SECTION I

CROP PRODUCTION TRIALS

1988
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DICKINSON BRANCH STATION
Dickinson, North Dakota

Production of Cereal Cultivars, Corn Sunflower, Safflower and Miscellaneous Minor and New Crops in Southwestern North Dakota

New crop cultivars and advanced experimentals from public and private agencies must be evaluated for their agronomic merit and usefulness in processed products as compared to varieties now grown. The North Dakota Agricultural Experiment Station is obligated to obtain information and make recommendations based on unbiased data and interpretations which the producer may use to choose cultivars for farm production. This project collects the necessary information on comparative performance of cultivars of cereals in southwestern North Dakota (1) to assist in evaluation of unnamed cultivars for possible release to North Dakota farmers; (2) to provide grain for quality analysis; and, (3) to provide production recommendations of varieties released by both public and private sources.

The project includes three separate experimental categories for cereal cultivars, including (1) regional nursery trials to evaluate advanced experimental genotypes of cereal grains; (2) comparison trials of named cereal cultivars and advanced experimentals in the final testing stages preparatory to release as named varieties; and, (3) off-station testing of newly released varieties from both public and private sources.

Regional Nursery Trials

Each year the regional nursery testing is done by agronomists in the U.S. and Canada cooperating with regional project leaders in North Dakota, South Dakota, Montana and Minnesota. Nurseries presently under test include:

The Uniform Regional Hard Red Spring Wheat Nursery
The Uniform Regional Durum Nursery
The Elite Hard Red Winter Wheat Nursery
The Intermediate Hard Red Winter Wheat Nursery
The Western Spring Barley Nursery
The Western Dryland Barley Nursery
The Advanced Two Row Barley Nursery
The Early Oat Nursery
The Midseason Oat Nursery

Variety Comparison Trials

This project provided much of the early yield, quality and agronomic evaluation of crop varieties in North Dakota. Each year this project evaluates approximately 40 or more hard red spring wheat (Triticum aestivum L.), 25 to 30 durum wheat (Triticum turgidum L.), 10 to 15 oat (Avena sativa L.), 10 to 15 six-rowed barley (Hordeum vulgare L.) 10 to 15 two-rowed barley (Hordeum distichon L.) 8 to 12 winter wheat (Triticum aestivum L.) and 6 to 10 winter rye (Secale cereale L.) cultivars. Genotypes evaluated include both named cultivars and experimental lines from NDSU, and other public and private breeding programs in the United States and Canada. Evaluations are used to make varietal recommendations. The grain produced from the hard red spring wheat, durum wheat and both two and six rowed barley plots is important because it is used in quality evaluations. Quality evaluations of experimental lines are compared to cultivars now grown by producers. The quality and agronomic performance of a genotype at various locations are the major bases for the recommended release of that line as a named variety or its removal from consideration for further testing. Data from this project in part determine which cultivars of these major crops will be released by the experiment station for commercial production. Experimental lines from other state universities and private plant breeding companies also are evaluated for quality. Although data from this project are not instrumental in the eventual release or rejection of private varieties, they provide information on genotype and agronomic characteristics prior to release and assist in making cultivar recommendations.

Off Station Testing

The principal objective of off-station trials is to provide a wider base for interpretation of yield data as it relates to varied soil types and growing conditions over the 14 counties of the Missouri Slope area. While the soils at the Dickinson Branch Station are representative of a large percent of those of southwestern North Dakota, they are not representative of all soil types being used for crop production in the region. Five different soil types are represented in the off-station trials. Local climatic differences also influence crop growth response. Data from these trials are combined with data from the off-station trials of the Hettinger Branch Station to provide a diverse test of crop performance at eleven locations in southwestern North Dakota.

Demonstration Plots

The same field plots used for yield and quality evaluations also serve as demonstration plots. This allows producers and scientists to observe the varieties and experimental lines of cereal crops grown in comparison trials for reaction to disease and insect pests.

Corn and Sunflower

Corn and sunflower are major crops in southwestern North Dakota.

Corn acreage in the three southwestern crop reporting districts increased from 166,000 acres in 1980 to 207,000 acres in 1984, and averaged 194,500 acres for that five year period. Acreage in 1985 was 233,000 and in 1986, 215,000 acres.

Average annual value of the corn crop in these districts for the five year period 1980-84 was $21,750,000.00, making the average per acre value $111.85. Using this value as a base, the value of the 1986 crop would be $24,041,300.00.

Sunflower acreage increased from 160,000 acres in 1980 to 460,000 acres in 1984, and averaged 307,600 acres annually in the three southwestern districts during that five year period. During that time the average annual value of the sunflower crop in those districts was approximately $32,000,000.00 with the per acre value being $104.03. Sunflower acreage dropped to 371,000 acres in these three districts in 1985. Production and marketing problems combined to further reduce the acreage in 1986 to 189,500 acres. Without some form of price stabilization, acreage of sunflower will no doubt continue to decline.

Modern production technology demands new types of hybrids of both corn and sunflower which will withstand high plant densities, be adapted for narrow row spacing, use fertilizers effectively, be adapted to combine harvesting and be capable of economical and consistent grain production.

New hybrids of both crops are being developed by private seed companies and are evaluated for adaptation to southwestern North Dakota growing conditions. Production practices are also evaluated.

Farmers of this area use the data collected from these trials to decide which hybrids to grow.

Miscellaneous Minor and New Crops

Safflower, sorghum, proso millet, buckwheat and dry beans are minor crops in southwestern North Dakota. Agronomic evaluation of new varieties and experimental lines of these and other miscellaneous crops is needed. Producers and potential processors require information on these crops to assist in making management decisions. New and improved production techniques for use by producers need to be discovered and their impact determined.

EXPERIMENTAL PROCEDURE

Seeding rates are calculated from 1000 kernel weights and germination percentages are adjusted to provide a seeding rate of 1,000,000 live seeds per acre for hard red spring wheat and durum and 750,000 live seeds per acre for oats and barley. These rates are approximately equivalent to 60 pounds of wheat and durum (1 bushel), 65 pounds of barley (1.3 bushels), and 48 pounds of oats (1.5 bushel) per acre.

All variety comparison trials and uniform regional nursery trials are seeded on summer fallow. Rotation and tillage trials follow appropriate cropping sequence. Soil tests are used to determine proper fertilizer application. Herbicide application follows current procedure as outlined in the NDSU agricultural weed control guide circular W253 as revised annually. All trials are machine-planted with a K.E.M. four-row double disk cone seeder at appropriate rates for each species being tested. Trials are seeded in randomized complete block design in either three or four replications as requested by respective project leaders. Plot size for all regional tests are four by fourteen feet. Plant growth is monitored and agronomic information on planting date, time of emergence, seeding vigor, stand percent, heading date, height, disease and insect phenomena is recorded by Station personnel as required by respective project leaders throughout the growing season. Grain yields are determined from hand-harvested plots. Grain samples for quality tests are supplied as requested by respective project leaders.

Variety comparison trials are seeded at the Dickinson Branch Station each year. Trials consist of named cereal cultivars and advanced experimentals in the final testing stages preparatory to release. All trials are seeded on summerfallow. Soil tests are used to determine proper fertilizer application for selected yield goals. Herbicide application follows current procedure as outlined in the NDSU agricultural weed control guide, circular W253 as revised annually. All trials are machine-planted with a Melroe double disk drill at appropriate rates for each species. Drill row spacing is six inches. Plot size is five feet by one hundred thirty-two feet. Trials are seeded in randomized complete block design using four replications. Plant growth is monitored as necessary to record agronomic, disease and insect phenomena occurring during the growing season. Grain yields are determined from combine harvest of the entire plot. Grain samples for quality tests are supplied as requested by the chairman of the Department of Agronomy, NDSU.

Off-station variety comparison trials of newly released varieties from both public and private sources are seeded on selected off-station sites in Golden Valley, Dunn, Morton, Oliver and Mercer Counties. Procedure described for the variety comparison trials will be followed for off-station trials also.

All row crops to include corn, sunflower, dry beans and grain sorghum, are planted with an Allis row crop planter equipped with double disk furrow openers spaced 36 inches apart. Trials are planted at an excessive rate and thinned to the desired uniform stand.

Plot size for all row crops are one-fiftieth acre with yield determined from hand-harvested samples of a one-hundredth acre portion of the plot. Grain or seed is weighed at harvest and moisture percentage determined. Yield is determined on a uniform moisture basis for the species being tested. Corn silage yields are determined on a 70% moisure basis.

All small seeded crops are machine planted with a Melroe double disk drill set at 6 inch row spacing or a K.E.M. double disk cone seeder designed to plant from 3 to 7 rows set at 6 inch row spacing, depending on amount of available seed and plot size.

Plot size for all small seeded crops is one-hundredth acre, seed supplies permitting. Yield determinations are from combine harvest. Grain samples for quality tests are supplied as required to the Department of Cereal Science and Food Technology, NDSU.

Data are analyzed using statistical procedure for analysis of variance.

DICKINSON EXPERIMENT STATION

GROWING CONDITIONS – 1988

Severe drought prevailed throughout the growing season of 1988.

Total precipitation for the twelve month period, September, 1987 through August, 1988 was 8.63 inches as compared to the 94 year average of 15.89 inches.

Low rainfall throughout the entire growing season was coupled with temperatures that were far above average. The month of June was the most devastating in terms of adverse weather with average temperatures 14°F higher than the 94 year norm, and with precipitation 2 inches below average. Evaporation for June, July and August was 34.9 inches compared to the norm of 21.3 inches. High temperature, low precipitation and excessive wind combined to create the worst growing conditions experienced in this region for the past fifty years.

The most severe plant disease problem in 1988 was the onset of wheat streak mosaic, which was an extremely serious problem, particularly on winter wheat, early in the season. Effects of the drought masked development of other leaf diseases.

WEATHER DATA SUMMARY
Dickinson 1987-88

Precipitation	**1986-87**	**1987-88**	**94 Year Average**
Sept. – Dec. 1986	6.43	1.16	3.15
Jan. – Mar. 1987	2.73	1.96	1.53
April – June	4.36	3.64	7.30
July – Aug.	7.67	1.87	3.91
Total	21.19	8.63	15.89

Average Temperature °F	**1987**	**1988**	**94 Year Average**
April	48	42	41
May	57	59	54
June	66	75	61
July	69	71	69
August	62	68	67

Table 1. 1988 Dickinson Hard Red Spring Wheat Trial

Variety	Bu/A Avg.	Test Wt. Lbs.	Heading Date	Height In.
Leif *	17.2	59.0	16-Jun	17
ALEX	12.8	61.0	18-Jun	18
AMIDON	12.1	60.5	17-Jun	19
Marshall *	11.0	60.0	17-Jun	17
Nordic *	11.0	61.5	16-Jun	18
ND 640	10.6	61.5	19-Jun	17
2375 *	10.6	60.0	15-Jun	15
Wheaton *	10.6	59.5	18-Jun	15
ND 651	10.6	61.0	19-Jun	16
W 2502 *	10.6	59.0	14-Jun	14
Laura	10.6	59.0	16-Jun	18
Pioneer 2369 *	10.6	59.0	16-Jun	16
ND 649 *	10.6	61.0	18-Jun	18
Tammy *	10.3	60.0	16-Jun	17
ND 618 *	9.9	60.5	17-Jun	16
W 2501 *	9.9	58.0	14-Jun	15
STOA	9.9	61.0	17-Jun	19
ND 652	9.5	60.5	17-Jun	17
Norak *	9.5	61.0	16-Jun	16
2385 *	9.5	57.5	13-Jun	17
ND 626 *	9.5	61.0	17-Jun	18
HS84-873 *	9.5	59.5	14-Jun	15
Success *	9.2	55.5	23-Jun	18
Rambo *	9.2	61.0	17-Jun	16
MN 82354 *	8.8	60.0	20-Jun	17
Prospect *	8.8	60.0	17-Jun	18
BUTTE 86	8.8	61.5	15-Jun	16
Telemark *	8.8	60.0	17-Jun	16
Kenyon	8.4	58.5	17-Jun	18
MN 81110 *	8.4	57.0	17-Jun	16
ND 650 *	8.4	61.5	20-Jun	16
COTEAU	8.3	60.0	21-Jun	17
Waldron	8.1	59.0	17-Jun	18
Celtic *	7.7	61.0	16-Jun	18
LEN *	7.7	60.5	18-Jun	19
Katepwa	7.0	59.0	17-Jun	19
Norseman *	7.0	59.5	18-Jun	15
Columbus	7.0	60.0	23-Jun	18
Roblin	6.6	58.5	17-Jun	14
CUTLESS *	5.5	59.5	14-Jun	17
Westbred 926 *	5.5	59.0	13-Jun	15

*Semidwarf

Seeding Rate: 1,000,000 live seeds/acre, (approx. 1 Bu/A)

Seeding Date: April 22 Harvest Date: July 26

Fertilizer Applied: 50 lbs./A 18-46-0

Herbicide Applied: Hoelon-Buctril tank mix

L.S.D. 5% = 3.2 Bu/A C.V. = 21.1 %

Note: Recommended varieties are capitalized.

Table 2. Long Term Yields – Hard Red Spring Wheat, Dickinson

Variety	1984	1985	1986	1987	1988	Average
Alex	30.4	43.6	45.4	34.7	12.8	33.4
Norak	49.5	52.4	54.2	28.9	9.5	38.9
Coteau	37.4	36.5	48.0	35.2	8.3	33.1
Len	42.5	52.9	54.6	32.7	7.7	38.1
Stoa	54.3	51.6	61.6	30.8	9.9	41.6
Waldron	31.5	40.4	49.2	35.5	8.1	32.9
Leif	41.8	40.9	60.8	27.0	17.2	37.5
Columbus	36.3	40.8	51.8	37.4	7.0	34.6
Marshall	38.5	40.4	56.5	30.5	11.0	35.4
Pioneer 2369	45.1	37.2	60.6	35.5	10.6	37.8
Wheaton	50.2	45.4	63.8	25.9	10.6	39.2
Norseman	51.3	45.5	49.2	40.7	7.0	38.7
Success	34.8	47.0	52.5	43.7	9.2	37.4
Cutless	---	47.3	49.2	30.1	5.5	33.0
Amidon	---	57.8	53.3	28.3	12.1	37.9
Butte 86	---	38.2	51.8	31.1	8.8	32.5
Celtic	---	51.1	51.2	27.2	7.7	34.3
Nordic	---	---	65.5	29.7	11.0	35.4
Prospect	---	---	62.0	22.0	8.8	30.9
Telemark	---	---	58.0	27.0	8.8	31.3
LSD .05	7.4	6.9	7.9	4.0	6.2	6.6

Table 3. 1988 Dickinson Off-Station Hard Red Spring Wheat Variety Trials

Variety	Dickinson	Beach	Beulah	Glen Ullin	Hannover	Manning	Average 6 Sites
Bushels per Acre							
Alex	12.8		12.7	20.4	14.3	10.2	14.1
Amidon	12.1		14.6	22.8	16.8	12.9	15.8
Butte 86	8.8		12.9	24.5	15.1	10.2	14.3
Celtic *	7.7		14.0	21.7	18.4	12.1	14.8
Coteau	8.3		14.3	25.9	19.3	13.5	16.2
Cutless *	5.5		11.6	22.0	14.3	11.6	13.0
Leif *	17.2		12.9	25.6	19.5	10.2	17.1
Len *	7.7		14.3	21.7	18.7	12.4	15.0
Norak *	9.5		12.9	22.0	19.0	14.3	15.5
Nordic *	11.0		10.7	26.1	22.6	8.3	15.7
Norseman *	7.0		12.7	23.9	19.0	11.3	14.8
Pioneer 2369 *	10.6		17.9	20.4	19.0	9.9	15.5
Stoa	9.9		19.8	28.3	21.5	14.6	18.8
Success *	9.2		14.0	22.8	16.0	10.7	14.5
*Semi-dwarf							
Seeding Date:	Apr. 22	Apr. 13	Apr. 15	Apr. 18	Apr. 19	Apr. 14	
Harvest Date:	July 26		July 29	Aug. 4	Aug. 5	July 25	
LSD 5% (Bu/A) :	3.2		4.5	4.4	3.6	5.8	4.4
CV (%) :	21.1		22.8	13.1	13.9	35.1	
Fertilizer Applied:	According to soil test at each site.						
Herbicide Applied:	Hoelon-Buctril tank mix						
Seeding Rate:	1 Bu/A						

Table 4. 1988 Dickinson Off-Station Hard Red Spring Wheat Variety Trials

Variety	Dickinson	Beach	Beulah	Glen Ullin	Hannover	Manning	Average 6 Sites
Test Wt. lbs./bu.							
Alex	61.0		61.5	59.0	59.0	60.5	60.2
Amidon	60.5		61.0	59.5	59.5	60.0	60.1
Butte 86	61.5		61.0	60.0	59.5	59.5	60.3
Celtic *	61.0		60.0	59.5	60.0	60.5	60.2
Coteau	60.0		60.0	58.5	59.0	59.5	59.4
Cutless *	59.5		59.5	59.0	59.5	59.0	59.3
Leif *	59.0		60.5	59.5	60.0	59.0	59.6
Len *	60.5		61.5	60.0	61.0	61.0	60.8
Norak *	61.0		60.5	60.0	60.0	59.5	60.2
Nordic *	61.5		60.0	60.5	61.5	61.0	60.9
Norseman *	59.5		59.5	58.0	59.0	59.5	59.1
Pioneer 2369 *	59.0		60.5	60.0	59.5	59.0	59.6
Stoa	61.0		60.5	60.0	59.5	59.0	60.0
Success *	55.5		59.0	57.0	58.5	60.0	58.0

Table 5. 1988 Dickinson Off-Station Hard Red Spring Wheat Variety Trials

Variety	Dickinson	Beach	Beulah	Glen Ullin	Hannover	Manning	Average 6 Sites
Protein @ 14% Moisture							
Alex	17.9		17.6	16.8	16.7	17.4	17.3
Amidon	17.9		18.0	17.3	17.2	17.6	17.6
Butte 86	17.8		17.7	17.0	16.6	17.1	17.2
Celtic *	17.5		17.1	16.5	16.4	17.3	17.0
Coteau	18.0		17.8	16.7	16.5	17.8	17.4
Cutless *	18.7		18.2	17.8	17.5	18.4	18.1
Leif *	17.9		17.7	16.9	16.6	17.6	17.3
Len *	18.3		17.6	17.0	17.2	17.7	17.6
Norak *	18.0		17.8	16.8	16.9	17.9	17.5
Nordic *	16.5		16.8	15.5	15.0	16.1	16.0
Norseman *	18.6		18.3	16.9	17.3	17.7	17.8
Pioneer 2369 *	18.4		17.8	17.1	17.3	18.0	17.7
Stoa	17.0		16.9	16.4	16.2	17.2	16.7
Success *	17.9		17.8	16.8	17.3	18.1	17.6

Table 6. 1988 Dickinson Durum Variety Trial

Variety	Bu/A Avg.	Test Wt. Lbs.	Heading Date	Height In.
D 8380 *	12.4	61.0	21-Jun	15
Rugby	11.8	60.0	18-Jun	18
MEDORA	11.6	60.0	17-Jun	18
VIC	11.6	60.0	18-Jun	17
D 8458	11.3	60.5	20-Jun	13
D 8291 *	11.0	61.0	21-Jun	15
Stockholm *	10.7	62.5	21-Jun	17
FA883-323	10.5	59.0	21-Jun	17
Laker *	10.2	61.0	18-Jun	17
MONROE	9.9	61.0	15-Jun	15
D 83103 *	9.9	59.0	18-Jun	18
D 8460	9.6	62.5	19-Jun	17
LLOYD *	9.6	61.0	21-Jun	15
RENVILLE	9.6	61.0	17-June	18
D 8302	9.6	60.5	21-Jun	14
D 8459	9.6	62.0	20-Jun	17
D 8261 *	9.4	62.5	21-Jun	17
Fjord	9.4	61.5	17-Jun	18
Sceptre	9.4	61.0	17-Jun	17
D 84130 *	9.4	60.5	21-Jun	16
D 8475	8.8	62.5	20-Jun	18
WARD	8.5	61.5	17-Jun	19
D 8374 *	8.3	61.0	23-Jun	17
D 84134 *	8.0	62.0	21-Jun	16
D 8479	7.7	60.5	21-Jun	17
D 8434	6.6	63.0	17-Jun	15
D 8370 *	5.8	61.5	23-Jun	15

*Semidwarf

Seeding Rate: 1,000,000 live seed/acre, (approx. 1 Bu/A)

Seeding Date: April 21 Harvest Date: July 27

Fertilizer Applied: 50 lbs./A 18-46-0

Herbicide Applied: Hoelon-Buctril tank mix

L.S.D. 5% = 2.8 Bu/A C.V. = 20.6%

Note: Recommended varieties are capitalized.

Table 7. Long Term Yields – Durum, Dickinson

Variety	1984	1985	1986	1987	1988	Average
Lloyd	37.4	55.4	51.2	43.2	9.6	39.4
Vic	34.9	33.4	36.5	32.7	11.6	29.8
Ward	27.0	36.4	45.2	36.0	8.5	30.6
Monroe	29.4	42.0	44.1	34.4	9.9	32.0
Renville	---	38.1	44.2	41.0	9.6	33.2
Rugby	30.3	---	49.6	40.7	11.8	33.1
Laker	---	---	45.4	42.1	10.2	32.5
Medora	---	---	47.8	41.0	11.6	33.5
Fjord	---	---	---	38.0	9.4	23.7
Stockholm	---	---	---	44.8	10.7	27.8
LSD .05	4.9	1.4	1.4	4.7	2.8	3.4

Table 8. 1988 Dickinson Off-Station Durum Variety Trials

Variety	Dickinson	Beach	Beulah	Glen Ullin	Hannover	Manning	Average 6 Sites
Bushels per Acre							
Laker *	10.2		10.2	22.6	15.7	11.8	15.1
Lloyd *	9.6		10.2	20.9	16.0	13.2	15.1
Medora	11.6		8.5	19.3	15.1	13.5	14.1
Monroe	9.9		11.0	19.3	15.1	12.4	14.4
Renville	9.6		11.0	20.9	15.4	13.2	15.1
Ward	8.5		8.5	21.2	13.8	12.9	14.1
Test Wt. lbs./bu.							
Laker *	61.0		63.0	59.5	62.0	62.5	61.6
Lloyd *	61.0		61.5	60.0	61.5	62.5	61.3
Medora	60.0		61.0	60.0	60.5	62.5	60.8
Monroe	61.0		61.5	60.5	60.5	61.5	61.0
Renville	61.0		62.0	59.5	60.5	62.0	61.0
Ward	61.5		61.5	60.0	61.0	62.0	61.2
*Semi-dwarf							
Seeding Date:	Apr. 21	Apr. 13	Apr. 15	Apr. 18	Apr. 19	Apr. 14	
Harvest Date:	July 27		July 29	Aug. 4	Aug. 5	July 25	
LSD 5% (Bu/A) :	2.8		3.7	4.5	2.1	8.0	4.7
CV (%) :	20.6		24.9	14.5	9.1	41.4	
Fertilizer Applied: According to soil test at each site.							
Herbicide Applied: Hoelon-Buctril tank mix							
Seeding Rate: 1 Bu/A							

Hard Red Winter Wheat

Survival was good in the 1987-88 winter wheat comparison trials on both summer-fallow and recrop. Stands were seriously reduced by wheat streak mosaic, and the crop was damaged further by the severe drought and high temperatures prevailing throughout the growing season. A heavy weed invasion of kochia and Russian thistle rendered the trials useless for purposes of variety comparison.

Long term yield data are given in Table 9. Yields recorded in 1988 at several other branch stations are summarized in Tables 10 and 11.

Table 9. Long Term Yields – Hard Red Winter Wheat, Dickinson

Variety	1984	1985	1986	1987	1988	Average
Roughrider	44.1	52.1	46.5	20.8	0.0	32.7
Winoka	45.4	44.6	48.4	24.2	0.0	32.5
Agassiz	45.9	50.0	50.6	17.3	0.0	32.8
Siouxland	---	---	59.4	11.8	0.0	23.7
Seward	---	---	---	24.4	0.0	12.2
LSD .05	7.3	2.5	3.8	4.8		4.9
Yield averages include value of 0 for 1988.						

Table 10. 1988 Variety Trial – Conventional Tillage (Fallow or Recrop)
Summary of Grain Yields by Location

Entry	Casselton	Hettinger	Minot	Williston	4-Location Yield	4-Location Survival
	----------Bu/A----------					
Agassiz	28.4	4.4	3.4	6.9	9.6	89.1
Roughrider	23.1	4.1	4.4	7.7	8.9	89.5
Seward	25.7	5.5	3.4	8.0	9.7	86.6
Norstar	19.2	4.8	4.4	4.3	7.5	92.7
Rose	14.9	6.5	2.9	7.9	7.6	69.5
Winoka	14.3	---	5.9	7.6	8.8	63.6
Siouxland	13.5	8.0	3.8	9.3	8.3	58.6
Thunderbird	1.4	5.1	1.5	8.3	4.3	38.9
Abilene	3.6	---	2.9	10.1	5.7	11.4
Norwin	13.0	---	2.3	7.7	7.0	69.2
ND8212	20.0	4.7	4.3	6.8	8.2	82.7
ND8215	15.9	5.5	8.4	7.2	8.8	84.5
ND8286	20.1	4.3	6.3	7.6	8.9	89.1
ND8407	16.2	6.9	5.0	7.7	8.5	86.4
ND8460	14.6	4.7	1.9	6.4	6.4	67.7
$\bar{X}$	16.3	5.2	4.0	7.7	7.9	73.9
C.V.	32.8	33.4	34.2	7.9	37.2	16.8
LSD 0.05	8.9	2.5	2.0	0.9	2.1	8.7

Table 11. 1988 Variety Trial – No Till
Summary of Grain Yields by Location

Entry	Casselton	Langdon	Minot	Williston	4-Location Yield	4-Location Survival
	----------Bu/A----------					
Agassiz	9.2	33.2	0.3	5.6	10.8	96.4
Roughrider	9.1	30.6	0.4	5.6	10.2	97.5
Seward	8.7	39.1	0.2	6.8	12.3	98.2
Norstar	9.5	34.3	0.2	3.8	10.5	98.9
Rose	7.1	30.3	0.2	6.3	9.9	95.7
Winoka	6.5	26.9	0.4	4.0	8.4	95.4
Siouxland	7.1	25.7	1.4	6.9	9.4	90.7
Thunderbird	9.7	38.7	0.6	7.1	12.6	93.2
Abilene	8.0	34.0	0.7	8.7	11.7	92.9
Norwin	5.3	30.9	0.3	3.8	9.0	95.7
ND8212	8.6	31.9	0.5	6.1	10.6	95.7
ND8215	9.9	31.0	1.2	5.1	10.6	98.6
ND8286	10.9	29.4	0.2	6.7	10.6	91.9
ND8407	8.0	27.2	0.2	5.9	9.3	96.4
ND8460	11.3	26.4	0.2	5.3	9.7	95.4
X	8.5	31.3	0.5	5.9	10.4	95.5
C.V.	33.6	17.4	72.8	16.9	27.2	8.0
LSD 0.05	NS	NS	0.5	1.4	2.0	5.4

Table 12. 1988 Dickinson Winter Rye Variety Trial

Variety	Bu/A Avg.	Test Wt. Lbs.	Heading Date	Height In.
ND 1	17.5	49.5	22-May	30
CHAUPON	15.9	50.0	22-May	30
ND 2	15.6	50.0	22-May	29
MUSKETEER	15.2	51.5	23-May	30
Frederick	15.0	52.5	25-May	30
PUMA	8.5	53.0	24-May	30
Seeding Rate: 60 lbs./A				
Seeding Date: September 1 Harvest Date: July 20				
Fertilizer Applied: 50 lbs./A 18-46-0				
Herbicide Applied: Hoelon-Buctril tank mix				
L.S.D. 5% = 3.2 Bu/A C.V. = 14.5 %				
Note: Recommended varieties are capitalized.				

Table 13. Long Term Yields – Winter Rye, Dickinson

Variety	1984	1985	1986	1987	1988	Average
Chaupon	62.8	72.7	49.1	53.9*	15.9	50.9
Musketeer	48.4	65.4	35.4	37.6	15.2	40.4
Puma	49.9	62.5	43.2	33.9	8.5	39.6
Frederick	---	---	33.0	35.1	15.0	27.7
LSD .05	10.4	7.5	4.8	3.6	3.2	6.5
* Chaupon II						

Table 14. 1988 Dickinson Barley Variety Trial

Variety	Bu/A Avg.	Test Wt. Lbs.	Heading Date	Height In.
HECTOR	19.3	47.5	25-Jun	20
GALLATIN	15.5	46.5	22-Jun	20
BOWMAN	14.8	46.0	21-Jun	19
Lewis	14.4	46.5	25-Jun	17
B 1602 *	12.0	45.5	21-Jun	18
MOREX *	11.7	46.5	20-Jun	18
B 1603 *	11.0	45.0	18-Jun	17
ND 9256 *	10.7	43.0	19-Jun	16
Hazen *	10.3	45.5	21-Jun	19
Robust *	8.9	46.5	20-Jun	17
ND 7309 *	8.6	44.0	21-Jun	16
ND 8671	7.6	46.0	20-Jun	20
ND 7691	7.6	45.0	22-Jun	19
AZURE *	7.2	43.0	18-Jun	18
Ellice	4.5	42.0	25-Jun	17

* 6-row variety

Seeding Rate: 1.3 Bu/A

Seeding Date: April 21 Harvest Date: August 1

Fertilizer Applied: 50 lbs./A 18-46-0

Herbicide Applied: Hoelon-Buctril tank mix

L.S.D. 5% = 4.2 Bu/A C.V. = 27.0 %

Note: Recommended varieties are capitalized.

Table 15. Long Term Yields – Barley, Dickinson

Variety	1984	1985	1986	1987	1988	Average
Azure	77.0	66.4	76.0	61.9	7.2	57.7
Bowman	84.9	73.6	82.2	52.3	14.8	61.5
Morex	62.2	77.4	85.6	56.4	11.7	58.7
Robust	65.7	75.3	79.8	61.5	8.9	58.2
Hazen	78.4	64.7	86.6	61.2	10.3	60.2
Hector	66.2	68.3	80.8	70.5	19.3	61.0
Lewis	---	77.5	95.9	63.3	14.4	62.8
Gallatin	80.8	---	99.3	72.5	15.5	67.0
Ellice	71.2	---	96.3	64.6	4.5	59.1
LSD .05	6.1	10.7	7.3	4.5	4.2	7.0

Table 16. 1988 Dickinson Off-Station Barley Variety Trials

Variety	Dickinson	Beach	Beulah	Glen Ullin	Hannover	Manning	Average 6 Sites
Bushels per Acre							
Azure *	7.2		13.8	20.6	13.1	11.0	13.1
Bowman	14.8		18.2	25.8	18.9	15.5	18.6
Gallatin	15.5		24.8	34.0	21.7	17.5	22.7
Hector	19.3		24.4	31.6	24.8	18.2	23.7
Morex *	11.7		19.9	21.3	17.5	14.4	17.0
Robust *	8.9		14.4	19.9	13.8	12.4	13.9
Test Wt. lbs./bu.							
Azure *	43.0		45.0	45.0	43.5	44.5	44.2
Bowman	46.0		48.0	49.0	47.5	48.0	47.7
Gallatin	46.5		47.0	48.5	48.0	46.0	47.2
Hector	47.5		47.0	49.0	48.5	48.5	48.1
Morex *	46.5		44.0	46.5	42.5	46.0	45.1
Robust *	46.5		46.0	47.0	45.0	45.5	46.0
*6-row							
Seeding Date:	Apr. 21	Apr. 13	Apr. 15	Apr. 18	Apr. 19	Apr. 14	
Harvest Date:	Aug. 1		July 29	Aug. 4	Aug. 5	July 25	
LSD 5% (Bu/A)	4.2		7.4	3.0	2.7	6.4	5.1
CV (%) :	27.0		25.5	7.7	9.9	28.6	
Fertilizer Applied: According to soil test at each site.							
Herbicide Applied: Hoelon-Buctril tank mix							
Seeding Rate: 1 Bu/A							

Table 17. 1988 Dickinson Oats Variety Trial

Variety	Bu/A Avg.	Test Wt. Lbs.	Heading Date	Height In.
MONIDA	24.8	26.0	20-Jun	19
Porter	23.4	21.5	20-Jun	21
STEELE	20.8	22.0	18-Jun	21
ND 830646	20.4	21.5	20-Jun	19
ND 830775	20.0	28.0	21-Jun	19
ND 820294	19.5	28.0	17-Jun	22
VALLEY	19.5	25.0	17-Jun	19
ND 821742	17.4	29.5	19-Jun	18
Hytest	14.8	30.5	16-Jun	24
RIEL	14.3	34.5	16-Jun	23
ND 831122	13.5	28.0	15-Jun	19
ND 820559	13.0	22.5	18-Jun	21
Robert	12.6	27.5	20-Jun	19
ND 840413	12.6	24.0	18-Jun	23
OTANA	12.2	23.5	18-Jun	24
ND 820744	11.3	25.5	18-Jun	21
ND 830185	10.9	22.5	17-Jun	23
Trucker	10.4	35.0	16-Jun	21
DUMONT	9.1	24.0	19-Jun	22
ND 810104	6.5	26.5	16-Jun	20
Tibor	3.9	38.5	16-Jun	23

Seeding Rate: 1.5 Bu/A

Seeding Date: April 20 Harvest Date: July 27

Fertilizer Applied: 50 lbs./A 18-46-0

Herbicide Applied: Buctril

L.S.D. 5% = 4.9 Bu/A C.V. = 23.4 %

Note: Recommended varieties are capitalized.

Table 18. Long Term Yields – Oats, Dickinson

Variety	1984	1985	1986	1987	1988	Average
Otana	56.8	81.3	101.6	77.0	12.2	65.8
Dumont	65.6	82.9	116.5	84.5	9.1	71.7
Steele	56.8	76.4	106.2	73.5	20.8	66.8
Monida	---	85.0	126.8	86.8	24.8	80.9
ND 810104	---	98.5	124.8	50.4	6.5	70.0
Porter	---	81.2	114.0	78.7	23.4	74.3
Valley	---	91.5	126.3	61.4	19.5	74.7
Hytest	---	---	99.5	55.0	14.8	56.4
Riel	---	---	112.4	67.7	14.3	64.8
Border	71.2	88.8	100.0	78.2	---	84.5
LSD .05	6.9	7.3	15.5	6.9	4.9	9.1

Table 19. 1988 Dickinson Off-Station Oats Variety Trials

Variety	Dickinson	Beach	Beulah	Glen Ullin	Hannover	Manning	Average 6 sites
Bushels per Acre							
Dumont	9.1		15.7	38.2	16.1	14.8	18.8
Hytest	14.8		15.6	30.8	13.9	12.6	17.5
Monida	24.8		22.6	48.2	26.9	22.6	29.0
Riel	14.3		20.4	41.7	20.8	22.1	23.9
Valley	19.5		17.4	35.6	13.0	16.1	20.3
Test Wt. lbs./bu.							
Dumont	24.0		31.0	31.0	30.5	24.0	28.1
Hytest	30.5		36.0	35.0	32.5	33.5	33.5
Monida	26.0		27.0	32.5	30.0	30.5	29.2
Riel	34.5		34.0	33.5	34.0	34.5	34.1
Valley	25.0		29.5	33.0	31.5	32.0	30.2
Seeding Date:	Apr. 20	Apr. 13	Apr. 15	Apr. 18	Apr. 19	Apr. 14	
Harvest Date:	July 27		July 29	Aug. 4	Aug. 5	July 25	
LSD 5% (Bu/A):	4.9		8.9	3.0	2.0	4.7	5.3
CV (%) :	23.4		31.4	5.0	7.3	17.1	
Fertilizer Applied:	According to soil test at each site.						
Herbicide Applied:	Buctril						
Seeding Rate:	1 Bu/A						

Miscellaneous Small Grains

Speltz has been grown at the Dickinson station since 1907. Triticale has been grown in production trials since its development in the 1950's and has also been used in feeding trials with beef cattle and swine. Spring rye has also been grown intermittently over the past fifty years.

Production trials with miscellaneous small grains continue on a limited basis to determine adaptability of newly developed varieties. Production of these miscellaneous species is often not equal to the more commonly grown cereal grains. However, they sometimes can be used as non-compliance crops in the federal farm program where acreage of the commonly grown types is restricted. For this reason farmers are interested in comparative performance.

Table 20. 1988 Dickinson Misc. Small Grains Variety Trial

Variety	Lbs./A Avg.	Test Wt. Lbs.
Bowman Barley	247.4	51.0
Speltz	159.7	38.0
Gazelle Spring Rye	144.9	52.0
Kramer Triticale	13.2	47.0
Seeding Date: April 22	Harvest Date: August 9	
Fertilizer: 50 lbs./A 18-46-0		

Table 21. Dickinson Misc. Small Grains 3-Yr. Average Yields

Variety	Pounds/Acre 1988	1987	1986	Avg.
Bowman Barley	247	1,699	3,946	1,964
Speltz	160	908	3,268	1,445
Gazelle Spring Rye	145	1,338	2,705	1,396
Kramer Triticale	13	662	3,168	1,281
Otana Oats	---	1,303	3,861	1,721

Flax Production in Southwestern North Dakota

Flax is a crop of relatively minor importance in southwestern North Dakota when compared to the cereal grains. However, flax acreage statewide as well as in southwest North Dakota has increased in the past several years. Production in the fourteen county Missouri Slope area for the five year period 1980-84, as reported by Carver in Agricultural Statistics No. 55, June, 1986, was 160,000 bushels on 16,800 seeded acres, for an average yield of 9.5 bushels per acre. Statewide production was 4,409, 600 bushels on 386,000 seeded acres for an average of 11.4 bushels per acre.

In both 1986 and 1987 flax acreage increased, over the 5-year average. There were 400,000 acres of flax planted statewide in 1987 with a harvested yields of 16.5 bushels per acre. In the 14 county Missouri Slope region 58,000 acres of flax planted in 1987 averaged 15.5 bushels per acre.

Clark, Flor, Culbert 79, and MacGregor are recommended varieties for southwestern North Dakota.

Table 22. 1988 Dickinson Flax Variety Trial

Variety	Bushesl /A	Test Wt. Lbs.
Flor	13.9	52.5
Culbert 79	11.8	53.0
Clark	11.5	53.5
MacGregor	10.0	52.5
Seeding Rate: 40 lbs./A		
Seeding Date: May 12 Harvest Date: Sept 1		
LSD 5% = 5.7 Bu/A CV = 30.0 %		
Fertilizer: 50 lbs./A 18-46-0, drill		

Safflower Production in Southwestern North Dakota

Safflower is a crop of minor importance in southwestern North Dakota as well as statewide. Trials at the Dickinson Branch Station are conducted in cooperation with the Williston Branch Station where variety improvement has been a cooperative effort with that station and the Eastern Montana Agriculutural Research Center, Sidney, Montana.

S-208, S-541, Girard, Finch and Hartman are recommended varieties for western North Dakota.

Table 23. 1988 Dickinson Safflower Variety Trial

Variety	Lbs./A Avg.	Test Wt. Lbs.	Percent Oil
Finch	809.0	42.5	
S-541	788.2	40.0	
Girard	746.7	40.5	
819-1-2	746.7	39.5	
S-208	746.7	39.0	
MT 3697	497.8	39.5	
Seeding Rate: 400,000 viable seeds / A			
Seeding Date: Apr. 29 Harvest Date: Sept. 23			
L.S.D. 5% = 251.2 Bu/A C.V. = 19.1 %			
Fertilizer: 50 lbs./A 18-46-0, drill			

Table 24. Long Term Yields Safflower, Dickinson

Variety	1985	1986	1987	1988	Average
Finch	1182	1484	958	809	1108
S-541	1223	1552	1220	788	1196
S-208	1144	1636	1002	747	1132
Girard	1087	1531	---	747	1122
Hartman	886	1088	1045	---	1006
819-1-2	---	---	---	747	---
Mt 3697	---	---	---	498	---

Buckwheat Production in Southwestern North Dakota

Buckwheat can be grown successfully in southwestern North Dakota, but has not become popular with area farmers, and is considered to be a crop of minor importance in the Missouri Slope region.

Grain yields at various experiment station locations in North Dakota over the past few years have varied depending on the growing season. Yields recorded in Dickinson station trials are equal or better than those recorded in other areas of the state.

Construction of the MinnDak elevator in Dickinson in 1988, belonging to a company which specializes in buckwheat and other specialty crops may help to increase the acreage of these crops in southwest North Dakota by providing a ready market for them.

Table 25. 1988 Dickinson Buckwheat Variety Trial

Variety	Lbs./A Avg.	Test Wt. Lbs.
Common	636.5	43.0
Manor	387.9	38.5
Mancan	338.1	38.5
Seeding Rate: 50 lbs./A		
Seeding Date: May 27 Harvest Date: September 1		
L.S.D. 5% = 218.6 Bu/A C.V. = 21.2 %		
Fertilizer: 50 lbs./A 18-46-0, drill		

Table 26. Long Term Yields – Buckwheat, Dickinson

Variety	1985	1986	1987	1988	Average
Mancan	1826	1290	1810	338	1317
Manor	2116	1523	1810	338	1459
Windsor Royal	1697	1172	1894	---	1588*
Common	2280	---	3016	637	1978*
*3-year average					

Dry Edible Bean Production

In 1987, the most recent year for which figures are available, beans were grown on 12,000 acres in the 14 county Missouri Slope region, which was only 3 percent of the total bean acreage in the state. Production in the Slope region averaged 8.6 cwt/acre in 1987 compared to 13.6 cwt/acre statewide.

Table 27 shows yields recorded at Dickinson in 1987, which was a very good year for bean production here. Table 28 gives yields for the drought year of 1988.

Table 27. 1987 Dickinson Misc. Dry Bean & Pea Trial

Variety	Lbs./A Avg.	Test Wt. Lbs.	Seeding Rate Lbs.	Row Width In.
Garbanzo	2865	56.0	150	10
Paloma Peas	2734	58.5	150	10
Lentil	2178	58.5	70	10
Hyden Navy	2056	58.0	45	30
White Lupin	2012	56.5	120	10
Nodak Pinto	1997	57.0	65	30
Seeding Date: May 13				
Lentils Seeded: May 29				
Fertilizer: 50 lbs./A 18-46-0				
L.S.D. 5% = 803.7 lbs./A C.V. = 21.0 %				

Table 28. 1988 Dickinson Misc. Dry Bean Trial

Variety	Lbs./A Avg.	Test Wt. Lbs.
Othello Pinto	743	58.5
Hyden Navy	717	59.0
Nodak Pinto	495	58.5
Wyoming 167 Pinto	0	NA
Seeding Date: May 25 Harvest Date: Aug. 26		
Fertilizer: 50 lbs./A 18-46-0		
L.S.D. 5% = 191.4 lbs./A C.V. = 24.5 %		

Millet

Foxtail and Proso millets are among the oldest hay crops grown at the Dickinson Branch Station. Results of comparison trials with millets and other crops species used as annual hay crops are recorded in the station's first annual report dated 1907. One of the millet varieties grown that year, Siberian, was also included in the 1987 trials, and continues to be one of the better yielding varieties. The Proso millets, both red and white, are grown principally for grain. Hay from Proso and German foxtail is inferior in quality to that made from Siberian millet.

Table 29 summarizes data from the 1987 millet trial at Dickinson. Table 30 shows yields recorded in the drought year of 1988. Trials in both years were seeded on fallow.

Table 29. 1987 Dickinson Millet Variety Trial

Variety	Hay Yield Tons/A*	Grain Lbs./A	Test Wt. Lbs.
Siberian	1.6	2608	55.0
Red Proso	1.7	2592	59.0
Otana Oats	1.3	2560	36.0
White Proso	2.0	2465	56.5
German Foxtail	1.9	795	49.5
* at 12% moisture			
Seeding Rate: 25 lbs./A (Oats, 48 lbs./A)			
Seeding Date: May 6			
Harvest Date: Hay, July 29			
Hay: L.S.D. 5 % = 0.24 Tons/A C.V. = 13.0 %			
Hay: L.S.D. 5 % = 203.5 lbs./A C.V. = 8.5 %			

Table 30. 1988 Dickinson Millet Variety Trial

Variety	Hay Yield Tons/A*
Siberian	1.9
Red Proso	2.2
Monida Oats	0.8
White Proso	2.1
German Foxtail	1.8
*at 12% moisture	
Seeding Rate: 25 lbs./A (Oats, 48 lbs./A)	
Seeding Date: May 27	
Harvest Date: July 19	
L.S.D. 5% = 0.2 Tons/A C.V. = 6.3 %	

Hybrid Corn Comparison Trial

As shown in Table 31, corn silage and grain yields were very good considering the severe drought that prevailed throughout the growing season of 1988. This once again emphasized the adaptability of corn as an alternative crop for southwest North Dakota and the advisability of utilizing it in the diversified crop-livestock production systems recommended for southwest North Dakota.

Table 31. 1988 Dickinson Hybrid Corn Trial

Hybrid	Silage Tons/A	Harvest Moisture	Grain Bu/A	Test Wt. Lbs./Bu.
Dahlgren DC 405	9.4	70.5	34.9	53.0
Cargill 1927	9.1	67.1	29.9	54.6
Top Farm 1181	8.4	68.1	36.7	57.1
Interstate IS 201	8.1	66.4	37.5	55.6
Jacques J 2750	8.1	67.4	40.3	56.2
Interstate IS 313A	8.0	67.1	41.2	57.3
Jacques J 4170	7.9	70.7	30.9	56.1
Top Farm	7.3	68.4	44.1	56.6
Jacques J 2950	7.2	68.5	34.3	51.3
Dahlgren DC 430	7.1	71.0	29.4	55.6
Jacques J 4100	7.1	66.0	33.2	53.3
King Agro 2204	6.8	67.8	39.0	54.6
Cargill 809	6.7	70.3	40.8	53.6
King Agro 237	6.4	70.1	38.4	53.7
King Agro 228	6.0	71.7	29.6	52.1
King Agro 127	7.2	63.7	---	---
Moisture Basis:	70%		12%	
Seeding Date:	May 10		May 10	
Harvest Date:	Aug. 12		Aug. 25	
L.S.D. 5% =	1.7 Tons/A		11.3 Bu/A	
C.V. =	16.4 %		13.6 %	
Seeding Rate: 18,000 seeds/A				
Row Width: 36 inches				
Harvest Population: 14,933 plants/A				
Herbicide Applied: Prowl, preemergence; Bladex, postemergence				

Hybrid Sunflower Comparison Trial

Sunflower hybrid comparison trials at Dickinson and Hettinger included seventeen entries in 1988. Considering the droughty character of the growing season, the crop developed very well at both stations. Severe bird damage to the Dickinson planting rendered it unusable for purposes of comparison and it was abandoned. Results from Hettinger are given in Table 32 to show how the crop produced under the drought conditions in 1988.

Table 32. 1988 Hettinger Hybrid Sunflower Trial

Hybrid	Lbs./A @ 10% Moist.	Test Wt. Lbs./Bu	Percent Oil	Harvest Moist.
Cargill 208	1497	30.4	44.8	5.7
Cargill 207	1381	31.6	47.7	6.2
Agripro 2057	1203	27.8	46.1	4.5
Cargill SF 100	1136	29.9	40.0	5.6
Seedtec ST 317	1071	30.5	52.0	4.8
Cargill SF 187	1065	30.1	46.4	5.3
ContiSeed Hysun 354	1047	31.8	47.5	3.8
Jacques Capri	1022	29.5	50.3	5.9
Dahlgren 827	1013	28.9	42.9	5.0
Seedtec ST 330	911	30.8	47.6	5.1
Pioneer 6440	877	29.7	46.3	4.8
Cenex 6101	863	27.1	46.7	4.3
Cenex 8101	743*	27.8	48.2	4.4
Jacques Exp. 8713	694	30.3	45.1	7.1
Dahlgren 855	583	29.8	43.8	4.8
Interstate 3001	547	29.1	51.4	4.7
Interstate 7111	428*	27.6	48.9	4.4
*Severe Lodging				
Seeding Date: May 17				
Harvest Date: Sept. 26				
L.S.D. 5% = 436 lbs./A C.V. = 32.0 %				
Seeding Rate: 18,000 seeds/A				
Row Width: 30 inches				
Harvest Population: 14,933 plants/A				
Fertilizer Applied: 150 lbs./A 29-28-0				
Herbicide Applied: Treflan plus Eptam				

Cooperative Small Grain Nursery Trials

Plantings in 1988 included: Uniform Regional Hard Red Spring Wheat, Project leader Dr. Robert Busch, University of Minnesota; Uniform Hard Red Winter Wheat, Dr. Darryl Cox, Agronomy Dept., North Dakota State University; Uniform Regional Durum, Project leader Dr. R.G. Cantrell, North Dakota State University; Uniform Early and Uniform Midseason Oats, Project leader Dr. Howard Rines, University of Minnesota; Western Spring Barley and Western Dryland Spring Barley, Project leader Dr. E.A. Hockett, Montana State University; and Advanced Two-row Barley Nursery, cooperator Dr. Jerry Franckowiak, North Dakota State University. Field performance reports are furnished to respective project leaders for evaluation and compilation into composite regional reports. Required samples for quality analysis are furnished to appropriate state or USDA cereal chemistry laboratories upon request of respective project leaders. Trials included 30 varieties and experimental lines in the Uniform Regional hard spring wheat trial; 28 lines in the Uniform Regional durum nursery; 81 varieties and experimentals in three barley nurseries, and 60 varieties and experimental cultivars in the Uniform Early and Uniform Midseason Oat Nurseries.

Yields in all nursery plantings were low, reflecting the droughty growing conditions prevailing during the year. Hard spring wheat yields ranged from a low 3.6 to a high of 9.5 bushels per acre. Durum yields ranged from 5.4 to 10.9 bushels per acre. The highest barley yield in 1988 was 20.8 bushels per acre from ND 9147. Low barley yield was 3.2 bushels per acre. Oat yields ranged from a high of 25.6 bushels to 7.3 bushels per acre. Lowest test weights ever recorded at the station for oats, from 13.5 to 19 pounds per bushel, were produced in 1988, and are an indication of the severity of the drought.

Table 33. Uniform Regional Hard Red Spring Wheat Nursery

Entry	Bu/A Avg.	Test Wt. Lbs.	Heading Date	Height In.	1000 K.W. Grams
Marquis	9.2	57.0	21-Jun	18	22.0
Chris	7.4	57.0	13-Jun	17	23.2
Stoa	7.0	56.0	16-Jun	18	23.4
Era	8.5	57.5	15-Jun	18	22.4
Butte 86	5.7	58.5	12-Jun	18	23.0
SD 3005	3.6	59.5	11-Jun	15	23.6
SD 3000	7.4	56.0	14-Jun	19	23.4
SD 2980	6.5	60.5	12-Jun	17	23.8
SD 2999	7.6	56.0	12-Jun	16	22.4
SD 3014	7.6	57.5	15-Jun	17	24.5
MN 81110	8.2	55.0	15-Jun	16	25.6
MN 82354	8.4	57.0	13-Jun	15	23.4
MN 85324	8.6	57.0	15-Jun	19	27.7
MN 85110	5.2	57.0	15-Jun	17	31.5
MN 85328	7.5	57.0	13-Jun	15	23.8
MN 85167	7.5	55.0	17-Jun	17	25.4
ND 618	8.7	57.0	15-Jun	20	22.3
ND 626	8.3	58.0	15-Jun	20	26.0
ND 640	9.5	57.5	16-Jun	19	23.2
ND 650	7.9	59.0	17-Jun	19	24.4
ND 652	8.5	58.0	18-Jun	18	24.8
HS85-30	8.1	57.0	16-Jun	17	27.9
HS85-476	6.9	54.0	15-Jun	17	26.0
HS85-674	9.0	58.0	15-Jun	16	27.3
HS85-902	7.5	58.0	17-Jun	17	27.6
2375	5.9	60.0	13-Jun	14	27.1
FA 984-384	8.8	58.0	13-Jun	19	23.7
BZ 986-345	6.5	54.5	13-Jun	16	33.4
WA 7493	9.3	56.0	12-Jun	15	27.8
WA 7494	7.3	56.0	13-Jun	16	27.4

Seeding Date: April 20 Harvest Date: July 20

LSD .05 = 2.8 Bu/A CV = 22.6%

Table 34. 1988 Uniform Regional Durum Nursery, Dickinson

Entry	Bu/A Avg.	Test Wt. Lbs.	Days to Head	Height Cm	1000 K.W. Grams
Mindum	7.6	59.5	61	56	32.1
Stoa	6.4	58.5	57	44	29.7
Ward	7.0	59.0	58	45	29.4
Rugby	7.8	59.5	58	51	31.3
Vic	5.7	59.0	58	54	33.6
Lloyd	7.5	59.0	59	47	34.5
Monroe	8.1	58.0	56	57	30.9
Renville	7.3	59.0	59	57	31.5
Medora	8.8	60.0	58	53	34.2
Sceptre	8.2	59.0	59	52	30.3
Stockholm	8.0	59.5	59	42	31.4
Fjord	9.6	60.0	58	52	32.5
D 8261	7.6	59.0	58	48	31.2
D 8291	10.1	59.0	61	44	30.2
FA 883-323	8.6	59.0	59	50	29.9
D 8302	10.9	59.0	58	46	32.2
D 8370	8.1	60.0	60	44	31.1
D 8374	7.6	60.0	61	45	34.3
D 8380	6.4	59.5	60	43	33.3
D 83103	7.2	59.0	58	47	35.0
D 8434	7.0	60.0	54	46	33.3
D 8458	9.7	59.0	58	44	32.0
D 8459	10.3	60.0	58	45	33.5
D 8460	9.0	59.0	58	45	28.9
D 8475	8.3	61.0	58	45	32.7
D 8479	7.8	59.0	59	43	35.4
D 84130	5.4	61.0	60	41	34.4
D 84134	7.3	59.5	58	39	31.1
Seeding Date: April 20		Harvest Date: July 20			
LSD .05 = 3.7 Bu/A		CV = 33.1%			

Table 35. 1988 Advanced 2-Row Barley Nursery (Exp. 12)

Entry	Bu/A Avg.	Test Wt. Lbs.	Heading Date	Height Cm
Bowman-19	11.7	47.0	19-Jun	42
Hazen	9.5	45.0	20-Jun	43
Lewis	12.5	47.5	23-Jun	44
Morex	12.8	46.5	17-Jun	44
ND 5971	3.3	32.0	23-Jun	41
ND 8953	7.9	42.0	18-Jun	43
ND 8995	9.4	48.0	20-Jun	39
ND 9034	12.4	50.0	21-Jun	39
ND 9104	7.2	44.5	22-Jun	34
ND 9147	12.2	47.5	23-Jun	38
ND 9859	11.7	46.0	21-Jun	43
ND 9864	8.5	46.0	21-Jun	40
ND 9866	8.2	48.0	21-Jun	44
ND 9867	9.4	48.0	22-Jun	41
ND 9870	11.0	47.5	22-Jun	47
ND 9905	14.4	47.0	22-Jun	47
ND 9917	9.0	45.0	22-Jun	40
ND 9926	9.8	47.0	23-Jun	39
ND 10030	11.1	48.0	23-Jun	39
ND 10042	13.4	48.0	22-Jun	40
ND 10071	12.6	49.0	22-Jun	46
ND 10122	10.7	45.0	23-Jun	47
ND 10143	10.7	46.0	22-Jun	34
ND 8671-3	3.2	33.0	22-Jun	40
ND 8671-18	4.8	35.5	23-Jun	44

Seeding Date: April 20 Harvest Date: July 21

LSD .05 = 3.9 Bu/A CV = 23.8%

Table 36. 1988 Western Spring Barley Nursery, Dickinson

Entry	Bu/A Avg.	Test Wt. Lbs.	Heading fr 1/1	Height Cm	----------Plumpness %---------- 6/64	5.5/64	Pan
Trebi *	14.6	41.0	177	34	69.7	16.4	13.9
Steptoe *	11.7	40.0	169	37	77.4	13.9	8.7
Klages	13.1	42.0	173	38	68.3	17.3	14.4
Morex *	18.5	48.0	173	35	75.8	13.1	11.1
ID 223222 *	14.1	44.0	172	43	70.1	17.2	12.7
MT 81143	18.6	46.0	173	40	77.3	13.4	9.3
MT 81502	17.2	46.0	177	40	70.0	13.6	16.4
ND 7691	15.7	44.0	177	42	71.9	17.6	10.5
VD 403582	15.4	46.0	172	36	73.6	19.5	6.9
PB 265	16.1	45.0	177	42	74.2	14.9	10.9
SF 8623 *	13.8	45.0	176	35	73.5	16.2	10.3
SM 8618	15.4	45.0	177	39	65.2	20.2	14.6
WA 877178	19.7	48.0	173	40	75.4	15.1	9.5
WA 102178 *	15.6	46.0	177	38	64.6	21.6	13.8
BA 4039	19.1	46.0	175	33	77.4	12.2	10.4
BA 8529	15.0	47.0	177	38	74.0	15.4	10.6
ID 82519 *	10.9	50.0	169	31	76.0	17.7	6.3
ID 71966 *	6.9	45.0	169	26	67.4	23.2	9.4
MT 83533	13.9	46.0	176	35	79.6	13.0	7.4
MT 140523	20.5	49.0	177	36	75.1	15.4	9.5
ND 9147	20.8	49.0	173	34	80.3	11.4	8.3
OR 842008	13.9	42.0	176	34	71.9	13.6	14.5
OR 842011	11.5	41.0	NA	26	58.8	19.2	22.0
UT 1731 *	9.5	38.0	170	35	76.9	12.4	10.6
UT 1075 *	14.5	43.0	NA	30	61.1	25.8	13.1
UT 2507 *	11.9	38.0	169	32	69.4	18.7	11.9
WA 944883	19.3	46.0	NA	34	75.0	12.8	12.1
WA 128098 *	7.9	42.0	171	34	83.6	10.0	6.4
WA 136278	10.7	45.0	NA	36	67.7	14.6	17.7
WP 7877 *	14.8	45.0	173	32	64.4	27.8	7.8

*6-row

Seeding Date: April 20 Harvest Date: July 26

LSD .05 = 5.8 Bu/A CV = 24.3%

Table 37. 1988 Western Dryland Spring Barley Nursery, Dickinson

Entry	Bu/A Avg.	Test Wt. Lbs.	Heading fr 1/1	Height Cm	----------Plumpness---------- 6/64	5.5/64	Pan
Munsing	16.5	47.0	174	35	69.9	21.9	8.2
Steptoe	10.0	41.0	169	37	74.7	12.4	13.9
Clark	14.0	48.0	174	37	78.5	14.2	8.3
Hector	12.5	46.0	177	38	75.2	13.7	11.1
ID 810099	10.6	44.0	177	26	36.4	43.9	19.7
Lewis	18.0	46.0	174	36	74.1	16.1	9.9
Bowman	12.8	45.0	172	37	76.9	12.1	11.1
BA 280350	15.5	46.0	177	34	70.7	16.2	13.2
ID 810274	12.4	45.0	177	36	71.7	14.5	13.8
MT 81161	11.6	41.5	178	42	72.5	16.2	11.4
MT 140523	15.4	51.0	172	39	82.8	11.2	6.0
MT 83422	17.3	47.0	177	37	76.8	12.8	10.4
MT 83424	13.0	46.0	176	41	72.2	17.6	10.2
MT 83435	18.4	49.0	177	42	74.0	16.0	10.1
MT 83533	15.7	48.0	178	33	75.9	15.0	9.1
ND 8671	15.4	48.0	172	39	86.8	8.2	5.0
WA 877178	12.2	47.0	177	35	74.4	12.7	12.9
ID 71966	14.3	46.0	169	33	73.0	20.4	6.6
MT 83491	14.4	45.0	178	36	71.7	16.8	11.5
MT 83518	12.1	44.0	178	38	74.0	13.3	12.7
ND 9870	15.8	48.0	172	42	90.0	5.6	4.9
ND 10122	18.0	49.0	176	46	82.5	9.8	8.2
WA 701883	11.9	46.0	177	38	83.5	7.9	8.6
WA 755283	15.5	49.0	174	32	74.3	18.3	7.4
WA 777383	9.5	43.0	176	37	77.2	12.3	10.5
WA 102178	7.1	38.0	174	37	81.9	10.2	7.9

Seeding Date: April 20 Harvest Date: July 25

LSD 0.5 = 4.1 Bu/A CV = 18.0%

Table 38. 1988 Uniform Early Oats Nursery, Dickinson

Entry	Bu/A Avg.	Test Wt. Lbs.	Height Cm	Heading Date	Heading fr 1/1
Otee (ck)	17.0	14.5	48	15-Jun	166
IL 81-1882	17.3	16.0	39	15-Jun	166
IL 83-8037-1	11.3	17.0	44	13-Jun	164
IL 83-8022	17.6	18.0	42	14-Jun	165
IL 84-3098-1	13.9	16.5	42	14-Jun	165
IL 80-2294	11.6	16.5	38	13-Jun	164
Don (ck)	16.7	16.0	43	14-Jun	165
IA D623-15	16.8	17.0	45	14-Jun	165
IA X933-11-2	7.3	16.0	49	12-Jun	163
Clintford (ck)	17.0	18.0	43	14-Jun	165
PA 8196-1334	18.5	17.0	43	14-Jun	165
PA 8290-7026	20.3	16.5	44	14-Jun	165
PA 8393-15050	13.3	17.5	37	14-Jun	165
PA 8393-17361	22.1	18.0	39	16-Jun	167
SD 830095	17.5	18.0	42	13-Jun	164
MN 84134	18.4	14.5	48	17-Jun	168
Andrew (ck)	12.6	18.5	45	12-Jun	163
MO 07831	14.4	15.5	39	13-Jun	164
MO 07929	12.7	17.5	38	13-Jun	164
MO 07824	22.0	17.5	36	15-Jun	166
MO 07941	10.7	16.0	37	15-Jun	166
MO 08054	15.8	16.0	38	15-Jun	166
Bates (ck)	17.2	17.0	40	13-Jun	164
WI X487 2-1-3	11.8	16.0	35	12-Jun	163

Seeding Date: April 20 Harvest Date: August 5

LSD .05 = 6.3 Bu/A CV = 24.6%

Table 39. 1988 Uniform Midseason Oat Nursery, Dickinson

Entry	Bu/A Avg.	Test Wt. Lbs.	Height Cm	Heading Date	Heading fr 1/1
IL 81-1882	18.9	15.0	47	17-Jun	168
IL 81-2570	16.0	15.5	36	17-Jun	168
IL 82-2154	17.3	17.5	46	20-Jun	171
IL 83-8518-1	14.9	19.0	41	16-Jun	167
IL 82-2070	17.1	18.0	30	16-Jun	167
Ogle	12.8	17.0	42	18-Jun	169
P7869D1-5-17-3	18.8	16.5	40	18-Jun	169
OA 698-2	20.9	16.0	41	17-Jun	168
W 82056	20.4	18.0	45	20-Jun	171
W 83101	19.0	17.0	47	22-Jun	173
W 84061	24.8	16.5	51	21-Jun	172
NY 80002-1	19.3	17.0	47	21-Jun	172
PA 8494-9588	20.6	15.5	44	21-Jun	172
PA 8494-4099	19.6	19.0	42	18-Jun	169
PA 8393-11138	17.0	18.0	46	21-Jun	172
PA 8494-11717	14.7	17.5	31	15-Jun	166
PA 8393-1500	25.6	18.5	37	21-Jun	172
Clintland	16.8	19.0	41	15-Jun	166
SD 820045	15.8	14.5	43	17-Jun	168
SD 840104	19.1	17.5	43	21-Jun	172
SD 84065	16.6	18.5	43	14-Jun	165
MN 84231	15.0	17.0	45	15-Jun	166
MN 85175	17.0	17.0	42	16-Jun	167
Gopher	13.3	16.5	44	17-Jun	168
ND 820294	19.6	17.5	47	15-Jun	166
ND 830775	16.2	15.0	46	16-Jun	167
ND 830646	18.9	17.0	41	16-Jun	167
ND 840876	20.1	14.5	41	22-Jun	173
ND 840341	17.3	13.5	48	21-Jun	172
ND 840769	20.2	14.0	50	19-Jun	170
Dal	16.1	17.0	46	15-Jun	166
WI X487 2-10	19.3	16.5	43	15-Jun	166
WI X487 2-2	15.9	18.0	43	15-Jun	166
WI X4223-2-1-1	19.0	16.0	44	15-Jun	166
WI X5208-2	18.5	18.0	44	16-Jun	167
WI X5240-1	22.6	19.0	42	17-Jun	168

Seeding Date: April 20 Harvest Date: August 5

LSD .05 = 7.2 Bu/A CV = 23.3%

MINIMUM TILLAGE AND SEEDING, AND DOUBLE DISKING AND CONVENTIONAL SEEDING ON RECROP

In 1976 there was no significant difference in wheat production between minimum tillage and conventional tillage on second cropping. Growing conditions were excellent in 1976.

In 1977, hot, dry spring weather conditions were not particularly favorable to germination and early crop growth because of dry surface soil. Because of the small diameter of the rotating coulters on the John Deere 1500 Power till seeder, it was not possible to place seed deep enough to get it into moist soil. As a consequence germination was spotty and delayed until later rainfall came. Excessive weed growth was also a problem on this treatment. Penetration of the surface soil and satisfactory seed placement was not as difficult with the Melroe 701 minimum tillage drill. Germination and growth was satisfactory and production was double that for the Power till seeder. Conventional disking and seeding was the best production method in the 1977 comparison.

In 1978 and 1979 only the Melroe 701 and the conventional tillage and seeding treatments were compared. Initial growth was slower on the minimum tillage treatment. This may be partly due to lower surface temperatures caused by the reflective and insulating effects of the straw and stubble on the field surface. Weed problems were also greater problems on the minimum tillage treatment.

In 1980 the Melroe 701 drill and conventional seeding was compared once again. Because of severe drought, production was zero for both treatments.

In 1981 the John Deere hoe drill was used for seeding the minimum tillage treatment. A good stand of wheat resulted from both the minimum tillage seeding and the conventional seeding, with the minimum tillage treatment producing slightly higher yields for the first time since the trial was begun.

In 1982 the John Deere hoe drill was once again used for seeding the minimum tillage treatment, with the conventional treatment consisting of double disking and seeding with the double disk press drill. Excellent growing conditions produced the highest yields recorded in this trial over the past seven year period.

In 1983 the LIlliston no-till drill was used for seeding the minimum tillage treatment. The conventional treatment once again consisted of double disking the land in preparation for seeding, then seeding with the double disk press drill. Ample stored soil water from heavy fall precipitation, and otherwise excellent growing conditions produced the highest yields recorded in the trial over the past 8 year period, with no advantage shown for either cropping method in this trial this year. Two additional trials in 1983 comparing no-till, conventional disking and seeding and the plow-packer-press drill on recrop land produced the following results. Barley yields were 49.6 bushels per acre for the plow-packer-press drill treatment, 28.1 for the no-till treatment and 27.9 for conventional disking and seeding.

Wheat seeded in a similar comparison trial produced 22.3 bushels per acre on plowing, 19.2 bushels per acre on conventional disking and 17.7 bushels per acre on the no-till treatment.

Equipment and seeding method for the 1984 trial was the same as described for 1983. The fall of 1983 was drier than average with less than two and on-half inches of precipitation in the four month period, September through December. Precipitation continued below average from January until April 27 when a thirty inch snowfall provided enough soil water to carry the crop through the driest May in 93 years of record. Excellent distribution of five inches of rainfall in June was followed by a very dry July.

In 1985, a Lilliston no-till drill was used again for seeding the minimum tillage treatment. The preceding fall and winter precipiatation was 1.12 inches below average. April precipitation was considerably lower than average. May rainfall of 4.31 inches was most effective for crop growth. June rains were less than average but were well distributed. Cool temperatures in June, promoted excellent growth of small grain crops.

In 1986, the same Lilliston no-till drill was used for seeding the minumum tillage treatment. The conventional treatment once again consisted of double-disking in preparation for seeding, followed by seeding with a double disk press drill. Effective weed control was provided by the use of Hoelon-bromoxynil tank mix applied at recommended rates.

Fall precipitation during the last four months of 1985 was two inches above average and provided good residual soil water for fallow and recrop stubble. Above average precipitation was well distributed during the growing season except for a dry period starting on May 25 and extending through June. While total precipitation for June was above average, 3.30 inches of that total fell during the last four days of the month.

In 1987, the LiIliston no-till drill was used once again for seeding the minimum tillage treatment. The conventional treatment consisted of double-disking in preparation for seeding, followed by seeding with a double disk press drill. Effective weed control was provided by the use of Hoelon-bromoxynil tank mix applied at recommended rates.

Total precipitation for the twelve month period, September, 1986 through August, 1987 was 21.19 inches which was slightly higher than for the preceding twelve month period. However, distribution of precipitation this year was much less favorable for crop growth than that of a year ago, resulting in considerably lower yields. Precipitation in April was only .17 inches. In May 1.87 inches and in June 2.32 inches, totalling 4.36 inches for the three month period. This was nearly 3.00 inches below normal. Coupled with below average precipitation was above average temperatures. Temperature for April was 7°F, for May 3°F and for June 5°F higher than the 94 year average.

High temperatures had a major effect on crops. From April through June the number of wheat growing degree days—the sum of daily degrees above 32—ranged from 500 to 700 more than normal across the state. This means that by July 1 the growing season for perennial plants and early-seeded crops was 14 to 17 days more advanced than usual. Above normal heat combined with a dry spell in April and May to reduce crop yields.

In 1988, the Lilliston no-till drill was used once again for seeding the minimum tillage treatment. The conventional treatment consisted of double-disking in preparation for seeding, followed by seeding with a double disk press drill. Effective weed control was provided by the use of Hoelon-bromoxynil tank mix applied at recommended rates. Severe drought prevailed throughout the growing season of 1988.

Total precipitation for the twelve month period, September 1987 through August, 1988 was 8.63 inches as compared to the 94 year average of 15.89 inches.

Low rainfall throughout the entire growing season was coupled with temperatures that were far above average. The month of June was the most devastating in terms of adverse weather with average temperatures 14°F higher than the 94 year norm, and with precipitation 2 inches below average. Evaporation for June, July and August was 34.9 inches compared to the norm of 21.3 inches. High temperature, low precipitation and excessive wind combined to create the worst growing conditions experienced in this region for the past fifty years.

Table 40. Minimum Tillage, Double Disking and Seeding for Wheat Production on Recrop

	Yield in bushels per acre on:	
	Minimum Tillage and Seeding	**Double Disking and Conventional Seeding**
1976	28.0	27.0
1977	12.6	15.0*
1978	10.3	28.5*
1979	9.6	15.9*
1980	0.0	0.0
1981	15.3	14.3
1982	20.9	31.8*
1983	39.0	38.5
1984	20.4	27.2*
1985	14.8	20.6*
1986	24.3	30.6*
1987	4.8	9.3*
1988	0.0	0.0
13 Year Average	15.4	19.9

*Years when yields exceeded no-till yields by significant margin.

WHEAT PRODUCTION ON FALLOW, AND SECOND CROPPING

In 1976, an excellent year for small grain production on stubble land in southwestern North Dakota, yields on conventional summerfallow were 43 bushels per acre, on second cropping 27 bushels per acre and on continuous cropping 22 bushels per acre. In 1977, a year when hot, dry spring weather conditions were not particularly favorable to the germination and early growth of the crop, yields were appreciably reduced, even though rainfall in late May and June provided ample soil water for satisfactory crop growth. Yields on fallow were 26.9 bushels per acre, on second cropping 11.5 and on continuous cropping 5.5 bushels per acre. Relative differences between production methods were remarkably similar for both years.

In 1978, wheat on summerfallow averaged 38.5 bushels per acre in this trial compared with 31.4 on second cropping and 30.6 on continuous cropping. High yields on stubble land were a result of the excellent soil water recharge provided by the well above average precipitation coming in the fall of 1977 plus adequate seasonal moisture and cool growing season temperatures.

In 1978, fall precipitation was only 4.58 inches compared to more than 10 inches in 1977. In addition, a late spring planting date and a very dry period extending from April 20 to June 18 was unfavorable for good, uniform germination and early crop growth. The effectiveness of stored soil water in fallow under stressed conditions is readily evident in the harvested yields.

In 1980, severe drought conditions prevailed through the third week in June. Grain production was reduced on summerfallow and was zero on recrop and continuous cropping treatment.

In 1981 early seeded small grain crops were severely frosted by a severe freeze on May 9th, but seemed to recover very well. The most severe weather affecting crop production occurred the first ten days in July when temperatures of 93°F and above were recorded on 7 days, with a maximum reading of 110°F. Evaporation measured 3.93 inches during this ten day period.

Precipitation during the last four months of 1981 was above average, providing a good soil water recharge. Snowfall was above average throughout the winter months, providing nearly three inches of precipitation from January through March. Above average rainfall through the growing season was well distributed.

The growing season of 1982 is best characterized as cool, wet, and late.

Rainfall in September and October, 1982 was well above average, providing an excelelnt soil water recharge. Total fall precipitation from September through December, 1982 was 9.4 inches compared to the 90 year average of 3.16 inches. Precipitation of 4.9 inches during April through June was below average, but for the rest of the year nearly normal. The combination of stored rainfall in September and October, 1982 and nearly normal seasonal precipitation provided ample water for good crop growth.

Mean temperatures for April, May and June in 1983 were well below the 71 year average. Hot spells of several days in July and August when temperatures exceeded 90°F affected late seeded grain but early seeded crops escaped serious damage from high temperatures.

The fall of 1983 was drier than average with less than two and one-half inches of precipitation in the four month period September through December. Precipitation from January through March 1984 was also below average, and the dry period extended well into April, with the largest amount of precipitation during the month coming in the form of thirty inches of snowfall on the 27th. May was the driest in 93 years of record. Excellent distribution of five inches of rain in June was followed by a very dry July.

In 1985, the fall and winter precipitation was 1.12 inches below average. April precipitation was considerably lower than average. May rainfall of 4.31 inches was the most effective for crop growth. June rains were less than average but were well distributed. Cool temperatures in June, which included a freeze on the 12th, promoted excellent growth of small grain crops.

Fall precipitation during the last four months of 1985 was two inches above average and provided good residual soil water for fallow and recrop stubble. Above average precipitation was well distributed during the growing season except for the dry period starting May 25 and extending through June. While total precipitation for June was above average, 3.30 inches of that total fell during the last four days of the month. The growing season was generally cool with temperatures in April, May, July and August well below the 94 year average.

Total precipitation for the twelve month period, September, 1986 through August, 1987 was 21.19 inches which was slightly higher than for the preceding twelve month period. However, distribution of precipitation this year was much less favorable for crop growth than that of a year ago, resulting in considerably lower yields. Precipitation in April was only .17 inches, in May 1.87 inches and in June 2.32 inches, totaling 4.36 inches for the three month period. This was nearly 3.00 inches below normal. Coupled with below average precipitation was above average temperatures. Temperature for April was 7°F, for May 3°F and for June 5°F higher than the 94 year average.

High temperatures had a major effect on crops. From April through June the number of wheat growing degree days—the sum of daily degrees above 32—ranged from 500 to 700 more than normal across the state. This means that by July 1 the growing season for perennial plants and early-seeded crops was 14 to 17 days more advanced than usual. Above normal heat combined with a dry spell in April and May to reduce crop yields.

Severe drought prevailed throughout the growing season of 1988.

Total precipitation for the twelve month period, September, 1987 through August, 1988 was 8.63 inches as compared to the 94 year average of 15.89 inches.

Low rainfall throughout the entire growing season was coupled with temperatures that were far above average. The month of June was the most devastating in terms of adverse weather with average temperatures 14°F higher than the 94 year norm, and with precipitation 2 inches below average. Evaporation for June, July and August was 34.9 inches compared to the norm of 21.3 inches. High temperature, low precipitation and excessive wind combined to create the worst growing conditions experienced in this region for the past fifty years.

Table 41. Wheat Production on Fallow and Recrop

	Yield (Bushels per Acre)	
Year Treatment:	**Fallow**	**Continuous Re-cropping**
1976	43.0	22.0
1977	26.9	5.0
1978	38.5	30.6
1979	32.4	12.8
1980	22.3	0.0
1981	21.3	14.0
1982	33.9	24.9
1983	46.1	38.5
1984	34.5	27.2
1985	36.7	20.6
1986	57.8	30.6
1987	20.7	9.3
1988	9.4	0.0
13 Year Average	32.6	18.1

CROPPING SYSTEMS RESEARCH

This trial is designed to include a comparison of several crop rotation sequences as follows:

Treatment 1: Compares a two year rotation of wheat and corn with a two year fallow-wheat rotation. Early corn varieties for grain production will be used in this comparison.

Treatment 2: Compares a two year rotation of wheat and sunflowers with a two year fallow-wheat rotation.

Treatment 3: Records production in a four year cropping sequence of sunflower on wheat stubble, barley on sunflower stubble, fallow on barley stubble and wheat on fallow.

Treatment 4: Compares wheat on fallow, wheat on continuous cropping and wheat on no-till recrop.

In 1983 fertilizer was applied on all recrop, corn and sunflowers at the rate of 80 lbs. N, 30 lbs. P_2O_5 and no K_2O. All wheat on fallow received 40 lbs. N, 30 lbs. P_2O_5 and no K_2O. All land to be fallowed was not fertilized. In 1984 fertilizer was applied on all corn, sunflower and small grain recrop at the rate of 60 lbs. N, 30 lbs. P, and no K_2O. All wheat on fallow received 30 lbs. N, 30 lbs. P and no K_2O. Land to be fallowed was not fertilized. In 1985 and 1986 60 lbs. of N and 30 lbs. of P were applied to all corn, sunflower, and small grain recrop. Fallow land was treated with 30 lbs. of N and 30 lbs. of P.

In both 1983 and 1984 weed control was accomplished with: Alachlor at 2 lbs. per acre and Dicamba at 0.25 lbs. per acre in a tank mix on corn; Trifluralin at 0.5 lbs. per acre preplant incorporated on sunflower; and, Diclofop at 0.75 lbs. per acre and Bromoxynil at 0.25 lbs. per acre in a tank mix on small grain. In 1985 and 1986, wheat and barley were sprayed with a tank mix of Hoelon at 2 pints per acre plus Buctril at 1 pint per acre. Weeds in sunflowers were controlled with 0.5 lbs. per acre Trifluralin preplant incorporated.

Varieties used in the 1983 cropping systems trial were: Alex wheat, Morex barley, Keltgen 582 corn and Interstate 777S sunflower. In 1984 Alex wheat and Morex barley were used, along with Jacques JX21 corn and Interstate 7111 sunflower. Stoa wheat, Bowman barley, Jacques JX21 corn, and Interstate 7111 sunflower were seeded in 1985. Stoa wheat, Bowman barley, and Interstate 7111 sunflower were again used in 1986 along with Dahlgren DC408 corn.

Tillage on fallow to prepare a seedbed was with a spring tine cultivator and harrow. Continuous crop stubble, sunflower stubble, and corn stubble land were double disked in preparation for seeding, as was all wheat stubble planted to corn or sunflowers. Excellent yields recorded for all crops in all rotation systems were the result of a combination of high fertility, ample reserve soil water, adequate seasonal precipitation, reasonably good growing conditions and satisfactory cropping management in 1983. Because of considerable drier growing conditions in 1984, yields were reduced with small grains showing the most reduction on all treatments. May 1985 rainfall was well above average. Cool temperatures in June slowed development of row crops but promoted excellent growth of small grains.

The excellent yields for all crops in 1986 was the result of above average precipitation and satisfactory growing conditions during most of the growing season. One period of dry weather extending from May 25 through June 25 resulted in soil water stress under recrop.

High temperatures had a major effect on crops in 1987. From April through June the number of wheat growing degree days—the sum of daily degrees above 32—ranged from 500 to 700 more than normal across the state. This means that by July 1 the growing season for perennial plants and early-seeded crops was 14 to 17 days more advanced than usual. Above normal heat combined with a dry spell in April and May to reduce crop yield.

In 1988, tillage and seeding procedures, fertilizer application and weed control were the same as was used in previous years.

Severe drought prevailed throughout the growing season of 1988.

Total precipitation for the twelve month period, September, 1987 through August, 1988 was 8.63 inches as compared to the 94 year average of 15.89 inches.

Low rainfall throughout the entire growing season was coupled with temperatures that were far above average. The month of June was the most devastating in terms of adverse weather with average tempertures 14°F higher than the 94 year norm, and with precipitation 2 inches below average. Evaporation for June, July and August was 34.9 inches compared to the norm of 21.3 inches. High temperature, low precipitation and excessive wind combined to create the worst growing conditions experienced in this region for the past fifty years.

Data from the cropping systems trial for the years 1983 through 1988 are summarized in Table 42.

Table 42. Cropping Systems Trial 1983-1988

Crop and Rotation:	Yield							6 Yr. Avg.	% of Fallow
	1983	1984	1985	1986	1987	1988			
Wheat yields on:									
Fallow	47.1	34.5	36.7	57.8	20.7	9.4		34.4	100
Continuous re-crop	38.5	27.2	20.6	36.1	9.3	0.0		22.0	64
No-till continuous	39.0	20.4	14.8	22.9	4.8	0.0		17.0	49
Sunflower stubble	46.1	21.4	16.9	39.5	6.5	0.0		21.7	63
Corn stubble	47.2	32.2	29.6	45.4	16.6	0.0		28.5	83
Barley yields on:									
Sunflower stubble	64.8	36.3	31.5	43.6	26.8	0.0		33.7	
Corn yields on:									
Wheat stubble									
Grain (bushels/acre)	72.6	72.4	56.5	57.2	82.4	11.2		58.7	
Silage (ton/acre)	10.3	8.9	12.6	9.7	12.7	4.5		9.8	
Sunflower on:									
Wheat stubble (lbs./acre)	1784	1664	1224	2423	1182	0.0		1380	