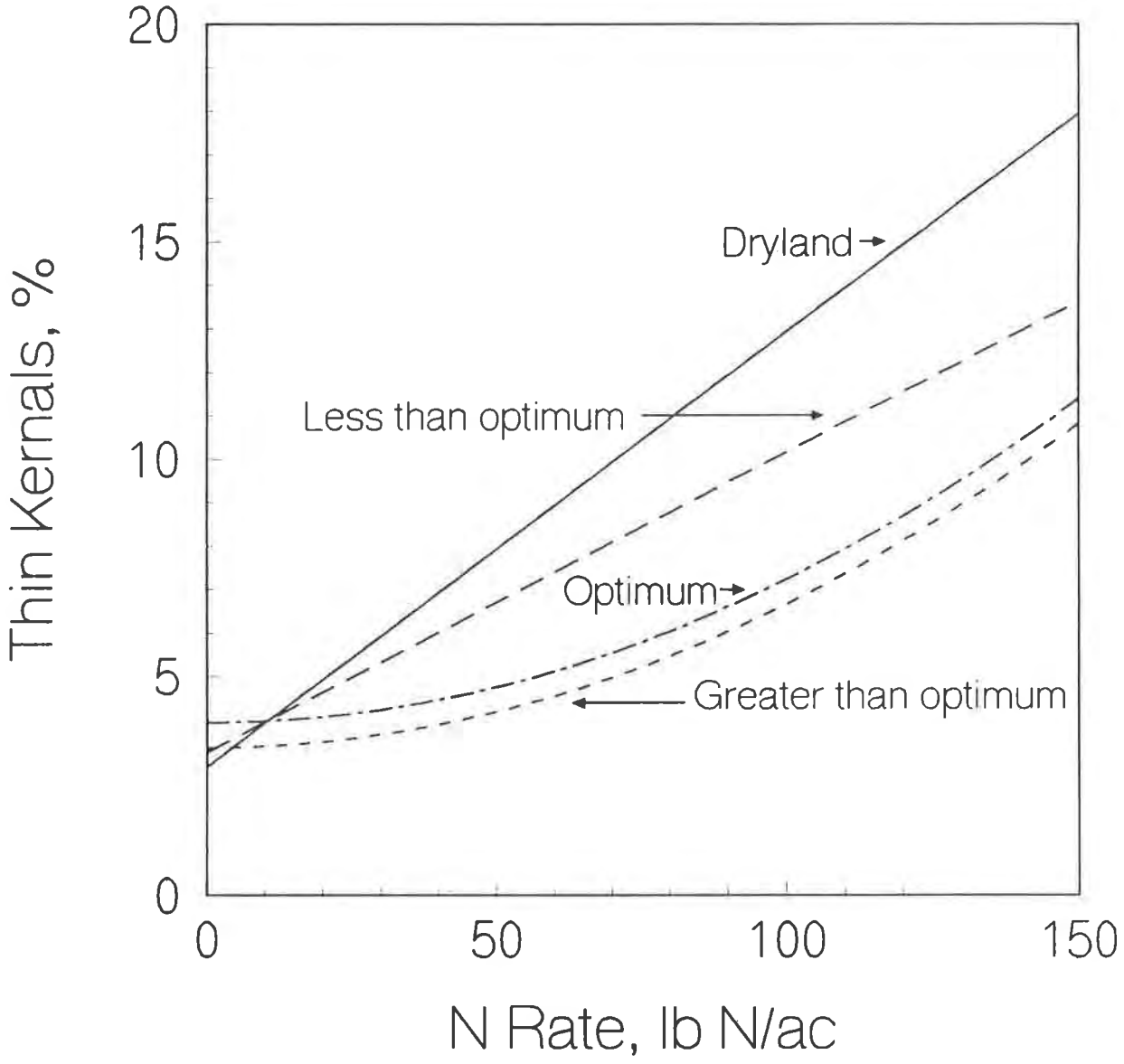
— $Y = 80.59 + 0.46X - 0.0083X^2$, $R^2 = 0.11$
– – $Y = 82.09 - 0.13X + 0.0012X^2$, $R^2 = 0.04$
—·· $Y = 84.58 + 0.099X - 0.0013X^2$, $R^2 = 0.01$
– – $Y = 87.33 + 0.16X - 0.0026X^2$, $R^2 = 0.03$

Fig. 11. Effect of N and Irrigation Rate on Barley Water Use Efficiency



— $Y = 3.41 + 0.092X - 0.00044X^2$, $R^2 = 0.80$
– – $Y = 3.43 + 0.071X - 0.00032X^2$, $R^2 = 0.77$
—·· $Y = 2.57 + 0.077X - 0.00033X^2$, $R^2 = 0.88$
– – $Y = 2.43 + 0.097X - 0.00043X^2$, $R^2 = 0.88$

Fig. 12. Effect of N and Irrigation Rate on Barley Thin Kernals



— $Y = 2.93 + 0.10X$, $R^2 = 0.29$
— - $Y = 3.26 + 0.069X$, $R^2 = 0.43$
—·· $Y = 3.94 + 0.00033X^2$, $R^2 = 0.39$
- - $Y = 3.37 + 0.00033X^2$, $R^2 = 0.28$

Table 35. Effect of nitrogen and irrigation rate on no-till spring barley - total water use.
Western Triangle Ag Research Center, Conrad, MT. 1991.

	- - - - - - - -soil depth - - - - - - - - - -
Treatment	0-1'	0-2'	0-3'	0-4'	0-5'
lbs N/A	- - - - - - - - - - - - in - - - - - - - - - -
			Dryland		
0	11.2	10.6	10.0	9.4	9.0
50	11.5	11.1	10.6	10.3	9.9
100	11.3	11.2	11.0	10.6	10.0
150	11.4	11.5	11.4	11.2	10.7
p-value	0.47	0.02	0.01	0.00	0.01
LSD (0.05)	NS	0.6	0.7	0.9	1.0
CV (%)	3.1	4.0	5.2	6.5	7.5
			W - 1		
0	11.6	10.9	10.0	9.5	8.9
50	11.9	11.4	10.6	10.0	9.4
100	12.1	12.1	11.9	11.7	11.3
150	12.1	12.3	12.2	12.1	11.6
p-value	0.03	0.00	0.00	0.00	0.00
LSD (0.05)	0.4	0.7	0.9	1.0	1.3
CV (%)	1.9	3.8	5.3	6.1	8.0
			W - 2		
0	12.8	11.9	11.0	10.3	10.2
50	13.1	12.4	11.9	11.5	11.0
100	13.7	13.9	13.7	13.4	13.2
150	13.3	13.4	13.3	13.0	12.5
p-value	0.00	0.00	0.00	0.00	0.00
LSD (0.05)	0.3	0.6	0.7	1.3	1.2
CV (%)	1.3	2.5	2.9	6.1	5.6
			W - 3		
0	13.4	12.5	11.5	10.6	9.9
50	13.3	12.4	11.4	11.0	10.4
100	13.8	13.2	12.5	11.7	11.1
150	14.0	14.0	13.7	13.2	12.5
p-value	0.00	0.00	0.00	0.00	0.00
LSD (0.05)	0.4	0.8	1.1	1.2	1.3
CV (%)	1.7	3.8	5.8	6.8	7.9

Growing season ppt: = 11.2"; W-1 = 11.62"; W-2 = 13.06"; W-3 = 13.65". Seeding date: April 23, 1991. Variety: 'Harrington'
Previous crop: Barley (3500 lbs residue)
Harvest date: August 12, 1991. Soil Series: Kevin cl
Irrigation date: July 10 W-1=0.20"; W-2=0.72"; W-3=0.92"
July 19 W-1=0.12"; W-2=1.14"; W-3=1.53"
Soil Test: pH=8.0; O.M.=1.6 %; P = 20 ppm; K = 225 ppm

Depth in	NO_3-N lb N/ac	Depth in	SO_4-S ppm
0-12	16	0-6	40
12-24	12	6-12	10
24-36	6		
36-48	10		
48-60	40		

Table 36. Effect of nitrogen and irrigation rate on no-till spring barley - water use efficiency.
Western Triangle Ag Research Center, Conrad, MT. 1991.

Treatment	----Depth of soil water measurement---- 0-1'	0-2'	0-3'	0-4'	0-5'
lbs N/A	----------bu/in----------				
			Dryland		
0	2.8	2.9	3.1	3.3	3.5
50	5.7	5.9	6.2	6.4	6.7
100	7.6	7.6	7.8	8.0	8.5
150	6.9	6.8	6.9	7.0	7.3
p-value	0.00	0.00	0.00	0.00	0.00
LSD (0.05)	1.1	1.2	1.2	1.3	1.3
CV (%)	14.7	15.1	15.5	15.4	15.4
			W - 1		
0	2.5	2.7	2.9	3.1	3.3
50	5.1	5.3	5.7	6.1	6.5
100	6.6	6.6	6.6	6.7	7.0
150	6.5	6.4	6.4	6.5	6.8
p-value	0.00	0.00	0.00	0.00	0.00
LSD (0.05)	0.8	0.9	0.9	1.0	1.2
CV (%)	10.8	10.8	11.0	11.9	13.0
			W - 2		
0	2.0	2.1	2.3	2.5	2.5
50	5.0	5.3	5.5	5.7	5.9
100	6.4	6.3	6.4	6.6	6.7
150	6.3	6.3	6.3	6.5	6.7
p-value	0.00	0.00	0.00	0.00	0.00
LSD (0.05)	1.3	1.3	1.3	1.3	1.4
CV (%)	14.9	14.4	13.8	13.5	14.3
			W - 3		
0	1.8	1.9	2.1	2.3	2.5
50	4.7	5.1	5.5	5.7	6.1
100	6.3	6.5	6.9	7.4	7.8
150	6.3	6.3	6.5	6.7	7.1
p-value	0.00	0.00	0.00	0.00	0.00
LSD (0.05)	0.7	0.7	0.9	1.0	1.2
CV (%)	9.3	9.8	10.9	11.7	13.1

Growing season ppt: = 11.2"; W-1 = 11.62"; W-2 = 13.06"; W-3 = 13.65". Seeding date: April 23, 1991. Variety: 'Harrington'
Previous crop: Barley (3500 lbs residue)
Harvest date: August 12, 1991. Soil Series: Kevin cl
Irrigation date: July 10 W-1=0.20"; W-2=0.72"; W-3=0.92"
July 19 W-1=0.12"; W-2=1.14"; W-3=1.53"
Soil Test: pH=8.0; O.M.=1.6 %; P = 20 ppm; K = 225 ppm

Depth in	NO_3-N lb N/ac	Depth in	SO_4-S ppm
0-12	16	0-6	40
12-24	12	6-12	10
24-36	6		
36-48	10		
48-60	40		

Table 37. Effect of nitrogen and irrigation rate on no-till spring barley - soil nitrate content. Western Triangle Ag Research Center, Conrad, MT. 1991.

	soil depth				
Treatment	0-1'	0-2'	0-3'	0-4'	0-5'
	lbs N/A				
		Dryland			
0	9.6	16.0	22.4	30.4	29.6
50	8.0	14.0	21.0	29.0	26.0
100	10.4	19.2	27.2	36.0	48.0
150	8.0	13.0	18.0	27.5	38.5
p-value	0.88	0.70	0.69	0.85	0.30
LSD (0.05)	NS	NS	NS	NS	NS
CV (%)	53.7	50.8	49.2	45.8	51.6
		W - 1			
0	8.0	12.0	16.0	21.3	32.0
50	4.0	10.0	14.0	18.0	27.0
100	6.4	10.4	14.4	19.2	25.6
150	8.7	12.7	16.7	18.0	27.0
p-value	0.14	0.66	0.66	0.64	0.43
LSD (0.05)	NS	NS	NS	NS	NS
CV (%)	44.8	31.5	23.2	21.2	21.4
		W - 2			
0	9.0	13.0	17.0	24.0	34.0
50	6.0	10.0	14.0	22.0	34.0
100	4.0	8.0	12.0	17.3	21.3
150	10.4	14.4	19.2	25.6	62.4
p-value	0.08	0.08	0.08	0.30	0.45
CV (%)	43.7	28.3	23.1	25.7	93.1
		W - 3			
0	6.7	10.7	14.7	18.7	24.0
50	6.0	10.0	14.0	18.7	24.0
100	4.8	9.6	13.6	19.2	26.4
150	5.3	10.0	14.0	19.3	26.7
p-value	0.83	0.99	0.99	0.97	0.94
CV (%)	45.2	30.7	22.0	19.1	21.9

Growing season ppt: = 11.2"; W-1 = 11.62"; W-2 = 13.06"; W-3 = 13.65". Seeding date: April 23, 1991. Variety: 'Harrington'
Previous crop: Barley (3500 lbs residue)
Harvest date: August 12, 1991. Soil Series: Kevin cl
Irrigation date: July 10 W-1=0.20"; W-2=0.72"; W-3=0.92"
July 19 W-1=0.12"; W-2=1.14"; W-3=1.53"
Soil Test: pH=8.0; O.M.=1.6 %; P = 20 ppm; K = 225 ppm

Depth in	NO_3-N lb N/ac	Depth in	SO_4-S ppm
0-12	16	0-6	40
12-24	12	6-12	10
24-36	6		
36-48	10		
48-60	40		