

PROJECT TITLE: Small Grain Variety Testing Under Continuous Cropping Conditions

PROJECT LEADER: Jerald W. Bergman, Superintendent, MSU, Eastern Agricultural Research Center

OBJECTIVES: To determine which varieties of spring wheat, barley, and oats are most adapted for production under continuous cropping conditions

MATERIALS AND METHODS: The experiments reported under this project are of the small plot replicated nursery type. The crop rotation order is spring wheat, small grain nursery plots, and safflower. A herbicide combination of bromoxynil at 4.0 oz/acre + MCP ester at 4.0 oz/acre is applied to spring wheat and the nursery plots for broadleaf weed control. Treflan or Sonolan herbicide is applied preplant and incorporated prior to safflower planting. The use of this crop rotation and these chemical weed control herbicides has been very effective in controlling weeds in the nursery plots. However, volunteer spring wheat has been a problem in the nursery plots, especially during drier seasons.

The experimental site was not fertilized in 1989 as soil tests showed no need for additional fertilizer. Two tool bar with harrow operations were used to incorporate the stubble and prepare the seedbed for planting. The small grain nursery plot area was also rolled with a Western land roller to firm the seedbed. The small grain nurseries were planted on May 1st.

Total moisture received during the crop year (September 1, 1988 thru August 1989) was 12.24 inches. Moisture received and mean temperatures during the growing season months were as follows:

May	-	1.98 inches,	56.1°F
June	-	0.97 "	65.2°F
July	-	0.90 "	75.6°F
August	-	1.32 "	70.8°F

SUMMARY OF CROP CONDITIONS: Winter precipitation was slightly above normal. Coupled with 1.74 inches of precipitation received in September 1988, the recrop potential improved for 1989 compared to the extreme drought year of 1988. Still the stored soil moisture depth in this experimental site just prior to planting was only 18 inches. May precipitation was normal and the crop nurseries were in excellent condition until early June. June precipitation was only 0.97 inches compared to the long term average of 2.76 inches and severe stress occurred on the small grain crops. July precipitation was also much below normal with much above normal temperatures. As a result, small grain harvest was very early with reduced yields and test weights but high seed proteins. Crop diseases were minimal and insects were not a problem in these nurseries.

**EXPERIMENTAL RESULTS:** Results obtained in 1989 for these nursery type experiments are reported in Table 1 (spring wheat), Table 6 (durum), Table 11 (barley), and Table 16 (oats).

The continuous crop small grain yields averaged 7.3 bushels per acre for spring wheat, 4.6 bushels for spring durum, 25.1 bushels per acre for barley, and 22.0 bushels per acre for oats. As shown in Table 1, only Grandin, NK 751, and Gus produced a significantly higher yield than Newana. Test weights and plant heights were also drastically lowered by the drought and heat stress.

Long term spring wheat summaries for yield, test weight, plant height, and protein content are presented in Tables 2-5, respectively. The highest yielding bread wheat entry under continuous cropping under at least three years of testing is Glenman, although this variety tends to be low in test weight. The bread wheats generally tend to outyield durum wheats when grown under continuous cropping conditions. Conversely, the durum wheats tend to produce higher test weights and protein than the bread wheats under these continuous cropped conditions (long term durum summaries are presented in Tables 6-10). Among the bread wheats, Newana has produced the highest test weight.

As expected, the standard height bread wheat and durum varieties have produced the most favorable height under continuous cropping conditions. The semi-dwarf varieties are usually 3-8 inches shorter in plant height than the standard height varieties under these cropping conditions. The semi-dwarf durum varieties, Cando, Lloyd, and Calvin, have produced the shortest straw on continuous cropping. Rambo and NK 751 have produced shorter straw than other semi-dwarf spring wheat varieties.

Bread wheat varieties having the most favorable protein contents have been the standard height varieties such as Alex, Stoa, Lew, Pondera, and Fortuna. Generally, the protein content of all the bread wheat and durum varieties grown on continuous cropping is higher than the same varieties grown on fallow.

The highest yielding barley varieties have been Bowman, a two-row North Dakota variety, and the six-row early maturing Minnesota varieties, Robust and Morex. The variety with the highest test weight is Bowman followed by Lewis and Gallatin. The protein content of the varieties range from 12.7% for Steptoe to 18.2% for Pirolina for varieties tested at least three years as shown in Table 15. A long term barley summary for yield is given in Table 12.

Results obtained in the continuous cropping oats nursery in 1989 are presented in Table 16. The highest yielding commercial varieties were Ogle, Appaloosa, Cayuse, and Otana. Among these varieties, Otana produces the highest test weight and has been a consistently high yielder as shown in the long term oat summary for yield given in Table 16. As such, Otana remains the preferred variety for recrop oat production. Long term summary tables for oats are presented in Tables 17-20.

**FUTURE PLANS:** Little information is available on the variety performance of spring wheat, durum, barley, and oat varieties grown under recropping conditions. The results of these small grain variety nurseries have provided eastern Montana growers with valuable information on varietal performance of spring wheat, durum, barley, and oat varieties on recropping. The plans are to continue the project in 1990.

Table 1 Agronomic data obtained from a dryland spring wheat variety nursery conducted under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana, 1989.

Date Seeded: May 1, 1989      Date Harvested: July 28, 1989      Size of Plot: 72 Sq. Ft. 1/2

C.I. or Sel. No.	Variety	Average Heading Date <sup>2/</sup>	Average Height Inches	Average Protein Content Percent	Average Test Weight Lbs/Bu	Average Yield Bu/Acre
ND 626	GRANDIN	174.6	19.3	19.6	55.8	11.2 <sup>aaa</sup>
NK 751	NK 751	174.0	15.6	20.6	53.5	10.9 <sup>aaa</sup>
ND 618	GUS	176.0	15.0	20.5	55.6	9.2 <sup>a</sup>
CI 17790	LEN	174.0	15.0	20.5	54.4	8.8
CI 17904	OWENS	175.0	15.3	18.2	59.0	8.6
ND 606	AMIDON	175.0	16.3	19.0	58.5	8.0
WPB 906R	WESTBRED 906R	173.3	15.3	20.1	56.6	7.6
MT 8402	MT7336/SHORTANA	175.3	15.0	20.0	57.4	7.6
WA 6920	PENAWAWA	176.3	14.3	18.1	57.7	7.4
CI 17828	PONDERA	175.0	15.6	20.4	58.4	7.3
CI 13596	FORTUNA	175.3	15.6	18.9	58.3	7.2
PI483235	GLENMAN	176.6	15.0	19.7	55.3	6.8
ND 582	STOA	176.0	15.0	19.4	57.8	6.7
CANLANC	LANCER	176.6	14.6	19.0	58.9	6.5
CI 15930	OLAF	176.6	13.0	19.0	58.1	6.4
CI 17910	ALEX	177.0	14.3	19.9	58.8	6.2
CI 17430	NEWANA	176.6	14.6	18.6	59.1	6.2
NDCUT	CUTLESS	175.6	13.6	20.0	57.1	5.8
CI 17429	LEW	176.3	16.3	19.9	57.2	5.5
MT 8182	YDING "S"/PCI "S"-28	176.0	16.0	21.0	54.7	5.2
CI 17920	MARSHALL	176.0	13.0	19.3	54.8	5.2
C982-324	RAMBO	177.0	12.0	18.5	57.4	4.1

(Continued)

Table 1 Agronomic data obtained from a dryland spring wheat variety nursery conducted under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana, 1989. (Continued)

Date Seeded: May 1, 1989      Date Harvested: July 28, 1989      Size of Plot: 72 Sq. Ft.<sup>1</sup>

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Mean grain yield for experiment = 7.25 bushels per acre  
F-Value for variety comparisons = 2.55 (Significant at .10, .05, and .01)  
S.E.x. = 1.11 bushels per acre  
L.S.D. at .10 = 2.63 bushels per acre  
L.S.D. at .05 = 3.16 bushels per acre  
L.S.D. at .01 = 4.23 bushels per acre  
C.V. (SE/Mean) = 15.27%  
C.V. (S/Mean) = 26.45%

<sup>1/</sup> 4 row plots, rows 18 feet long and 1.0 foot apart. At harvest, two 16 foot rows were harvested from the two center rows for yield, test weight, and protein determinations.

<sup>2/</sup> Heading dates are in Julian days (number of days from January 1). 173 = June 22.

<sup>a</sup> Indicates a significantly higher yield than the check variety at the .10 level of significance.

<sup>aaa</sup> Indicates a significantly higher yield than the check variety at the .01 level of significance.

NOTE: Newana is considered to be the check variety for this nursery with an average yield of 6.2 bushels per acre.

Previous crop: Spring wheat

Soil type: Williams Clay Loam

Fertilizer: No fertilizer was applied to this nursery due to residual fertilizer left from previous applications.

Herbicide: 1.0 pint per acre Bronate applied June 3, 1989.

Insecticide: None.

Precipitation for average crop year = 13.49 inches. Precipitation for 1989 crop year = 12.24 inches. Crop year considered to be from September 1, 1988, through harvest, 1989.

Precipitation for April 1 - July 31 period during 1989 = 6.50 inches. Average precipitation for same period = 7.69 inches.

Table <sup>2</sup> Relative yielding ability of spring wheat varieties as compared to Newana when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Yield Bu/Acre	Yield in % of Newana Same Trials
		1984	1985	1986	1987	1989		
Gus	1	--	--	--	--	9.2	9.2	148.4
Westbred 906R	1	--	--	--	--	7.7	7.7	124.2
MT 8402	1	--	--	--	--	7.6	7.6	122.6
Westbred Rambo	2	--	--	--	28.2	4.1	16.2	119.6
Glenman	5	5.9	7.7	39.7	24.4	6.8	16.9	114.7
Grandin	2	--	--	--	17.7	11.2	14.5	107.0
Stoa	5	4.5	3.1	42.2	21.0	6.7	15.5	105.2
Lew	5	5.1	2.8	39.0	23.3	5.6	15.2	102.8
Newana	5	7.3	2.7	36.7	20.8	6.2	14.7	100.0
Alex	4	--	2.7	38.5	18.9	6.3	16.6	100.0
Owens	5	5.1	2.5	37.1	19.6	8.7	14.6	99.1
Lancer	2	--	--	--	20.1	6.6	13.4	98.9
NK 751	3	--	--	29.9	20.9	11.0	20.6	97.0
Cutless	1	--	--	--	--	5.8	5.8	93.5
Amidon	2	--	--	--	17.2	8.0	12.6	93.3
Len	3	--	--	29.8	20.1	8.8	19.6	92.2
Olaf	2	6.0	--	--	--	6.4	6.2	91.9
Pondera	5	4.9	2.6	31.9	20.5	7.3	13.4	91.2
Marshall	4	7.2	--	35.0	15.4	5.2	15.7	88.5
MT 8182	1	--	--	--	--	5.3	5.3	85.5
Fortuna	5	5.6	3.1	35.2	10.3	7.3	12.3	83.4

NOTE: Varieties in this summary should not be compared to each other since they are not grown in the same years at the same locations. Compare yield only to the check variety Newana.

NOTE: No recrop nurseries were grown in 1988.

Table 3 Relative test weights of spring wheat varieties as compared to Newana when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Test Wt. Lbs/Bu	Test Wt. in % of Newana Same Trials
		1984	1985	1986	1987	1989		
Olaf	2	53.3	--	--	--	58.1	55.7	100.5
Newana	5	51.7	58.7	62.5	62.5	59.1	58.9	100.0
Alex	4	--	57.4	63.0	62.0	58.8	60.3	99.3
Lancer	2	--	--	--	61.5	58.9	60.2	99.0
Lew	5	52.8	56.6	63.0	61.0	57.2	58.1	98.7
Amidon	2	--	--	--	61.5	58.5	60.0	98.7
Westbred Rambo	2	--	--	--	62.5	57.4	60.0	98.6
Pondera	5	53.3	54.6	62.5	61.5	58.4	58.1	98.6
Fortuna	5	52.6	55.6	62.0	60.6	58.3	57.8	98.2
Grandin	2	--	--	--	63.5	55.8	59.7	98.1
Stoa	5	52.5	54.6	62.0	61.5	57.8	57.7	97.9
Marshall	4	52.1	--	62.0	61.5	54.8	57.6	97.7
MT 8402	1	--	--	--	--	57.4	57.4	97.1
Owens	5	51.3	53.3	60.5	61.0	59.0	57.0	96.8
Cutless	1	--	--	--	--	57.1	57.1	96.6
Westbred 906R	1	--	--	--	--	56.6	56.6	95.8
Glenman	5	51.9	53.4	61.0	60.0	55.3	56.3	95.6
Len	3	--	--	60.0	60.5	54.4	58.3	95.0
NK 751	3	--	--	60.0	61.0	53.5	58.2	94.8
Gus	1	--	--	--	--	55.6	55.6	94.1
MT 8182	1	--	--	--	--	54.7	54.7	92.6

NOTE: Varieties in this summary should not be compared to each other since they are not grown in the same years at the same locations. Compare test weights only to the check variety Newana.

NOTE: No recrop nurseries were grown in 1988.

Table 4 Relative heights (inches) of spring wheat varieties as compared to Newana when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Height Inches	Height in % of Newana Same Trials
		1984	1985	1986	1987	1989		
Grandin	2	--	--	--	20	19	19.5	111.4
Lancer	2	--	--	--	24	15	19.5	111.4
Fortuna	5	24	16	27	20	16	20.6	108.4
Alex	4	--	17	29	21	14	20.3	108.0
MT 8182	1	--	--	--	--	16	16.0	106.7
Lew	5	21	15	25	24	16	20.2	106.3
Glenman	5	22	15	25	21	15	19.6	103.2
Amidon	2	--	--	--	20	16	18.0	102.9
Newana	5	20	15	25	20	15	19.0	100.0
Olaf	2	22	--	--	--	13	17.5	100.0
Stoa	5	18	15	26	21	15	19.0	100.0
Westbred 906R	1	--	--	--	--	15	15.0	100.0
Gus	1	--	--	--	--	15	15.0	100.0
MT 8402	1	--	--	--	--	15	15.0	100.0
Pondera	5	20	15	23	18	16	18.4	96.8
Len	3	--	--	24	19	15	19.3	96.7
Cutless	1	--	--	--	--	14	14.0	93.3
Marshall	4	20	--	24	18	13	18.3	91.7
Owens	5	17	14	22	19	15	17.4	91.6
NK 751	3	--	--	19	15	16	16.7	83.3
Westbred Rambo	2	--	--	--	17	12	14.5	82.9

NOTE: Varieties in this summary should not be compared to each other since they are not grown in the same years at the same locations. Compare heights only to the check variety Newana.

NOTE: No recrop nurseries were grown in 1988.

Table 5 Relative protein contents of spring wheat varieties as compared to Newana when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Protein Content Percent	Protein in % of Newana Same Trials
		1984	1985	1986	1987	1989		
MT 8182	1	--	--	--	--	21.1	21.1	113.4
Gus	1	--	--	--	--	20.5	20.5	110.2
Westbred 906R	1	--	--	--	--	20.2	20.2	108.6
MT 8402	1	--	--	--	--	20.1	20.1	108.1
Cutless	1	--	--	--	--	20.0	20.0	107.5
Alex	4	--	19.5	15.2	18.3	19.9	18.2	106.7
Pondera	5	19.7	19.5	14.4	17.6	20.4	18.3	106.4
Stoa	5	19.9	19.0	15.6	17.6	19.4	18.3	106.3
Olaf	2	19.2	--	--	--	19.0	19.1	106.1
Lew	5	20.6	19.5	14.9	16.3	20.0	18.3	106.0
Fortuna	5	18.9	18.2	16.1	18.2	18.9	18.1	104.9
Marshall	4	18.8	--	14.4	17.8	19.4	17.6	103.8
Amidon	2	--	--	--	18.3	19.0	18.7	103.6
Grandin	2	--	--	--	17.6	19.7	18.7	103.6
Len	3	--	--	13.7	17.2	20.5	17.1	102.8
NK 751	3	--	--	14.0	16.5	20.7	17.1	102.4
Lancer	2	--	--	--	17.4	19.0	18.2	101.1
Glenman	5	19.3	18.4	13.6	15.9	19.7	17.4	100.9
Newana	5	17.8	18.3	14.0	17.4	18.6	17.2	100.0
Westbred Rambo	2	--	--	--	17.2	18.5	17.9	99.2
Owens	5	17.3	17.1	12.7	16.4	18.2	16.3	94.9

NOTE: Varieties in this summary should not be compared to each other since they are not grown in the same years at the same locations. Compare protein contents only to the check variety Newana.

NOTE: No recrop nurseries were grown in 1988.

Table 6 Agronomic data obtained from a dryland spring durum variety nursery conducted under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana, 1989.

Date Seeded: May 1, 1989 Date Harvested: July 28, 1989 Size of Plot: 72 Sq. Ft.<sup>1/</sup>

C.I. or Sel. No.	Variety	Average Heading Date <sup>2/</sup>	Average Height Inches	Average Protein Content Percent	Average Test Weight Lbs/Bu	Average Yield Bu/Acre
PI478289	MONROE	173.6	15.6	21.3	57.1	6.4 <sup>aa</sup>
CI 17282	CROSBY	175.6	17.3	21.5	56.6	6.1 <sup>a</sup>
PI 15326	ROLETTE	172.3	17.6	21.1	59.3	5.7
DT 380	SCEPTRE	176.3	15.3	21.6	57.3	5.3
CI 17789	VIC	176.0	16.3	20.1	58.4	5.2
PI476211	LLOYD	177.0	14.0	20.4	56.5	5.0
STOCK000	STOCKHOLM	175.0	13.6	20.2	57.9	4.4
PI 15892	WARD	175.6	16.6	20.8	57.0	4.3
DT 433	MEDORA	175.3	17.6	20.9	54.7	3.9
PI510696	RENVILLE	175.6	14.6	22.1	54.7	3.6
WPBLAKER	LAKER	176.6	16.0	20.0	56.7	3.5
CI 17438	CANDO	177.0	11.3	19.6	--	.8 <sup>xxx</sup>

Mean grain yield for experiment = 4.56 bushels per acre

F-Value for variety comparisons = 5.49 (Significant at .10, .05, and .01)

S.E.x. = 0.64 bushels per acre

L.S.D. at .10 = 1.55 bushels per acre

L.S.D. at .05 = 1.88 bushels per acre

L.S.D. at .01 = 2.55 bushels per acre

C.V. (SE/Mean) = 14.02%

C.V. (S/Mean) = 24.28%

<sup>1/</sup> 4 row plots, rows 18 feet long and 1.0 foot apart. At harvest, two 16 foot rows were harvested from the two center rows for yield, test weight, and protein determinations.

<sup>2/</sup> Heading dates are in Julian days (number of days from January 1). 173 = June 22.

(Continued)

Table 6 Agronomic data obtained from a dryland spring durum variety nursery conducted under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana, 1989. (Continued)

Date Seeded: May 1, 1989 Date Harvested: July 28, 1989 Size of Plot: 72 Sq. Ft. 1/2

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NOTE: Ward is considered to be the check variety for this nursery with an average yield of 4.4 bushels per acre.

- ^^ Indicates a significantly higher yield than the check variety at the .05 level of significance.
- ^ Indicates a significantly higher yield than the check variety at the .10 level of significance.
- \*\*\* Indicates a significantly lower yield than the check variety at the .01 level of significance.

Previous crop: Spring wheat

Soil type: Williams Clay Loam

Fertilizer: No fertilizer was applied to this nursery due to residual fertilizer left from previous applications.

Herbicide: 1.0 pint per acre Bronate applied June 3, 1989.

Insecticide: None.

Precipitation for average crop year = 13.49 inches. Precipitation for 1989 crop year = 12.24 inches. Crop year considered to be from September 1, 1988, through harvest, 1989.

Precipitation for April 1 - July 31 period during 1989 = 6.50 inches. Average precipitation for same period = 7.69 inches.

Table 7 Relative yielding ability of spring durum varieties as compared to Ward when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Yield Bu/Acre	Yield in % of Ward Same Trials
		1983	1984	1985	1987	1989		
Westbred Laker	2	--	--	--	35.6	3.5	19.6	132.1
Fjord	1	--	--	--	32.0	--	32.0	127.0
Sceptre	2	--	--	--	28.2	5.4	16.8	113.5
Vic	4	28.7	6.0	--	28.8	5.2	17.2	111.5
Lloyd	5	29.4	5.4	3.2	23.2	5.0	13.2	102.8
Ward	5	26.2	6.6	2.8	25.2	4.4	12.9	100.0
Crosby	3	28.1	--	--	19.7	6.2	18.0	96.8
Monroe	2	--	--	--	20.4	6.5	13.5	90.9
Renville	1	--	--	--	--	3.7	3.7	84.1
Stockholm	2	--	--	--	20.3	4.4	12.4	83.4
Medora	2	--	--	--	18.8	4.0	11.4	77.0
Cando	5	30.1	4.4	2.3	9.3	0.9	9.4	73.0
Rolette	2	--	--	--	10.0	5.7	7.9	53.0

NOTE: Varieties in this nursery should not be compared to each other since they are not grown in the same years at the same locations. Compare yields only to the check variety Ward.

NOTE: Recrop nurseries were not grown in 1986 and were not harvested 1988.

Table 8 Relative test weights of spring durum varieties as compared to Ward when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Test Wt. Lbs/Bu	Test Wt. in % of Ward Same Trials
		1983	1984	1985	1987	1989		
Vic	4	61.0	57.3	--	63.6	58.4	60.1	102.5
Stockholm	2	--	--	--	63.3	57.9	60.6	101.2
Rolette	2	--	--	--	61.4	59.3	60.4	100.8
Sceptre	2	--	--	--	62.7	57.3	60.0	100.2
Ward	5	60.0	54.7	56.9	62.8	57.0	58.3	100.0
Crosby	3	60.5	--	--	62.5	56.6	59.9	99.9
Westbred Laker	2	--	--	--	62.5	56.7	59.6	99.5
Fjord	1	--	--	--	62.5	--	62.5	99.5
Cando	4	59.0	54.5	56.3	63.0	--	58.2	99.3
Monroe	2	--	--	--	61.5	57.1	59.3	99.0
Lloyd	5	59.5	51.7	55.7	62.2	56.5	57.1	98.0
Medora	2	--	--	--	62.4	54.7	58.6	97.7
Renville	1	--	--	--	--	54.7	54.7	96.0

NOTE: Varieties in this nursery should not be compared to each other since they are not grown in the same years at the same locations. Compare test weights only to the check variety Ward.

NOTE: Recrop nurseries were not grown in 1986 and were not harvested 1988.

Table 9 Relative heights (inches) of spring durum varieties as compared to Ward when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1983 - 1989 period.

Variety	Number of Years	Year Grown					Average Height Inches	Height in % of Ward Same Trials
		1983	1983	1984	1987	1989		
Medora	2	--	--	--	20	18	19.0	102.7
Ward	5	27	21	17	20	17	20.4	100.0
Fjord	1	--	--	--	20	--	20.0	100.0
Rolette	2	--	--	--	19	18	18.5	100.0
Vic	4	28	21	--	19	16	21.0	98.8
Crosby	3	27	--	--	19	17	21.0	98.4
Westbred Laker	2	--	--	--	20	16	18.0	97.3
Monroe	2	--	--	--	18	16	17.0	92.0
Sceptre	2	--	--	--	18	15	16.5	89.2
Renville	1	--	--	--	--	15	15.0	88.2
Stockholm	2	--	--	--	17	14	15.5	83.8
Cando	5	24	18	13	17	11	16.6	81.4
Lloyd	5	21	18	13	16	14	16.4	80.4

NOTE: Varieties in this nursery should not be compared to each other since they are not grown in the same years at the same locations. Compare heights only to the check variety Ward.

NOTE: Recrop nurseries were not grown in 1986 and were not harvested 1988.

Table 10 Relative protein content of spring durum varieties as compared to Ward when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1983 - 1989 period.

Variety	Number of Years	Year Grown					Average Protein Content Percent	Protein in % of Ward Same Trials
		1983	1983	1984	1987	1989		
Renville	1	--	--	--	--	22.1	22.1	106.3
Sceptre	2	--	--	--	21.0	21.6	21.3	103.9
Cando	5	17.6	21.5	20.6	20.4	19.6	19.9	102.4
Medora	2	--	--	--	20.8	20.9	20.9	101.7
Rolette	2	--	--	--	20.5	21.1	20.8	101.5
Lloyd	5	17.1	21.4	20.6	19.4	20.4	19.8	101.5
Crosby	3	17.1	--	--	19.7	21.6	19.5	101.0
Ward	5	16.8	20.0	19.6	20.2	20.8	19.5	100.0
Vic	4	16.1	21.3	--	19.7	20.1	19.3	99.2
Monroe	2	--	--	--	19.1	21.3	20.2	98.5
Fjord	1	--	--	--	19.7	--	19.7	97.5
Stockholm	2	--	--	--	19.2	20.2	19.7	96.1
Westbred Laker	2	--	--	--	17.6	20.0	18.8	91.7

NOTE: Varieties in this nursery should not be compared to each other since they are not grown in the same years at the same locations. Compare protein contents only to the check variety Ward.

NOTE: Recrop nurseries were not grown in 1986 and were not harvested 1988.

Table 11: Agronomic data obtained from a dryland spring barley nursery conducted under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana, 1989.

Date Seeded: May 1, 1989      Date Harvested: July 28, 1989      Size of Plot: 72 Sq. Ft.<sup>1/</sup>

C.I. or Sel. No.	Variety	Average Heading Date <sup>2/</sup>	Average Height Inches	Average Plump Kernels Percent	Average Protein Content Percent	Average Test Weight Lbs/Bu	Average Yield Bu/Acre
CI 15229	Steptoe	173.3	19.0	5.0	14.2	39.0	24.2 <sup>aa</sup>
PI483237	Bowman	177.3	19.0	6.0	17.6	48.0	20.8
CI 15514	Hector	179.6	19.6	1.0	20.0	45.5	20.2
MT 81161	Lewis//Kgs/Smt	180.0	17.3	1.0	20.2	43.0	19.4
MT140523	Hector/Klages	181.0	15.6	1.0	20.5	44.5	19.0
CI 15856	Lewis	179.3	17.0	2.0	20.4	47.5	18.3
CI 15857	Clark	180.0	16.6	1.0	20.5	44.0	17.9
PI491534	Gallatin	178.3	17.0	1.0	20.5	46.0	17.8
CI 9558	Piroline	177.6	17.0	---	20.6	43.0	17.2 <sup>x</sup>
BA 1202	Busch Agr 1202	183.0	14.0	1.0	22.2	44.0	9.3 <sup>xxx</sup>
MT 81616	TR440/Clark	183.6	14.6	1.0	21.4	45.5	8.7 <sup>xxx</sup>
SK 76333	Harrington	179.3	15.0	2.0	20.4	45.2	7.5 <sup>xxx</sup>

Mean grain yield for experiment = 16.7 bushels per acre  
 F-Value for variety comparisons = 18.18 (Significant at .10, .05, and .01)  
 S.E.x. = 1.24 bushels per acre  
 L.S.D. at .10 = 3.00 bushels per acre  
 L.S.D. at .05 = 3.62 bushels per acre  
 L.S.D. at .01 = 4.92 bushels per acre  
 C.V. (SE/Mean) = 7.40%  
 C.V. (S/Mean) = 12.82%

<sup>1/</sup> 4 row plots, rows 18 feet long and 1.0 foot apart. At harvest, two 16 foot rows were harvested from the two center rows for yield, test weight, and protein determinations.

<sup>2/</sup> Heading dates are in Julian days (number of days from January 1). 173 = June 22.  
 (Continued)

Table 11 Agronomic data obtained from a dryland spring barley nursery conducted under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana, 1989.  
(Continued)

Date Seeded: May 1, 1989      Date Harvested: July 28, 1989      Size of Plot: 72 Sq. Ft. 1/

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NOTE: Hector is considered to be the check variety for this nursery with an average yield of 30.2 bushels per acre.

^^ Indicates a significantly higher yield than the check variety at the .05 level of significance.

\*\*\* Indicates a significantly lower yield than the check variety at the .01 level of significance.

Previous crop: Spring wheat

Soil type: Williams Clay Loam

Fertilizer: No fertilizer was applied to this nursery due to residual fertilizer left from previous applications.

Herbicide: 1.0 pint per acre Bronate applied June 3, 1989.

Insecticide: None.

Precipitation for average crop year = 13.49 inches. Precipitation for 1989 crop year = 12.24 inches.  
Crop year considered to be from September 1, 1988, through harvest, 1989.

Precipitation for April 1 - July 31 period during 1989 = 6.50 inches. Average precipitation for same period = 7.69 inches.

Table 12 Relative yielding ability of spring barley varieties as compared to Hector when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Yield Bu/Acre	Yield in % of Hector Same Trials
		1984	1985	1986	1987	1989		
Robust	3	24.9	15.3	61.9	--	--	34.0	128.1
Morex	2	--	12.4	69.5	--	--	41.0	120.4
Step toe	4	--	9.7	62.7	27.2	24.2	31.0	104.6
Bowman	5	24.5	6.2	57.7	25.3	20.8	26.9	103.4
Hazen	4	17.8	7.1	68.0	20.4	--	28.3	103.1
Hector	5	11.7	6.8	61.2	30.2	20.2	26.0	100.0
Gallatin	5	14.8	9.9	53.9	27.0	17.8	24.7	94.9
MT 140523	1	--	--	--	--	19.0	19.0	94.1
Clark	5	15.3	10.9	53.9	23.0	17.9	24.2	93.0
Lewis	5	13.9	10.3	55.3	20.8	18.3	23.7	91.2
Piroline	5	17.0	8.2	50.6	23.5	17.2	23.3	89.5
MT 81161	2	--	--	--	24.5	19.4	22.0	87.1
Harrington	5	13.3	5.3	60.4	21.3	7.5	21.6	82.9
Bearpaw	2	--	--	--	23.1	8.7	15.9	63.1
BA 1202	1	--	--	--	--	9.3	9.3	46.0

NOTE: Varieties in this summary should not be compared to each other since they are not grown in the same years at the same locations. Compare yields only to the check variety Hector.

NOTE: Recrop nurseries were not harvested in 1988.

Table 13 Relative test weights of spring barley varieties as compared to Hector when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Test Wt. Lbs/Bu	Test Wt. in % of Hector Same Trials
		1984	1985	1986	1987	1989		
Bowman	5	44.3	42.9	53.0	42.0	48.0	48.0	104.7
Lewis	5	38.5	43.1	51.5	51.5	47.5	46.4	101.2
Gallatin	5	39.2	42.1	51.5	52.0	46.0	46.2	100.6
Hector	5	38.1	41.8	52.5	51.5	45.5	45.9	100.0
Clark	5	38.5	41.3	50.5	50.5	44.0	45.0	98.0
Harrington	5	38.7	40.5	50.5	50.0	45.2	45.0	98.0
Piroline	5	39.4	40.8	51.0	50.5	43.0	44.9	98.0
Bearpaw	2	--	--	--	49.5	45.5	47.5	97.9
MT 140523	1	--	--	--	--	44.5	44.5	97.8
BA 1202	1	--	--	--	--	44.0	44.0	96.7
MT 81161	2	--	--	--	49.0	43.0	46.0	94.3
Robust	3	35.1	37.2	53.0	--	--	41.8	94.6
Steptoe	4	--	33.8	47.5	48.5	39.0	44.6	93.2
Morex	2	--	35.3	50.5	--	--	42.9	91.0
Hazen	4	32.4	35.0	51.0	47.5	--	41.5	90.2

NOTE: Varieties in this summary should not be compared to each other since they are not grown in the same years at the same locations. Compare test weights only to the check variety Hector.

NOTE: Recrop nurseries were not harvested in 1988.

Table 14 Relative heights (inches) of spring barley varieties as compared to Hector when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Height Inches	Height in % of Hector Same Trials
		1984	1985	1986	1987	1989		
Hector	5	32	13	25	18	20	21.6	100.0
Morex	2	--	13	25	--	--	19.0	100.0
MT 81161	2	--	--	--	16	17	16.5	86.8
Steptoe	4	--	13	19	15	19	16.5	86.8
Lewis	5	20	14	23	17	17	18.2	84.3
Gallatin	5	19	13	24	18	17	18.2	84.3
Bearpaw	2	--	--	--	17	15	16.0	84.2
Hazen	4	21	11	24	18	--	18.5	84.1
Piroline	5	20	12	24	17	17	18.0	83.3
Clark	5	21	13	23	16	17	18.0	83.3
Bowman	5	20	7	24	17	19	17.4	80.6
MT 140523	1	--	--	--	--	16	16.0	80.0
Robust	3	18	13	23	--	--	18.0	77.1
Harrington	5	18	8	23	15	15	15.8	73.1
BA 1202	1	--	--	--	--	14	14.0	70.0

NOTE: Varieties in this summary should not be compared to each other since they are not grown in the same years at the same locations. Compare heights only to the check variety Hector.

NOTE: Recrop nurseries were not harvested in 1988.

Table 15

Relative protein contents of spring barley varieties as compared to Hector when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Protein Content Percent	Protein in % of Hector Same Trials
		1984	1985	1986	1987	1989		
BA 1202	1	--	--	--	--	22.2	22.2	110.4
Pirolina	5	20.5	19.5	13.0	17.3	20.6	18.2	106.7
Bearpaw	2	--	--	--	15.8	21.4	18.6	105.7
Lewis	5	20.9	19.2	12.6	16.1	20.4	17.8	104.7
Gallatin	5	19.7	19.1	13.3	16.1	20.5	17.7	104.1
MT 140523	1	--	--	--	--	20.6	20.6	102.5
Harrington	5	18.7	18.9	12.7	16.1	20.5	17.4	102.0
MT 81161	2	--	--	--	15.4	20.3	17.9	101.4
Hector	5	18.7	18.9	12.4	15.1	20.1	17.0	100.0
Clark	5	19.6	16.1	12.3	16.1	20.5	16.9	99.3
Hazen	4	18.5	16.2	13.1	15.2	--	15.8	96.8
Robust	3	18.3	16.4	13.4	--	--	16.0	96.2
Morex	2	--	16.3	13.1	--	--	14.7	93.9
Bowman	5	16.8	16.1	12.1	14.4	17.6	15.4	90.4
Stephoe	4	--	13.1	11.1	12.5	14.2	12.7	76.5

NOTE: Varieties in this summary should not be compared to each other since they are not grown in the same years at the same locations. Compare proteins only to the check variety Hector.

NOTE: Recrop nurseries were not harvested in 1988.

Table 16 Agronomic data obtained from a dryland spring oat variety nursery conducted under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana, 1989.

Date Seeded: May 1, 1989      Date Harvested: July 28, 1989      Size of Plot: 72 Sq. Ft. 1/

C.I. or Sel. No.	Variety	Average Heading Date <sup>2/</sup>	Average Height Inches	Average Protein Content Percent	Average Test Weight Lbs/Bu	Average Yield Bu/Acre
ID815792	74Ab2608/Cayuse	174.6	16.3	15.8	29.0	29.8 <sup>aaa</sup>
CI 9401	Ogle	174.6	18.3	15.6	29.0	27.1
CI 9297	Appaloosa	177.3	17.0	15.9	24.5	26.2
NPB86586	Ogle/OT 3215 Sel. 85	175.3	12.6	15.6	26.5	26.2
CI 8263	Cayuse	175.3	16.3	15.4	24.5	25.7
CI 9252	Otana	177.0	19.6	15.4	28.0	24.7
SD810109	Trucker (Moore//Dal/	172.6	21.3	17.4	35.0	24.6
ID821178	74AB1952/75AB1576	176.0	14.0	15.8	31.5	24.5
ID804725	Cayuse/74/AB1956	176.6	13.6	15.6	28.5	24.4
NP871742	Ogle/OT 32-15, Sel.	177.6	13.3	16.4	28.5	24.3
NPB86575	Ogle/OT 32-15, Sel.	177.3	12.6	16.5	27.5	24.3
CI467882	Border	177.6	16.3	15.5	24.0	23.6
ID821142	74ab1952/74ab2608	176.6	13.0	16.0	29.0	23.5
83AB3725	74Ab1952/74Ab2608	177.6	15.0	16.3	29.0	23.5
ID805807	74AB2608/Cayuse	176.6	16.0	15.8	27.0	23.2
ID 75861	Cayuse/Otana	177.3	15.6	16.1	24.5	23.0
ID 82248	Cayuse/Monida	178.6	14.6	14.8	23.5	22.8
ND820603	Valley (Froker/RL 3038/2/Hud)	175.6	16.6	15.7	30.0	22.4
W 80474	Riel (RL 3057/Otana)	176.0	19.6	16.1	33.5	21.7 <sup>x</sup>
83AB3119	Cayuse/76Ab6843	178.6	14.3	16.5	26.5	21.6 <sup>x</sup>
CI483126	Monida (ID 751170)	177.3	17.3	14.5	25.5	21.5 <sup>x</sup>
W 82056	Robert (OT 212/RL 30)	176.0	18.0	15.4	26.5	19.9 <sup>xxx</sup>
83AB3250	Cayuse/Monida	178.3	14.6	14.5	20.0	18.9 <sup>xxx</sup>
NPB86801	Ogle/OT 32-15, Sel.	178.0	14.0	16.5	23.0	18.4 <sup>xxx</sup>
ID805322	Border74AB1956	179.0	14.3	15.8	24.0	18.1 <sup>xxx</sup>
ID 80988	74AB1952/74AB2608	177.6	13.0	15.5	24.5	16.7 <sup>xxx</sup>
CI 6611	Park	178.3	17.6	16.1	24.5	16.3 <sup>xxx</sup>
W 78286	Dumont	177.3	18.3	15.5	23.5	15.1 <sup>xxx</sup>
ID742608	Cayuse/Otana	179.0	14.3	14.7	21.0	14.6 <sup>xxx</sup>
OT 308	Calibre	178.3	19.3	13.8	21.0	11.0 <sup>xxx</sup>

(Continued)

Table 16 Agronomic data obtained from a dryland spring oat variety nursery conducted under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana, 1989. (Continued)

Date Seeded: May 1, 1989 Date Harvested: July 28, 1989 Size of Plot: 72 Sq. Ft.<sup>1/</sup>

Mean grain yield for experiment = 21.97 bushels per acre  
F-Value for variety comparisons = 12.40 (Significant at .10, .05 and .01)  
S.E.x = 1.19 bushels per acre  
L.S.D. at .10 = 2.86 bushels per acre  
L.S.D. at .05 = 3.45 bushels per acre  
L.S.D. at .01 = 4.64 bushels per acre  
C.V. (SE/Mean) = 5.43%  
C.V. (S/Mean) = 9.40%

<sup>1/</sup> 4 row plots, rows 18 feet long and 1.0 foot apart. At harvest, two 16 foot rows were harvested from the two center rows for yield, test weight, and protein determinations.  
<sup>2/</sup> Heading dates are in Julian days (number of days from January 1). 173 = June 22.

\*\*\* Indicates a significantly higher yield than the check variety at the .01 level of significance.  
\* Indicates a significantly lower yield than the check variety at the .10 level of significance.  
\*\* Indicates a significantly lower yield than the check variety at the .05 level of significance.

NOTE: Otana is considered to be the check variety for this nursery with an average yield of 24.8 bushels per acre.

Previous crop: Spring wheat Soil type: Williams Clay Loam

Fertilizer: No fertilizer was applied to this nursery due to residual fertilizer left from previous applications.

Herbicide: 1.0 pint per acre Bronate applied June 3, 1989.

Insecticide: None.

Precipitation for average crop year = 13.49 inches. Precipitation for 1989 crop year = 12.24 inches. Crop year considered to be from September 1, 1988, through harvest, 1989.

Precipitation for April 1 - July 31 period during 1989 = 6.50 inches. Average precipitation for same period = 7.69 inches.

Table 17 Relative yielding ability of spring oat varieties as compared to Otana when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Yield Bu/Acre	Yield in % of Otana Same Trials
		1984	1985	1986	1987	1989		
Otana	5	20.1	16.1	89.6	59.8	24.8	42.1	100.0
Trucker	1	--	--	--	--	24.7	24.7	99.6
Appaloosa	5	18.8	12.2	91.9	58.4	26.2	41.5	98.6
Cayuse	5	22.5	11.3	80.0	67.7	25.8	41.5	98.5
Monida	5	18.0	15.5	90.6	59.3	21.5	40.1	97.4
Random	2	--	--	88.4	55.3	--	71.9	96.2
Border	5	18.8	14.3	88.3	55.2	23.6	40.0	95.2
Cascade	4	17.8	16.7	85.8	55.1	--	43.9	94.5
Porter	2	--	--	82.2	54.9	--	68.6	91.8
Valley	3	--	--	79.2	53.9	22.4	51.8	89.3
Calibre	3	--	--	88.2	53.3	11.0	50.8	87.5
Dumont	3	--	--	83.6	50.0	15.1	49.6	85.4
Ogle	3	--	--	70.0	50.9	27.2	49.4	85.0
Park	5	13.6	12.5	78.1	54.6	16.3	35.0	83.2
Robert	1	--	--	--	--	19.9	19.9	80.2
Riel	3	--	--	74.2	40.1	21.7	45.3	78.1
Steele	4	15.2	13.3	76.0	33.5	--	34.5	74.4

NOTE: Varieties in this summary should not be compared to each other since they are not grown in the same years at the same locations. Compare yields only to the check variety Otana.

NOTE: Recrop nurseries were not harvested in 1988.

Table 18

Relative test weights of spring oat varieties as compared to Otana when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Test Wt. Lbs/Bu	Test Wt. in % of Otana Same Trials
		1984	1985	1986	1987	1989		
Trucker	1	--	--	--	--	35.0	35.0	125.0
Riel	3	--	--	39.0	38.5	33.5	37.0	105.7
Valley	3	--	--	40.0	37.0	30.0	35.7	101.9
Porter	2	--	--	40.0	38.0	--	39.0	101.3
Otana	5	30.0	33.7	40.0	37.0	28.0	33.7	100.0
Steele	4	29.2	35.3	38.5	36.0	--	34.8	98.8
Dumont	3	--	--	38.5	39.5	23.5	33.8	96.7
Ogle	3	--	--	36.5	34.0	29.0	33.2	94.8
Robert	1	--	--	--	--	26.5	26.5	94.6
Random	2	--	--	36.5	33.5	--	34.1	93.7
Calibre	3	--	--	37.5	39.0	21.0	32.5	92.9
Border	5	28.0	30.0	37.5	34.5	24.0	30.8	91.3
Monida	5	22.6	30.2	38.0	36.0	25.5	30.5	90.3
Park	5	22.5	29.5	38.0	34.0	24.5	29.7	88.0
Cayuse	5	25.4	27.4	36.0	34.0	24.5	29.5	87.3
Appaloosa	5	24.9	29.2	36.0	31.0	24.5	29.1	86.3
Cascade	4	20.5	26.3	37.0	33.0	--	29.2	83.0

NOTE: Varieties in this summary should not be compared to each other since they are not grown in the same years at the same locations. Compare test weights only to the check variety Otana.

NOTE: Recrop nurseries were not harvested in 1988.

Table 19. Relative heights (inches) of spring oat varieties as compared to Otana when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown					Average Height Inches	Height in % of Otana Same Trials
		1984	1985	1986	1987	1989		
Trucker	1	--	--	--	--	35	35.0	175.0
Cascade	4	20	18	36	25	--	24.8	101.0
Otana	5	20	18	34	26	20	23.6	100.0
Steele	4	19	20	34	24	--	24.3	99.0
Calibre	3	--	--	31	27	19	25.7	96.3
Riel	3	--	--	33	24	20	25.7	96.3
Dumont	3	--	--	33	24	18	25.0	93.8
Park	5	18	19	30	24	18	21.8	92.4
Porter	2	--	--	29	25	--	27.0	90.0
Robert	1	--	--	--	--	18	18.0	90.0
Random	2	--	--	29	24	--	26.5	88.3
Monida	5	19	16	29	23	17	20.8	88.1
Cayuse	5	18	17	26	24	16	20.2	85.6
Appaloosa	5	16	15	27	22	17	19.4	82.2
Border	5	16	16	27	21	16	19.2	81.4
Valley	3	--	--	26	21	17	21.3	80.0
Ogle	3	--	--	24	21	18	21.0	78.8

NOTE: Varieties in this summary should not be compared to each other since they are not grown in the same years at the same locations. Compare heights only to the check variety Otana.

NOTE: Recrop nurseries were not harvested in 1988.

Table 20 Relative protein contents of spring oat varieties as compared to Otana when grown under continuous cropping conditions at the Eastern Agricultural Research Center, Sidney, Montana during the 1984 - 1989 period.

Variety	Number of Years	Year Grown			Average Protein Content Percent	Protein in % of Otana Same Trials
		1986	1987	1989		
Trucker	1	--	--	17.4	17.4	112.3
Steele	1	--	15.9	--	15.9	103.9
Park	3	14.6	15.5	16.2	15.4	103.6
Riel	3	14.7	15.3	16.1	15.4	103.1
Otana	3	13.9	15.3	15.5	14.9	100.0
Porter	2	13.7	15.5	--	14.6	100.0
Border	3	13.5	15.5	15.6	14.9	99.8
Valley	2	--	14.8	15.8	15.3	99.4
Robert	1	--	--	15.4	15.4	99.4
Ogle	3	13.4	14.7	15.6	14.6	97.8
Cascade	2	12.8	15.2	--	14.0	95.9
Dumont	3	13.1	14.1	15.6	14.3	95.7
Appaloosa	3	12.3	14.6	15.9	14.3	95.7
Cayuse	3	12.8	14.1	15.4	14.1	94.6
Monida	3	12.7	14.3	14.6	13.9	93.1
Random	2	12.3	14.6	--	13.5	92.1
Calibre	3	12.9	14.2	13.8	13.6	91.5

NOTE: Varieties in this summary should not be compared to each other since they are not grown in the same years at the same locations. Compare protein contents only the check variety Otana.

NOTE: Recrop nurseries were not harvested in 1988.