IMPROVING WHEAT VARIETIES FOR NEBRASKA

1999 STATE BREEDING AND QUALITY EVALUATION REPORT

Report to the

NEBRASKA WHEAT DEVELOPMENT, UTILIZATION
AND MARKETING BOARD

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I. INTRODUCTION

Wheat variety development research in Nebraska is cooperative effort between the Agricultural Research Division, IANR of the University of Nebraska-Lincoln, and the Agricultural Research Service/USDA, Northern Plains Area. Winter wheat breeding, which includes variety, line, hybrid parent, and germplasm development, is a major component of the state wheat improvement research. This report will deal only with the state portion of the total wheat breeding effort. The basic project is located in the Department of Agronomy at the University of Nebraska-Lincoln. Very important contributions come from state, and federal researchers in the department and at the Nebraska research and extension centers, from state and private researchers in South Dakota, Wyoming, Kansas, Oklahoma, Texas, and Colorado, from researchers in the Department of Plant Pathology (both state and federal), from plant pathologists located at the USDA Cereal Disease Laboratory, St. Paul, Minnesota, and USDA entomologists at Manhattan, Kansas and Stillwater, Oklahoma. All of these programs invest time and funds in this program. Grants from the Nebraska Wheat Development, Utilization and Marketing Board provide key financial support for this research. Without the Wheat Board's support, much of the state breeding efforts would be curtailed and many of the wheat quality analyses to evaluate our breeding material would not be available.

II. THE 1998-99 NEBRASKA WHEAT CROP

1. Growing Conditions

The 1999 crop was planted into soils with adequate or received adequate moisture shortly after planting. Planting was generally on time. The winter was mild and there was no winterkilling due to cold temperatures anywhere in the normal winter wheat production areas. In the spring, moisture was adequate to above average in eastern and central Nebraska, dry in the western central part and eastern panhandle of Nebraska, and adequate moisture in the western panhandle. A good crop was generally produced though pockets of drought (i.e. near Grant) and areas of excessive rainfall leading to lodging did exist. In general, there was no winterkilling and sufficient moisture that most lines were able to finish with little stress. Hence in some environments, winter tender wheats which often are winterkilled and later wheats which are often “pinched” by dry weather did well. The adequate moisture led to conditions that were ideal for foliar diseases (i.e. leaf blotches and rusts) in eastern Nebraska and lodging in much of central Nebraska. Hence strong-strawed semi-dwarf lines with good disease resistance were favored in many locations. Wesley, Alliance, Culver, and 2137 performed well across the state, as did the newly released Millennium.

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2. Diseases

Foliar diseases are highly dependent on moisture, hence foliar diseases were important on the southeastern and southcentral wheat crop. In 1999, the main diseases were foliar leaf blotches and leaf rusts. Wheat soilborne mosaic virus, and wheat streak mosaic virus were present, but caused little damage. Stem rust was barely present, and below economic loss levels. Many diseases (wheat streak mosaic virus,

barley yellow dwarf virus, leaf rust, stem rust, and various leaf blotches) can be extremely destructive under the appropriate conditions and will continue to need close monitoring, as will the survey for karnal bunt. Drs. John Watkins and Roy French continue to be invaluable in disease identification, survey, and understanding.

3. Insects

In general, most insect pests were at low levels on wheat in 1999. Russian wheat aphid damage was small and required little spraying. Chinch bugs and Hessian fly were generally minor. Wheat curl mite, the vector for wheat streak mosaic virus, and aphids, the vectors for barley yellow dwarf virus, are important insect pests because they can carry devastating diseases.

4. Wheat Production

The 1999 Nebraska Wheat Crop was estimated at 86,400,000 bu, which represented a 48 bu/a state average yield on 1,800,000 harvested acres. 2,000,000 acres were planted to winter wheat. This crop was larger than the 1998 crop (82,800,000 bu harvested from 1,800,000 acres with a 46 bu/a yield average), the 1997 crop (70,300,000 bu harvested from 1,900,000 acres with a 37.0 bu/a yield average), and the 1996 crop (73,100,000 bu harvested from 2,150,000 acres with a 34 bu/a yield average). Despite continued genetic improvement, the main determinant in wheat production seems to be acres harvested and weather.

5. Cultivar Distribution

Arapahoe continues to be the most popular and widely grown variety (25.0% of the state) in 1999. To put Arapahoe's acceptance in perspective, it was grown on more acres than varieties developed by other states and by commercial seed companies combined in Nebraska. Niobrara was the second most widely grown variety followed by Alliance and Pronghorn (which is rapidly replacing Centura).

While no wheat listed below has all of the characteristics of an ideal wheat, the diverse wheats provide the grower an opportunity to choose high yielding, high quality wheats that have resistance or tolerance to the diseases or insects prevalent in his or her region. Cultivars developed by the cooperative USDA-University of Nebraska wheat improvement program occupied 77% of the state acreage. Other public varieties occupied 12% and private varieties occupied 11.0% of the state acreage.

NEBRASKA—WHEAT VARIETIES
ESTIMATED PERCENTAGES PLANTED TO EACH VARIETY, 1993-1999

				%			
Variety	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
2137	-----	-----	-----	-----	-----	1.4	3.6
Agripro Abilene	6.2	3.0	4.1	4.2	2.2	2.4	2.7
Agripro Laredo	-----	-----	1.2	1.1	-----	-----	----
Agripro Ogallala	-----	-----	-----	2.2	1.5	1.6	1.2
Agripro Thunderbird	12.4	10.0	7.8	5.9	5.7	3.5	3.9
Agripro Tomahawk	1.0	3.9	3.1	2.9	2.5	2.6	1.6
Akron	-----	-----	-----	-----	-----	-----	1.6

Alliance	-----	-----	-----	2.7	7.3	8.4	10.4
Arapahoe	28.6	32.9	33.6	31.7	30.1	28.3	25.0
Buckskin	4.7	5.5	4.0	5.8	6.0	6.5	5.0
Centura	8.5	11.1	8.0	9.2	9.8	7.7	7.7
Ike	-----	-----	-----	1.6	1.3	1.5	-----
Jagger	-----	-----	-----	-----	-----	-----	1.1
Karl/Karl 92	2.1	3.8	6.9	7.3	6.9	6.6	5.5
Niobrara	-----	-----	-----	1.4	6.5	7.5	11.4
Pronghorn	-----	-----	-----	-----	-----	4.6	7.8
Redland	7.9	6.3	4.3	3.4	1.2	1.0	-----
Scout & Scout 66	2.8	1.6	3.4	2.4	1.6	2.3	1.0
Siouxland	8.2	6.4	4.0	4.7	3.2	1.2	1.1
Vista	-----	-----	4.6	3.6	4.6	3.9	2.1
Windstar	-----	-----	-----	-----	-----	-----	1.3
Other Public Varieties	4.2	6.0	5.9	4.9	5.4	5.9	4.1
Other Private Varieties	1.9	3.3	1.9	0.8	3.1	1.9	1.9

6. New Cultivars

Three new cultivars, Cougar, Millennium, and Nuplains, were formally recommended for release in 1999. Cougar is a hard red winter wheat (*Triticum aestivum* L.) cultivar developed cooperatively and jointly released by the Nebraska Agricultural Experiment Station and the USDA-ARS. Cougar was selected from the cross NE85707/Thunderbird. The pedigree of NE85707 is Wrr*5/Agent//Kavkaz/4/ NE63218/KY58/3/ NTH/2*CMTH//PNC/*2 CNN. Cougar was released primarily for its having a very long coleoptile (similar to Scout 66) with exceptional straw strength (superior to 2137 and Wesley). It has excellent test weight and kernel size. Similar to Thunderbird its yield level is lower except where its coleoptile length and standability are needed.

Cougar is an awned, white-glumed cultivar. Its field appearance is most similar to 'Thunderbird' and ‘Big Dawg’. After heading, the canopy is open and upright. The spike is tapering in shape, moderately long to long, and middense. The glume is short and wide, and the glume shoulder is square. The beak is moderately short in length with an acuminate tip. The spike is usually erect to inclined at maturity. Kernels are red colored, hard textured, midlong, and elliptical to ovate in shape. The kernel has no collar, a midsize to large brush of medium length, rounded cheeks, midsize germ, and a midwide and shallow crease.

Cougar was tested as NE93496 in Nebraska yield nurseries starting in 1994 and in the Southern Regional Performance Nursery in 1997 and 1998, and in Nebraska cultivar performance trials in 1998 and 1999. In two years of testing in Nebraska cultivar performance trials, it has performed competitively in the southeast, southcentral, and southwestern Nebraska, areas where historically Thunderbird also performed well. In this region (17 environments), Cougar had a yield of 61.0 bu/a (4100 kg/ha) which was lower than Wesley (69.9 bu/a, 4700 kg/ha) and 2137 (68.9 bu/a, 4630 kg/ha) but superior to Pronghorn (56.8 bu/a, 3820 kg/ha), the only other modern, long coleoptile wheat in the trial. Cougar was ranked 38th of 45 lines tested in the Southern Regional Performance in 1997 (36 environments) and 42nd of 45 lines tested in 1998 (35 environments). The main advantage Cougar has when compared to most

other available wheat cultivars, within its area of adaptation, is its long coleoptile, exceptional straw strength, good grain volume weight and kernel size, and competitive grain yields.

Other measurements of performance from comparison trials show that Cougar is medium early in maturity, about 1 d earlier flowering than Arapahoe, similar to Alliance, and 1 d later than Pronghorn. It has a long coleoptile, similar to Scout 66 and Pronghorn, and longer than Arapahoe, Alliance, and Wesley. The mature plant height of Cougar (35.5 in, 90 cm) is one inch (3 cm) taller than Arapahoe, but 3 in (7 cm) shorter than Pronghorn. Cougar is very strong strawed, equal to or better than the strongest strawed cultivars currently grown in Nebraska. The winterhardiness of Cougar is good to very good and comparable to other winter wheat cultivars adapted and commonly grown in Nebraska.

Cougar is moderately resistant to stem rust (caused by *Puccinia graminis Pers. : Pers.*; contains *Sr31* and possibly *Sr24*), moderately susceptible to leaf rust (caused by *P. triticina* Erikss.; contains *Lr26* and possibly *LR24*), and susceptible to wheat soilborne mosaic virus, Hessian fly (*Mayetiola destructor* Say), barley yellow dwarf virus, and wheat streak mosaic virus. Cougar has excellent grain volume weight (60.5 lbs/bu, 77.9 kg/hl), higher than Alliance, Arapahoe, Niobrara, and Pronghorn. The milling and baking properties of Cougar (NE93496) were determined for five years by the Nebraska Wheat Quality Laboratory. In these tests, Arapahoe and Scout 66 were used as check cultivars. The average wheat protein content of Cougar (13.3%) was high than Arapahoe (12.8%) and Scout 66 (12.5%). The average flour extraction on the Buhler Laboratory Mill for the Cougar (71.8%) was similar to Arapahoe, but less than Scout 66. The flour ash content was slightly higher than the check varieties. The average flour protein content (12.1%) was higher than the check varieties. Dough mixing properties of Cougar were less than Arapahoe and stronger than Scout 66. Average baking absorption (60.8%) was less than the check varieties. The average loaf volume of Cougar was greater than the check cultivars. The scores for the internal crumb grain and texture were generally good, though slightly more variable, which were slightly less than Arapahoe and Scout 66. The slightly higher variability in crumb grain and texture in Cougar is most likely due to its being homogeneous for the 1B/1R translocation. Despite the presence of the 1B/1R translocation, the overall end-use quality characteristics for Cougar should be acceptable to the milling and baking industries.

In positioning Cougar, based on performance data to date, it should be well adapted to most dryland wheat production systems where a dry seed bed requires planting to moisture and to conditions of high fertility or moisture which require superior straw strength. With its lower yield potential, it will not be recommended as being broadly adapted, but rather is viewed as a niche wheat with unique attributes. It performance is best in southern Nebraska and similar growing areas in adjacent states. In these areas, it is modern Thunderbird type and can be grown wherever Thunderbird has been previously grown. It is genetically complementary to 2137, Alliance, Arapahoe, Culver, Jagger, Niobrara, Pronghorn, Vista, and Windstar.

Cougar has been uniform and stable since 1998. Less than 0.5% of the plants were rogued from the Breeder's seed increase in 1998. All of the rogued variant plants were taller in height (10 - 25 cm) or had red chaff. Up to 1% (10:1000) taller or red chaff variant plants may be encountered in subsequent generations. The Nebraska Crop Improvement Association provided technical assistance in describing the cultivar characteristics and accomplishing technology transfer. The Nebraska Foundation Seed Division, Department of Agronomy, University of Nebraska-Lincoln, Lincoln, NE 68583 had foundation seed available to qualified certified seed enterprises in 1998. The U.S. Department of Agriculture will not have seed for distribution. The seed classes will be Breeder, Foundation, Registered, and Certified. The Registered seed class will be a nonsalable seed class. Cougar will be submitted for registration and

plant variety protection under P. L. 10577 with the certification option.

Millennium is a hard red winter wheat cultivar developed cooperatively by the Nebraska Agricultural Experiment Station and the USDA-ARS. It was jointly released in 1999 by the developing institutions and South Dakota Agricultural Experiment Station. Millennium was selected from the cross Arapahoe/Abilene//NE86488. The pedigree of NE8648 is Colt/3/Warrior 5*/Agent//Kavkaz. Millennium was released primarily for its superior adaptation to dryland wheat production systems in Nebraska (except southeastern Nebraska) and similar growing areas in South Dakota and adjacent states. However, additional years of testing with more severe winterkilling are needed to identify its area of reliable production and adaptation in South Dakota. Millennium is an awned, white-glumed cultivar. Its field appearance is most similar to 'Arapahoe'. The spike is tapering in shape, long, and middense. The glume is short to midlong and midwide, and the glume shoulder is square to rounded. The beak is medium in length with an acuminate tip. The spike is usually nodding at maturity. Kernels are red colored, hard textured, midlong, and elliptical in shape. The kernel has no collar, a midsize brush of medium length, rounded cheeks, midsize germ, and a narrow and shallow crease.

Millennium was performance tested as NE94479 in Nebraska yield nurseries starting in 1995 and in the Northern Regional Performance Nursery in 1997 and 1998, and in Nebraska cultivar performance trials in 1998 and 1999. In two years of testing in Nebraska cultivar performance trials, it has performed extremely well throughout most of Nebraska, but it is best adapted to southwestern and western Nebraska. The average dryland yield of Millennium (26 environments) was 4200 kg/ha (62.5 bu/a) which compares favorably to Alliance (4150 kg/ha, 61.7 bu/a), Culver (4190 kg/ha, 62.3 bu/a) and Niobrara (4160 kg/ha, 61.9 bu/a). Millennium also performed quite well under irrigation (5760 kg/ha, 85.6 bu/a), though would not be considered a high management wheat due to its height being a taller semi-dwarf with good, but not exceptional straw strength under irrigation. Millennium was tested in the Northern Regional Performance Nursery in 1997 and 1998. It ranked 9th of 35 entries in 1997 and 9th of 28 entries in 1998 and averaged 320 kg/ha (5 bu/a) higher yielding than 'Abilene'. The main advantages Millennium has when compared to most other available wheat cultivars, within its area of adaptation, is its high grain yield, ability to yield well under favorable production conditions, and broad adaptation in dryland production systems.

Other measurements of performance from comparison trials show that Millennium is medium in maturity, about 0.5 d later flowering than Arapahoe and 2 d later than Alliance. The mature plant height of Millennium (34.7 in, 88 cm) is similar to Niobrara and one cm taller than Arapahoe. The coleoptile length of Millennium is moderately short, shorter than TAM 107 and Arapahoe. Millennium has good straw strength, similar to Ogallala and superior to Alliance, Arapahoe, Culver, Niobrara, and Pronghorn. The winterhardiness of Millennium is good to very good, similar to Abilene and comparable to other winter wheat cultivars adapted and commonly grown in Nebraska.

Millennium is moderately resistant to stem rust (caused by *Puccinia graminis Pers. : Pers.*; most likely containing *Sr6* and *Sr24*), leaf rust (caused by *P. triticina* Erikss.; most likely contains *Lr24*, *Lr10*, and possibly *Lr16***)**, and Hessian fly (*Mayetiola destructor* Say, similar to Arapahoe, and most likely contains the Marquillo-Kawvale genes for resistance), and susceptible to wheat soilborne mosaic virus, and barley yellow dwarf virus. In preliminary field tests, Millennium has exhibited a low level of tolerance to wheat streak mosaic virus. Millennium has a good grain volume weight (59.5 lbs/bu, 76.5 kg/hl) is higher than Arapahoe, Niobrara, and Culver, but lower than Pronghorn. The milling and baking properties of Millennium were determined for five years by the Nebraska Wheat Quality Laboratory. In these tests, Arapahoe and Scout 66 were used as check cultivars. The average wheat

protein content of Millennium was lower than Arapahoe and Scout 66. The average flour extraction on the Buhler Laboratory Mill for the Millennium was similar to Scout 66, and higher than Arapahoe. The flour ash content was similar to the check varieties. The average flour protein content was less than the check varieties. Dough mixing properties of Millennium were lower than Arapahoe and stronger than Scout 66. Average baking absorption was slightly less than the check varieties. The average loaf volume of Millennium was similar to Arapahoe and larger than Scout 66. The scores for the internal crumb grain and texture were good, which was similar to Arapahoe, but less than Scout 66. The overall end-use quality characteristics for Millennium should be acceptable to the milling and baking industries.

In positioning Millennium, based on performance data to date, it should be well adapted to most dryland wheat production systems, with average or above average yield potential in most of Nebraska except the southeastern district. It should perform well in similar growing areas in adjacent states. It has performed well in South Dakota, but additional years of testing including more severe winters are needed to identify Millennium's area of adaptation. Where it is adapted, Millennium should be a good replacement for Arapahoe as it has a higher yield potential, better straw strength, and grain volume weight. Millennium is genetically complementary to 2137, Alliance, Jagger, Pronghorn, and Windstar. It is non-complementary to Arapahoe (one of its parents), Culver, Niobrara, and Vista. Unlike Arapahoe and Culver, Millennium appears to have an early spring growth pattern less susceptible to drought stress which can reduce yield and yield stability.

Millennium has been uniform and stable since 1998. Less than 0.5 % of the plants were rogued from the Breeder's seed increase in 1998. The rogued variant plants were taller in height (10 - 15 cm), or were awnless with red chaff. Up to 1% (10:1000) variant plants may be encountered in subsequent generations. The Nebraska Crop Improvement Association provided technical assistance in describing the cultivar characteristics and accomplishing technology transfer. The Nebraska Foundation Seed Division, Department of Agronomy, University of Nebraska-Lincoln, Lincoln, NE 68583 had foundation seed available to qualified certified seed enterprises in 1999. The U.S. Department of Agriculture will not have seed for distribution. The seed classes will be Breeder, Foundation, Registered, and Certified. The Registered seed class will be a nonsalable seed class. Millennium will be submitted for registration and plant variety protection under P. L. 10577 with the certification option.

Nuplains is the first hard white winter wheat developed by the USDA-ARS (Dr. C. J. Peterson's leadership) and the Nebraska Agricultural Experiment Station. It is a high yielding semi-dwarf wheat with adapted to dryland and irrigated production. Nuplains is well suited to higher yielding dryland conditions and should be an excellent companion wheat for Trego, a dryland white wheat recently released by Kansas, which seems to be better adapted to more stressful and lower yielding conditions.

III. FIELD RESEARCH

1. Increase of New Experimental Lines

Two experimental lines (NE94654 and NE95473) are under large-scale increase for possible release in 2000. **NE94654** (Arapahoe/Abilene//Arapahoe) is a semidwarf Arapahoe type with good winterhardiness, very good dryland yield, and average straw strength, kernel weight, and test weight. The coleoptile length is longer than Arapahoe, hence would be considered long for a semi-dwarf wheat. It is a white chaffed, awned, hard red winter wheat. It is medium late in maturity (later than Arapahoe) and medium in plant height (slightly shorter than Arapahoe). Its best performance area seems to west central

and western Nebraska under dryland conditions where its later maturity can be favored. Its straw strength precludes it from being grown under irrigation. **NE94654** is moderately resistant to stem rust (most likely contains *Sr6* and *Sr24*), leaf rust (most likely contains *Lr16*, *Lr24*, and other unnamed genes) and Hessian fly (most likely has the Marquillo-Kawvale genes for resistance), and is susceptible to Russian wheat aphid, barley yellow dwarf virus, wheat soilborne mosaic virus, and wheat streak mosaic virus. **NE94654** has very good to acceptable end-use quality in our tests.

NE95473 (unknown Russian parent/Arapahoe) is a semidwarf Arapahoe type with good winterhardiness, straw strength, and test weight; very good dryland yield; and lower kernel weight.. It is a white chaffed, awned, hard red winter wheat. It is medium in maturity and medium in plant height (similar to Arapahoe for both traits). The best performance area seems to west central and western Nebraska under dryland conditions. It has adequate straw strength for irrigated production. **NE95473** is moderately resistant to stem rust (most likely contains *Sr6* and *Sr17*, and is heterogeneous for *Sr24*) and Hessian fly (most likely has the Marquillo-Kawvale genes for resistance), moderately susceptible to leaf rust (most likely contains *Lr10* and is heterogeneous for *Lr24*), and susceptible to Russian wheat aphid, barley yellow dwarf virus, wheat soilborne mosaic virus, and wheat streak mosaic virus. **NE95473** has acceptable end-use quality in our tests.

Two lines, **NE93405** and **NE93613** were dropped from further consideration for release. One line is under small-scale increase: **NE95510** (Abilene/Arapahoe).

As state experiment stations expand their focus on regional efforts, we will need to discuss how best to release lines that were initially developed in one state, but have utility in other states or niche markets. Currently, this is not a problem because many state experiment stations have compatible release procedures for hard red winter wheat. However, there are different marketing mechanisms for hard white wheat (i.e. grower organizations, or contract production via seed companies and milling companies). The market place will continue to diversify and regionalize especially for niche market wheats (purple, blue, organic, etc.), hence it should be expected that new relationships will be developed which may include marketing publicly varieties outside the state of origin in small multistate niche areas

With the release of new varieties Alliance, Cougar, Culver, Millennium, Niobrara, Nuplains, Pronghorn, Wesley, and Windstar, many of the most advanced current breeding lines are not expected to be released.

2. Nebraska Variety Testing

Numerous entries and three seed treatments were included in some or all of the locations in the Fall Sown Small Grain Variety Tests in 1999. Ten dryland, two irrigated, and one ecofallow nurseries were harvested for yield data.

In 1999, the top ten entries for dryland production were:

Entry	Av. Yield bu/a	Entry	Av. Yield bu/a
2137	63.9	NE94653	60.9
Wesley	63.3	NE94482	60.4
Millennium	61.2	NE95473	60.2
NE94654	61.1	NW97S195	60.1

Niobrara	60.9	NE93613	59.3

In 1998, the top ten entries for dryland production were:

Entry	Av. Yield bu/a	Entry	Av. Yield bu/a
2137	68.8	NE94479	66.6
NE93613	68.1	Alliance	66.6
Wesley	68.0	Windstar	64.5
NE94653	67.6	Niobrara	64.4
Culver	67.5	N94L205	63.9

In 1997, the top ten entries for dryland production were:

Entry	Av. Yield bu/a	Entry	Av. Yield Bu/a
Alliance-D*	51.6	Arapahoe-D*	48.5
2137	50.2	Nekota	48.1
Alliance	49.7	Pronghorn	48.0
NE93554	49.3	Arapahoe	47.8
Windstar	49.3	Niobrara	47.4

*"-D" denotes the seed was treated with Dividend seed treatment.

Of the lines tested in all locations except the irrigated test, Turkey had the lowest grain yield (41.0 bu/a) which was as expected when winterkilling is relatively minor. The yield of the nurseries is higher than the state average yield indicating our nurseries tend to be better production areas than parts of the state.

Hybrid wheat lines, which have performed extremely well in the test in the past, had an above average year, but do best under high management production efforts. All hybrids and many varieties were not tested in allocations, hence some high yielding hybrids and varieties may be overlooked when using statewide averages. Also, with the recent corporate changes in hybrid wheat development strategies (HybriTech is not longer developing hybrid wheats), no future experimental hybrids are expected for a number of years.

3. Irrigated Wheat Trials:

A major improvement in our irrigated trials occurred in 1999 with the coordination of irrigated testing between Nebraska and Wyoming (thanks to Drs. D. Baltensperger and J. Krall). The top ten lines for grain yield in 1999 were:

Entry	Avg. Yield (bu/a)	Entry	Avg. Yield (bu/a)

XH1888	90	Millennium	86
Betty (W)	88	NE94482	86
XH9806	87	NE94653	83
NE95473	86	Jagger	83
2137	86	Ogallala	82

The irrigated wheat nursery was planted in Cheyenne County on a commercial farm by Dr. D. Baltensperger. The top ten lines for grain yield were in 1998:

Entry	Av. Yield bu/a	Entry	Av. Yield bu/a
AP7510	125	NE94482	106
Laredo	114	Jagger	103
Ogallala	108	Wesley	103
N96L1229	107	N96S031	102
H1881	106	Coronado	102

The irrigated wheat nursery was planted in Cheyenne County on a commercial farm by Dr. D. Baltensperger. The top ten lines for grain yield were in 1997:

AP 7510	98 bu/a	2137	88
Jagger	94	Laredo	88
Coronado	89	AP 7501	87
N95L159	88	Karl 92	84
Wesley	88	Ogallala	83

The irrigated data this year was quite interesting as a number of experimental lines performed well, as did a number of released cultivars. The hybrids performed relatively poorly (that is did not greatly exceed the yield of the experimental lines and cultivars). On the basis of this data and of our previous data, it appears we are getting closer to developing a truly adapted irrigated wheat.

As in the past, we have an experimental line irrigated nursery. The nursery is grown under irrigation in western Nebraska and under dryland conditions throughout the state. The goal of this nursery is to identify higher yielding lines under irrigation and under higher rainfall conditions, which periodically occur in Nebraska. The results of the irrigated nursery in 1999 are:

		----------DRYLAND----------					--------Irrigated-------	
ENTRY	VARIETY	Lincoln	North Platte	Alliance	AVG.	Rank	Sidney	Rank
		bu/a	bu/a	bu/a	bu/a		bu/a	
1	NI99401	41.48	46.95	41.73	43.39	47	55.58	48
2	NI99402	58.18	50.73	40.98	49.96	24	75.31	12
3	NI99403	48.48	73.70	39.93	54.04	12	68.34	26

4	NI99404	42.60	64.73	35.98	47.77	36	69.23	22
5	NI99405	33.00	74.00	38.33	48.44	32	71.89	18
6	NI99406	30.35	61.43	51.85	47.88	35	65.91	35
7	NI99407	53.13	69.93	40.83	54.63	11	61.78	40
8	NI99408	47.80	64.98	46.88	53.22	15	65.36	36
9	NI99409	37.55	55.88	45.70	46.38	39	51.98	49
10	NI99410	45.65	64.90	48.05	52.87	16	82.60	3
11	NI99411	44.20	68.93	39.55	50.89	22	74.00	13
12	NI99412	58.10	77.50	41.28	58.96	2	69.03	23
13	NI99413	35.50	64.63	45.85	48.66	30	66.87	32
14	NI99414	29.40	56.05	51.65	45.70	40	76.87	9
15	NI99415	40.35	42.15	48.18	43.56	46	80.09	6
16	NI99416	40.55	74.65	49.93	55.04	8	72.07	16
17	NI99417	57.45	61.93	50.35	56.58	4	64.07	38
18	NI99418	39.05	66.35	60.18	55.19	7	73.96	14
19	NI99419	54.13	58.55	45.63	52.77	18	65.20	37
20	NI99420	38.05	50.93	50.55	46.51	38	60.74	42
21	NI99421	47.70	50.10	50.25	49.35	27	70.05	21
22	NI99422	51.55	68.75	44.35	54.88	10	58.40	44
23	NI99423	40.33	48.93	37.20	42.15	48	55.63	47
24	NI99424	45.18	51.58	35.50	44.09	44	58.25	46
25	NI99425	29.83	53.03	48.05	43.64	45	68.85	24
26	NI99426	45.68	55.18	44.90	48.59	31	71.89	17
27	NI99427	48.63	47.35	39.28	45.09	41	66.58	33
28	NI99428	43.15	57.63	46.20	48.99	29	80.36	5
29	NI99429	33.63	56.88	21.35	37.29	50	86.05	2
30	NI99430	38.55	63.60	47.05	49.73	26	58.36	45
31	NI99431	38.85	59.18	47.30	48.44	33	71.85	19
32	NI99432	36.78	77.83	39.45	51.35	21	80.78	4
33	NI99433	40.90	69.38	37.53	49.27	28	60.76	41
34	NI99434	40.85	52.83	40.50	44.73	42	68.42	25
35	NI99435	36.13	74.73	49.75	53.54	13	66.04	34
36	NI99436	50.50	62.08	38.73	50.44	23	68.11	27
37	NI99437	54.23	69.08	36.48	53.26	14	60.49	43
38	NI99438	40.93	76.83	38.80	52.19	19	67.82	28
39	NI99439	37.75	47.30	37.75	40.93	49	44.45	50
40	NI98411	40.15	53.95	39.00	44.37	43	63.71	39
41	NI98413	31.30	75.20	51.83	52.78	17	67.36	30

42	NI98414	42.63	73.40	52.40	56.14	5	71.78	20
43	NI98427	44.60	76.08	35.08	51.92	20	78.27	7
44	NI98437	38.75	61.90	43.88	48.18	34	73.82	15
45	NI98438	38.93	88.68	53.43	60.35	1	75.34	11
46	NI97405	27.63	66.93	47.73	47.43	37	75.38	10
47	YUMA	45.48	64.98	38.90	49.79	25	67.56	29
48	RAWHIDE	46.25	75.98	43.70	55.31	6	76.89	8
49	2137	50.10	67.85	46.93	54.96	9	90.40	1
50	ABILENE	55.20	76.13	42.63	57.99	3	67.05	31
	GRAND MEAN	42.74	63.44	43.78	49.99		68.83	
	CV	21.52	13.27	18.56			10.59	
	LSD	15.42	14.11	13.62			12.22	

2137 continued to perform under dryland and irrigated conditions in 1999. Few lines were able to perform well under both conditions. Three lines from this nursery were advanced to the Nebraska Triplicate Nursery (NTN) and eight lines were retained for further testing in the irrigated nursery (two lines for the third year of testing).

There were six experimental entries in the 1998 Irrigated Nursery which were moved to the 1999 Irrigated nursery or the 1999 Triplicate Nursery. These samples were milled on the Buhler Laboratory Mill. One entry (NI98439) was noted to have milling quality of: Good+; with outstanding flour yield (from a Buhler Mill) of 75.5%. We consider 70.0% to be an acceptable or average flour yield. The proteins for this samples were: Wheat – 11.8% (14% moisture base), and Flour – 10.5% (14% moisture base). Including this sample; all six entries in this nursery had superior baking characteristics. All samples received baking scores for external characteristics, crumb grain and texture (sensory) from: Very Good– to Very Good+.

The results of the irrigated nursery in 1998 are:

ENTRY	VARIETY	Lincoln bu/a	N.Platte bu/a	Alliance bu/a	Dryland Avg. bu/a	Rank Dryland	Irrigated-Sidney bu/a	Rank Irrigated
1	NI98401	83.8	42.5	64.5	63.6	41	97.6	29
2	NI98402	76.9	56.9	79.1	70.9	19	98.7	26
3	NI98403	76.9	57.4	65.1	66.5	32	101.9	23
4	NI98404	71.6	58.5	77.7	69.2	24	84.6	47
5	NI98405	68.1	48.6	77.8	64.8	36	85.1	45
6	NI98406	72.0	47.1	64.7	61.2	48	96.9	31
7	NI98407	81.1	47.1	89.3	72.5	16	61.8	50
8	NI98408	71.4	50.5	60.1	60.7	49	78.1	49
9	NI98409	78.9	44.0	61.8	61.6	47	110.1	11
10	NI98410	79.4	63.2	68.4	70.3	21	105.7	19
11	NI98411	75.3	57.6	72.1	68.3	27	119.3	1
12	NI98412	75.5	54.1	92.1	73.9	12	92.6	38
13	NI98413	70.8	57.5	81.6	70.0	22	115.7	5

14	NI98414	78.4	52.4	107.6	79.5	3	110.2	10
15	NI98415	68.5	64.7	67.6	66.9	30	109.5	13
16	NI98416	74.8	60.8	63.0	66.2	33	92.8	37
17	NI98417	75.3	44.6	69.0	63.0	44	105.6	20
18	NI98418	81.7	48.7	99.0	76.5	9	109.0	14
19	NI98419	71.1	74.7	76.3	74.0	11	103.6	21
20	NI98420	69.9	62.8	85.0	72.6	15	96.0	34
21	NI98421	71.3	61.6	57.2	63.4	42	111.1	8
22	NI98422	67.5	52.8	71.6	64.0	39	84.7	46
23	NI98423	77.6	52.2	78.4	69.4	23	97.6	30
24	NI98424	76.2	58.2	70.3	68.2	29	106.8	18
25	NI98425	76.2	50.8	64.3	63.8	40	98.7	27
26	NI98426	70.4	41.6	69.6	60.5	50	81.3	48
27	NI98427	76.4	62.3	67.9	68.9	25	117.8	2
28	NI98428	80.6	46.3	72.8	66.6	31	109.6	12
29	NI98429	78.1	49.6	67.1	64.9	35	112.3	6
30	NI98430	77.5	55.3	56.1	63.0	43	100.5	24
31	NI98431	75.5	55.4	74.0	68.3	28	95.0	35
32	NI98432	73.4	47.0	75.8	65.4	34	91.7	39
33	NI98433	82.0	51.4	60.4	64.6	37	108.7	15
34	NI98434	84.6	48.6	81.7	71.6	18	102.5	22
35	NI98435	88.3	58.1	73.4	73.2	13	96.0	33
36	NI98436	79.3	53.9	54.6	62.6	45	110.4	9
37	NI98437	82.6	56.3	72.1	70.3	20	111.9	7
38	NI98438	83.6	68.9	70.8	74.4	10	117.4	3
39	NI98439	88.1	64.8	81.9	78.2	5	99.1	25
40	NI97405	71.4	79.8	79.6	76.9	7	108.5	16
41	NI97409	73.1	43.1	69.0	61.7	46	88.1	42
42	NI97410	74.8	50.4	67.7	64.3	38	108.2	17
43	NI97435	80.3	65.6	92.1	79.3	4	85.6	44
44	NI97442	75.9	66.5	72.9	71.8	17	90.8	40
45	NI97444	79.2	69.2	81.1	76.5	8	93.3	36
46	YUMA	68.6	72.8	93.1	78.2	6	116.0	4
47	RAWHIDE	69.6	58.0	78.1	68.6	26	87.0	43
48	2137	82.8	76.8	81.7	80.4	1	98.0	28
49	ABILENE	79.5	81.2	80.5	80.4	2	96.8	32
50	VISTA	79.9	61.1	77.9	73.0	14	90.0	41
	GRAND MEAN	76.5	57.1	74.3			99.8	

The data for the 1997 irrigated nursery are listed below:

Entry	Linc.	ClayC.	N.Plat bu/a	Cheyn. Irr.	Avg.	Rank	DryAvg. bu/a	DryRank
NI97401	37.55	19.65	38.00	66.75	42.85	42	34.88	48
NI97402	35.55	12.25	45.03	72.10	40.30	48	29.70	49
NI97403	45.25	32.25	42.03	55.93	44.00	39	40.02	34

NI97404	42.05	25.33	44.80	73.32	48.67	22	40.45	32
NI97405ϕ	47.60	29.53	60.40	85.46	54.28	6	43.89	14
NI97406	49.80	44.15	40.88	46.78	47.46	25	47.68	3
NI97407	39.80	39.68	45.88	62.84	48.33	24	43.50	16
NI97408	38.40	36.88	33.25	44.02	38.03	50	36.04	43
NI97409ϕ	39.05	42.43	48.28	83.98	52.24	10	41.66	25
NI97410*ϕ	54.75	50.03	40.28	79.72	54.75	4	46.42	7
NI97411	47.35	46.73	42.23	63.26	49.35	20	44.71	11
NI97412	41.50	34.40	40.05	77.36	46.85	31	36.68	40
NI97413	43.25	46.78	49.03	68.32	49.76	18	43.57	15
NI97414	37.60	28.85	49.63	59.44	42.35	44	36.66	42
NI97415	44.55	38.00	41.93	77.68	50.98	13	42.08	22
NI97416	42.45	37.88	44.45	65.44	47.02	29	40.88	30
NI97417	44.65	33.15	48.55	66.04	46.46	32	39.94	35
NI97418*	50.90	51.53	46.03	76.82	56.61	3	49.87	2
NI97419	39.15	45.38	39.38	49.95	44.38	36	42.53	20
NI97420	33.30	35.25	45.63	65.13	42.96	41	35.56	46
NI97421	36.15	25.30	47.63	59.77	41.92	45	35.96	44
NI97422	44.35	48.98	33.48	72.23	50.46	17	43.20	17
NI97423*	51.35	56.70	50.88	75.56	57.64	2	51.67	1
NI97424*	47.30	43.03	50.90	74.53	53.72	7	46.79	6
NI97425	42.45	35.63	38.33	77.44	50.77	15	41.88	23
NI97426	35.50	31.58	33.58	55.19	40.45	47	35.54	47
NI97427	37.90	32.45	36.93	56.45	41.62	46	36.67	41
NI97428	39.25	31.85	50.65	64.00	47.30	26	41.74	24
NI97429	40.55	50.48	46.10	51.23	48.39	23	47.44	4
NI97430	37.45	44.60	41.98	60.70	47.21	27	42.71	18
NI97431	39.50	35.70	44.78	63.98	45.72	35	39.63	36
NI97432	42.25	48.93	44.50	64.43	50.88	14	46.36	8
NI97433	45.70	40.30	48.40	73.80	49.41	19	41.28	29
NI97434	45.60	47.13	31.35	77.68	50.57	16	41.53	28
NI97435ϕ	44.35	40.83	39.38	81.96	51.65	11	41.55	27
NI97436	45.85	33.70	43.80	53.58	43.86	40	40.62	31
NI97437	46.70	34.73	46.65	66.41	46.92	30	40.43	33
NI97438	49.40	23.05	44.63	63.97	42.77	43	35.70	45
NI97439	45.10	53.75	35.80	52.10	46.24	33	44.29	13
NI97440	39.10	45.98	37.88	50.62	44.36	37	42.27	21
NI97441	48.20	39.18	36.65	77.55	51.30	12	42.54	19
NI97442ϕ	38.15	51.98	47.58	78.23	53.20	8	44.85	10
NI97443	40.50	30.55	38.93	63.67	44.14	38	37.63	38
NI97444ϕ	40.85	49.38	38.03	80.03	54.57	5	46.09	9
NI97445	40.25	38.93	44.00	70.11	48.69	21	41.55	26
2137	53.95	36.83	47.18	90.06	57.70	1	46.92	5
ABILENE	39.40	35.10	45.38	69.56	46.02	34	38.17	37
RAWHIDE	44.15	32.00	35.10	78.38	47.19	28	36.79	39
VISTA	38.70	52.58	36.93	77.40	52.65	9	44.40	12
YUMA	41.90	4.33	33.58	72.61	38.08	49	26.57	50
Mean	42.73	38.11	42.73	67.87	47.86		41.19	
CV	12.39	16.15	16.43	12.36				
LSD	8.88	10.32	11.77	14.07				

*Advanced to NTN

ϕAdvanced to Replicated Irrigated Trial

4. Nebraska Intrastate Nursery:

The Nebraska Intrastate Nursery (NIN) was planted at eight locations (Lincoln, Clay Center, North Platte, McCook, Grant, Sidney, Alliance, and Mead) and harvested at seven locations. Most trials had four replications, but Sidney (not harvested due to hail) and Grant, McCook, Mead, and North Platte had two replications. With the exception of Clay Center (diseases and excessive moisture at harvest), Grant (drought), the nurseries were exceptional (yields ranging from 50-70 bu/a. While these yield were excellent for producers a greater diversity of yields would be useful to select for the various growing conditions that producers may encounter. Alliance and Culver performed very well among the released varieties, but a number of excellent experimental lines seem to be progressing towards future release. The Results for the 1999 NIN are:

		yield (bu/a)								State Rank
ENTRY	VARIETY	Linc.	Mead	Cl.Cent	N.Platte	McCook	Grant	Alliance	Average	
1	ARAPAHOE	53.5	51.2	35.4	48.0	66.9	31.9	55.7	48.9	48
2	NIOBRARA	51.2	50.2	35.0	57.1	66.1	37.2	63.6	51.5	27
3	NE93405	63.2	55.0	37.4	51.1	58.8	28.1	50.3	49.1	47
4	COUGAR	62.1	55.6	27.2	56.1	61.1	32.9	51.0	49.4	43
5	CULVER	64.0	53.3	34.2	60.6	72.7	33.8	62.1	54.4	13
6	NE93613	62.7	57.0	33.5	62.5	74.4	31.2	58.7	54.3	16
7	MILLENNIUM	57.6	62.3	35.7	56.2	51.5	32.3	54.5	50.0	39
8	NE94482	66.2	61.5	26.1	68.9	70.6	33.6	54.0	54.4	12
9	NE94589	60.6	47.5	24.6	58.6	69.2	29.9	61.5	50.3	33
10	ALLIANCE	56.7	51.7	25.4	68.2	75.9	38.0	68.1	54.8	9
11	VISTA	60.5	50.5	29.2	70.4	67.8	34.8	48.7	51.7	26
12	NE94653	58.1	62.1	40.2	76.8	63.6	37.9	58.8	56.8	3
13	NE94654	53.8	52.7	44.2	62.8	62.6	34.3	63.2	53.4	20
14	NE94655	53.2	53.6	35.4	61.6	56.6	33.0	54.3	49.7	42
15	NE95473	59.9	65.6	37.8	68.4	69.5	38.2	55.0	56.3	4
16	NE95510	62.7	64.8	36.6	62.0	69.9	41.8	63.0	57.2	2
17	NE95553	65.2	52.7	28.5	55.1	49.5	26.8	54.1	47.4	53
18	NE96435	58.4	42.9	19.8	60.1	60.7	35.3	59.7	48.1	51
19	NE96573	56.3	53.9	30.0	59.7	56.1	32.1	57.6	49.4	45
20	NE96579	70.2	62.9	36.2	60.6	70.1	31.6	54.5	55.1	8
21	WINDSTAR	54.9	45.4	23.1	54.1	72.2	32.4	60.2	48.9	50
22	NE96618	61.4	50.5	28.8	57.9	62.5	32.9	55.5	49.9	40
23	NE96632	50.7	47.6	24.3	52.1	61.8	35.5	56.9	47.0	55
24	NE96649	59.9	48.5	28.6	47.5	72.9	33.1	63.3	50.5	31
25	NE96654	64.1	57.5	39.9	61.1	57.5	32.6	63.1	53.7	17
26	NE96676	58.2	39.7	31.8	50.4	58.3	33.6	56.1	46.9	56
27	NE96737	72.1	53.3	36.3	57.0	64.1	34.6	57.1	53.5	19
28	NE93427	68.5	62.0	39.0	54.1	69.8	39.1	49.5	54.6	10
29	NE97407	71.7	42.5	33.5	54.9	63.5	28.6	54.1	49.8	41
30	NE97421	68.1	37.0	28.8	54.4	61.4	38.4	63.4	50.2	36
31	BUCKSKIN	46.1	43.4	22.2	45.3	56.4	34.2	54.0	43.1	58
32	CHEYENNE	48.6	45.4	19.0	42.9	51.9	30.9	53.7	41.8	60

33	NE97426	70.0	51.2	31.0	54.0	75.0	31.6	55.0	52.6	24
34	NE97465	71.7	61.5	35.1	57.0	68.2	36.8	60.3	55.8	5
35	NE97489	51.1	46.9	37.7	51.8	53.9	32.5	63.0	48.1	52
36	NE97518	64.0	49.7	30.1	64.5	73.4	29.2	45.4	50.9	30
37	NE97553	56.9	46.7	32.8	52.8	65.9	28.3	45.8	47.0	54
38	NE97558	56.8	55.5	30.6	57.9	62.5	32.9	61.4	51.1	29
39	NE97612	63.9	59.3	43.9	55.0	60.0	36.5	51.1	52.8	22
40	NE97638	53.8	59.9	38.1	60.6	75.0	33.8	59.3	54.3	14
41	PRONGHORN	62.9	53.7	23.5	59.1	54.6	40.8	57.3	50.3	34
42	SCOUT66	45.2	40.1	14.4	54.2	57.4	37.8	45.4	42.1	59
43	NE97669	60.2	56.5	25.1	62.1	78.5	37.8	61.2	54.5	11
44	NE97670	66.7	58.6	35.5	66.2	70.4	37.5	54.8	55.7	6
45	NE97675	54.3	57.1	39.1	65.9	61.6	39.1	54.9	53.2	21
46	NE97689	52.2	55.9	33.8	64.6	79.7	38.5	62.3	55.3	7
47	NE97693	51.2	39.5	25.7	52.5	39.7	41.1	60.0	44.2	57
48	NE97716	58.3	63.4	25.8	70.9	54.4	33.6	56.4	51.8	25
49	NI97423	63.8	55.7	34.2	66.1	70.5	41.4	43.3	53.6	18
50	WESLEY	64.4	58.9	26.7	67.4	69.9	36.2	56.7	54.3	15
51	N96L1226	63.7	46.2	30.0	66.5	72.3	26.7	40.4	49.4	44
52	N96L1229	52.9	48.5	31.6	66.5	63.2	31.3	48.4	48.9	49
53	N97L162	55.9	42.1	30.3	62.8	70.3	34.1	49.9	49.4	46
54	N96V039	65.1	56.4	31.7	65.2	51.9	35.3	52.8	51.2	28
55	N97V031	68.4	51.8	35.8	62.1	62.6	31.5	39.6	50.3	35
56	N97V121	72.1	54.8	40.7	77.7	70.8	44.0	44.5	57.8	1
57	NE97519	60.5	49.7	32.4	71.3	61.9	27.7	48.6	50.3	32
58	NE97614	69.8	45.8	30.3	68.5	78.4	23.8	52.5	52.7	23
59	NE97664	64.7	46.6	23.0	70.6	66.2	28.3	51.1	50.0	38
60	NE95546	63.3	53.1	29.8	64.7	70.9	23.7	44.9	50.1	37
	GRAND MEAN	60.4	52.4	31.4	60.2	64.7	33.9	55.0	51.2	
	CV	14.7	10.0	21.6	14.2	9.4	15.4	11.0		
	LSD	10.4	8.7	7.9	14.3	10.2	8.7	7.1		

Fifty-three entries in the 1999 NIN were milled on the Buhler Laboratory mill. Of these, nine were varieties, entered as checks. Forty-four were experimental lines. All samples received a mill rating of "Good" with the exception of NE96618. The mill score for this sample was: Fair+. The quality characteristics of this line were also found to be questionable. It was noted to have weaker-type tolerance from the Mixograph analysis. Additionally, the crumb grain color was scored: very yellow; and the baking characteristics ranged from: Good- to Fair-.

One experimental variety, NE94654, exhibited superior quality traits. The bread baking scores for external characteristics, crumb grain, and texture were: Good+, Very Good- and Very Good-. Additionally, NE94654 produced noodles that were noted to have good noodle color and is under increase for possible release in 2000.

The data for 1998 is listed below:

VARIETY	LINCOLN	RANK	CLAY CT	RANK	N.PLATTE	RANK	MCCOOK	RANK	SIDNEY	RANK	ALLIANCE	RANK	Avg.	RANK
ARAPAHOE	71.3	17	63.1	31	60.9	28	41.4	11	70.5	26	72.7	31	63.31	23
NIOBRARA	76.6	3	68.5	10	60.1	32	50.5	3	77.9	7	82.3	6	69.29	2
NE92652	71.4	16	65.7	15	60.7	29	42.1	10	71.7	19	68.8	38	63.40	21
NE93405	70.3	28	63.2	28	58.5	42	35.8	39	67.9	34	67.5	44	60.54	38
NE93496	68.1	37	63.1	30	56.6	47	32.7	48	66.2	40	67.1	45	58.95	47
NE93554	71.4	15	66.5	13	58.2	44	40.2	15	69.8	30	73.3	28	63.23	24
NE93613	70.8	21	72.7	4	70.6	1	38.2	23	73.1	14	80.2	7	67.58	6
NE94445	70.3	29	64.5	21	61.3	25	33.9	42	65.6	42	84.6	3	63.36	22
NE94479	75.5	4	75.6	1	62.3	17	50.6	2	71.1	23	74.0	23	68.19	5
NE94482	70.7	22	73.7	3	61.0	27	35.9	37	71.4	20	77.3	13	64.99	11
NE94589	65.0	50	63.9	24	67.0	4	42.8	8	73.2	11	78.4	11	65.03	10
NE94632	68.6	35	60.3	42	59.1	36	39.2	20	61.7	53	76.9	16	60.96	34
NE94653	67.2	43	70.3	6	62.0	21	42.9	7	70.0	29	77.5	12	64.97	12
NE94654	73.7	8	65.2	17	68.4	2	53.5	1	80.3	4	83.9	4	70.82	1
ALLIANCE	75.1	5	64.3	22	64.3	12	40.1	16	81.5	1	85.0	2	68.38	4
KARL92	68.7	34	53.7	57	49.0	60	31.7	53	65.0	44	51.9	60	53.34	59
NE94655	71.5	14	66.4	14	58.0	46	42.3	9	70.9	25	72.9	30	63.67	19
NE95473	74.8	6	72.4	5	62.3	18	47.9	4	73.6	10	80.2	8	68.52	3
NE95489	70.4	26	63.2	29	55.7	49	38.2	24	72.4	17	58.7	56	59.74	40
NE95510	70.4	24	65.3	16	59.3	35	40.6	13	70.9	24	72.1	34	63.09	25
NE95546	74.0	7	57.8	51	68.2	3	33.8	44	72.8	16	90.3	1	66.16	7
NE95553	67.3	42	64.3	23	66.6	7	37.9	27	59.6	56	71.7	35	61.23	31
NE95593	71.6	13	52.6	59	62.0	20	34.2	41	67.1	37	68.5	40	59.36	42
NE95656	61.8	53	63.3	27	66.9	6	40.0	17	69.6	31	79.9	10	63.56	20
NE96435	66.1	47	62.1	35	58.8	39	39.4	18	73.1	12	74.3	22	62.29	28
NE96461	81.6	1	63.8	25	62.1	19	33.4	47	80.0	5	68.7	39	64.92	13
NE96515	69.3	32	59.3	45	58.8	40	32.2	49	71.3	21	63.7	50	59.10	46
NE96573	72.4	12	65.0	19	59.0	37	38.0	25	72.8	15	76.4	19	63.94	17
VISTA	70.5	23	58.5	48	63.0	14	36.5	34	81.0	2	73.0	29	63.78	18
WINDSTAR	65.4	48	62.1	34	66.1	8	39.1	22	74.5	8	76.9	15	64.01	16
NE96579	70.3	27	74.5	2	54.8	51	31.3	54	62.0	52	56.0	57	58.13	49
NE96580	60.9	54	66.8	12	54.7	52	38.0	26	63.1	48	55.2	58	56.42	53
NE96584	73.5	9	59.9	43	58.0	45	37.5	30	62.5	50	63.3	51	59.12	44
NE96585	70.4	25	61.1	39	53.8	54	33.4	46	57.2	58	54.6	59	55.07	57
NE96605	66.3	45	55.7	53	58.8	41	31.2	55	63.4	47	64.0	49	56.55	52
NE96607	60.7	56	65.2	18	54.2	53	30.2	59	73.9	9	62.2	53	57.75	51
NE96618	66.9	44	53.4	58	65.0	9	37.5	29	78.5	6	83.2	5	64.08	15
NE96622	70.1	30	59.4	44	61.9	22	36.2	35	61.6	54	74.6	21	60.63	36
NE96623	71.0	20	56.6	52	63.9	13	37.0	33	66.7	39	76.5	18	61.94	29
NE96625	63.0	52	61.9	36	59.7	33	36.2	36	70.2	27	72.2	32	60.55	37
NE96628	60.8	55	54.1	56	56.6	48	41.1	12	57.1	59	67.6	43	56.21	55
NE96630	71.0	19	68.5	9	61.7	23	30.3	58	67.3	36	66.4	46	60.86	35
NE96632	71.3	18	63.7	26	66.9	5	44.1	6	67.5	35	73.3	27	64.47	14
NE96638	68.2	36	62.9	33	53.3	57	32.0	52	57.8	57	60.5	54	55.77	56
BUCKSKIN	60.4	57	58.4	49	58.9	38	39.4	19	65.5	43	72.1	33	59.11	45
CHEYENNE	53.5	60	59.3	46	53.7	55	37.1	32	64.8	45	68.9	37	56.22	54
NE96641	67.7	40	58.2	50	59.5	34	33.5	45	71.2	22	76.8	17	61.15	32
NE96644	65.3	49	54.4	55	61.0	26	27.4	60	71.9	18	70.8	36	58.47	48
NE96649	72.7	11	64.6	20	62.8	15	37.2	31	80.6	3	75.3	20	65.52	9
NE96652	65.0	51	63.0	32	60.5	30	33.8	43	62.4	51	64.1	48	58.12	50
NE96654	68.0	38	61.2	38	64.9	10	37.5	28	62.8	49	73.7	25	61.36	30
NE96676	69.7	31	61.0	40	62.4	16	34.7	40	73.1	13	73.8	24	62.44	26
NE96677	68.8	33	61.8	37	58.2	43	30.4	57	66.1	41	73.7	26	59.82	39

NE96690	67.7	39	67.7	11	53.7	56	35.8	38	68.3	33	62.6	52	59.31	43
NE96737	67.4	41	69.9	7	60.4	31	40.4	14	68.5	32	67.6	42	62.37	27
NE96744	66.3	46	54.9	54	50.8	59	31.1	56	63.6	46	60.3	55	54.48	58
NE96747	73.4	10	60.3	41	55.3	50	32.1	51	70.0	28	65.2	47	59.38	41
NE93427	78.1	2	69.7	8	64.8	11	39.2	21	66.7	38	77.0	14	65.92	8
PRONGHORN	60.1	58	58.6	47	61.6	24	44.3	5	61.3	55	80.0	9	60.97	33
SCOUT66	59.4	59	52.0	60	52.2	58	32.1	50	51.5	60	68.0	41	52.52	60
GRAND ME	68.8		62.8		60.2		37.4		68.7		71.5		61.57	

The data for 1997 was:

VARIETY	Yield (bu/a)								State
	Linc	Mead	Clay C.	N.Plat	McCook	Sidney	Allianc	Avg.	Rank
ARAPAHOE	45.48	28.60	54.58	51.25	73.11	34.46	46.96	47.774	21
NIOBRARA	47.12	24.58	38.78	57.76	69.62	37.87	44.32	45.722	33
PRONGHORN	48.26	29.64	49.29	59.04	71.05	34.09	48.60	48.566	18
WINDSTAR	47.71	30.20	61.38	59.79	69.96	33.59	46.83	49.923	12
NE91518	50.50	25.47	38.01	61.66	65.94	38.12	46.80	46.641	28
NE91631	43.94	31.34	38.10	52.39	70.40	43.08	39.85	45.586	36
NE92628	43.87	21.20	50.62	56.72	69.87	39.39	41.68	46.190	32
NE92646	49.20	25.02	46.64	52.07	75.09	36.54	44.65	47.030	26
NE92662	46.92	34.94	39.94	57.86	74.57	44.93	46.32	49.355	15
ALLIANCE	42.38	30.38	55.95	58.34	69.77	45.19	54.88	50.983	5
VISTA	40.51	26.05	45.17	52.91	70.69	41.83	48.24	46.484	30
NE93405	49.69	32.79	54.64	56.48	68.86	39.70	46.65	49.829	14
NE93496*	46.59	32.60	60.51	57.25	67.58	34.40	50.02	49.849	13
NE93522	43.70	27.38	46.81	50.97	63.16	26.61	46.12	43.534	46
NE93554*	47.77	30.62	51.42	53.96	79.26	41.70	50.67	50.772	8
NE93613	41.57	24.33	57.53	60.64	80.88	44.42	42.80	50.309	10
NE94445	50.80	26.96	40.30	57.37	67.03	41.25	47.33	47.289	24
NE94479*	57.73	33.74	57.86	58.03	73.70	53.39	51.00	55.063	1
NE94482*	50.38	27.56	54.60	59.22	69.54	52.23	50.91	52.062	3
REDLAND	43.14	28.90	52.55	51.06	72.74	46.04	45.54	48.566	17
TAM107	44.26	22.10	22.34	51.71	71.58	35.62	43.34	41.566	58
NE94489	44.33	22.81	47.39	53.02	64.57	31.93	47.76	44.545	40
NE94567	39.01	22.40	24.93	60.12	68.57	39.80	44.07	42.697	52
NE94588	41.71	25.03	36.65	61.35	70.32	26.95	40.79	43.257	48
NE94589	42.80	25.89	47.21	63.33	68.63	39.90	37.70	46.494	29
NE94632*	47.24	19.26	52.87	52.48	69.87	33.86	43.81	45.625	35
NE94653*	48.55	30.91	56.10	61.84	72.19	37.49	50.32	51.058	4
NE94654	43.58	30.82	48.01	59.37	81.70	44.19	47.98	50.807	7
NE94655*	44.85	29.44	52.44	52.83	67.92	34.88	44.29	46.665	27
NEKOTA	41.84	26.16	45.85	63.26	65.12	44.41	46.71	47.621	23
KARL92	38.81	24.70	17.30	43.65	67.20	30.10	45.49	38.178	59
NE95417	48.38	23.84	25.95	53.34	67.30	35.01	48.57	43.196	49
NE95473	50.69	28.77	49.84	53.80	71.56	50.01	51.67	50.906	6
NE95482	49.05	28.91	54.32	57.53	78.69	53.41	48.66	52.937	2
NE95489	46.66	26.90	53.61	52.37	67.39	37.20	46.78	47.271	25
NE95509	40.45	29.52	20.82	36.90	61.39	32.47	45.09	38.091	60
NE95510	44.29	27.19	48.62	52.84	75.98	52.26	50.07	50.179	11
NE95536	44.01	28.66	40.20	56.83	71.24	37.67	40.89	45.640	34
NE95537	48.94	25.95	48.72	53.31	69.83	26.77	45.00	45.503	37
SCOUT66	36.86	26.93	41.40	57.30	56.10	36.94	41.56	42.440	55
CENTURA	33.87	28.14	42.02	55.62	66.15	35.78	39.34	42.989	50
NE95546	40.54	29.86	28.58	57.70	71.92	39.66	36.99	43.606	45
NE95553	45.06	27.84	47.87	66.35	78.84	34.66	44.45	49.295	16
NE95587	42.88	24.84	47.09	52.94	68.95	41.81	45.68	46.313	31
NE95593	47.30	25.00	52.33	60.73	77.79	32.60	43.94	48.528	19
NE95632*	36.63	23.88	38.85	50.62	55.81	46.36	45.74	42.555	54

NE95656	41.72	23.88	30.09	56.83	67.81	29.06	41.78	41.595	57
NE95686	48.74	26.73	49.94	58.83	61.87	45.38	43.43	47.845	20
N94L212	48.87	27.20	47.46	50.24	66.02	30.84	46.58	45.315	38
CHEYENNE	39.86	26.94	39.67	61.95	55.83	39.45	34.77	42.637	53
BUCKSKIN	39.44	34.33	39.55	57.11	63.16	31.89	39.78	43.609	44
NE93549	36.43	22.57	45.81	48.33	72.12	27.17	46.46	42.699	51
NE94481	45.90	28.16	51.41	58.49	74.17	44.78	51.16	50.582	9
NE95518	38.54	24.88	38.29	57.34	64.31	35.38	38.02	42.393	56
NE95683	36.76	27.29	35.81	56.06	68.02	43.22	48.82	45.141	39
NE94507	41.29	32.19	41.59	59.29	64.71	25.19	43.52	43.969	42
NE95451	45.05	27.94	34.18	52.93	67.89	38.01	42.28	44.040	41
NE95508	42.27	28.51	45.68	55.99	60.12	34.93	39.79	43.896	43
NE95520	39.57	32.39	47.82	57.52	60.25	32.65	33.06	43.322	47
NE92652*	49.69	29.07	44.61	55.62	68.67	40.15	45.70	47.644	22
GRAND MEAN	44.40	27.50	44.63	55.87	69.07	38.31	45.03		
CV	11.38	13.26	14.20	8.40	5.98	17.63	8.78		
LSD	5.91	6.09	7.41	5.49	6.90	7.90	4.62		

*Advanced to USDA regional nurseries

5. Nebraska Triplicate Nursery:

The same comments about the NIN data apply to the Nebraska Triplicate Nursery (NTN). 2137 and number of experimental lines had very good years. Data for the 1999 NTN follow:

ENTRY	VARIETY	Linc.	Mead	Cl. Cent.	N. Platte	McCook	Grant	Alliance	Average	State
		bu/a	bu/a	bu/a	bu/a	bu/a	bu/a	bu/a	bu/a	Rank
1	NE98404	62.3	50.5	35.4	56.8	58.1	30.4	55.3	49.8	55
2	NE98405	68.6	43.9	34.7	44.5	65.6	46.7	60.6	52.1	46
3	NE98410	67.1	52.3	27.3	69.5	68.1	51.3	56.5	56.0	21
4	NE98416	63.5	58.9	26.5	72.3	76.8	38.4	59.8	56.6	19
5	NE98424	69.5	49.4	36.6	66.1	76.8	39.4	61.4	57.0	15
6	NE98425	75.2	57.8	26.8	65.1	74.5	48.1	54.7	57.4	10
7	NE98445	69.9	69.3	30.0	64.7	59.5	44.7	58.3	56.6	18
8	NE98454	66.5	60.7	33.3	66.2	64.7	34.9	53.6	54.3	35
9	NE98455	75.7	60.2	36.0	62.0	69.0	39.9	54.3	56.7	17
10	NE98466	78.6	60.6	42.2	65.6	62.1	38.8	53.3	57.3	11
11	NE98468	73.0	73.3	31.3	69.1	58.1	46.7	59.0	58.6	5
12	NE98471	78.9	66.3	26.3	72.6	64.6	42.4	66.7	59.7	2
13	NE98476	77.1	61.9	32.5	74.0	66.3	38.0	50.4	57.2	12
14	NE98493	67.9	57.9	19.3	65.1	60.8	45.0	48.0	52.0	47
15	ALLIANCE	62.5	39.1	20.6	60.4	81.6	37.0	63.8	52.1	45
16	NE98499	68.9	41.0	19.8	55.7	68.8	36.2	65.8	50.9	50
17	NE98502	65.5	61.6	30.3	62.4	64.7	43.2	59.1	55.3	24
18	NE98503	68.3	61.5	27.2	70.3	71.0	42.8	64.8	58.0	8
19	NE98522	73.8	59.0	29.3	65.1	60.0	37.6	61.0	55.1	26
20	NE98529	72.8	55.4	26.7	60.5	60.8	38.5	54.1	52.7	44

21	NE98530	78.3	60.0	42.2	71.9	74.5	39.7	54.7	60.2	1
22	NE98535	58.7	60.9	25.9	68.3	62.9	41.0	64.0	54.5	31
23	NE98537	64.5	60.7	35.4	64.1	59.5	38.0	54.8	53.9	36
24	NE98548	68.6	45.1	27.2	66.3	69.6	40.4	64.5	54.5	30
25	NE98552	64.4	57.8	33.4	46.9	64.1	34.3	50.0	50.1	53
26	NE98564	67.7	65.8	32.9	66.4	74.5	37.5	68.7	59.1	4
27	NE98569	66.7	59.0	32.4	58.6	63.0	34.1	44.4	51.2	48
28	NE98574	61.6	56.6	25.9	65.5	68.7	39.7	63.5	54.5	32
29	NE98577	68.4	44.3	23.7	60.9	58.8	36.5	59.6	50.3	52
30	ARAPAHOE	62.4	41.6	31.9	52.1	67.9	36.4	60.5	50.4	51
31	NE98578	65.7	59.2	24.1	55.9	56.8	34.3	60.9	51.0	49
32	NE98589	78.4	58.8	27.5	64.4	70.6	36.0	61.8	56.8	16
33	NE98594	59.8	54.7	36.5	64.7	70.0	37.3	60.3	54.7	28
34	NE98602	71.7	61.7	33.5	65.1	63.0	34.6	58.5	55.4	23
35	NE98632	77.3	60.0	40.5	67.8	67.1	37.6	64.2	59.2	3
36	NE98646	54.8	45.7	23.7	72.3	87.7	40.1	61.3	55.1	27
37	NE98655	65.4	45.1	39.9	47.5	56.4	33.0	56.9	49.2	56
38	NE98657	65.0	58.2	33.4	48.2	64.9	44.1	67.3	54.4	33
39	NE98662	63.1	45.3	30.5	58.0	73.1	41.5	60.7	53.1	41
40	NE98666	66.1	52.3	26.1	58.3	71.3	36.6	63.7	53.5	39
41	NE98667	68.0	45.4	25.8	66.6	65.7	41.8	62.2	53.6	37
42	NE98675	59.6	52.7	28.1	64.4	59.0	43.2	66.4	53.3	40
43	NE98684	58.6	45.3	31.5	68.4	79.3	43.4	48.2	53.5	38
44	NE98686	56.8	45.2	21.7	66.4	68.5	32.5	58.6	49.9	54
45	JAGGER	56.2	26.3	13.6	66.5	56.2	44.1	64.3	46.7	60
46	NE98691	81.0	52.5	28.9	67.7	70.7	27.1	55.1	54.7	29
47	NE98692	72.2	63.0	31.6	59.2	72.3	36.0	65.0	57.0	14
48	NE98694	58.3	52.1	25.5	67.8	53.1	32.5	54.9	49.2	57
49	NE98696	73.5	55.9	28.5	67.6	71.8	32.3	62.9	56.1	20
50	NE98714	55.5	43.9	21.1	62.9	62.8	28.9	55.5	47.2	59
51	NE98708	70.1	52.0	32.1	67.8	62.7	32.5	52.4	52.8	43
52	NE98714	68.2	42.0	22.8	74.1	78.3	46.1	56.8	55.4	22
53	NE98717	66.3	55.9	30.4	61.9	65.7	37.2	52.2	52.8	42
54	NI97444	64.2	47.5	26.5	52.1	66.7	30.6	47.4	47.8	58
55	NI98418	76.3	53.5	23.0	64.1	76.1	42.5	68.6	57.7	9
56	NI98438	50.7	43.3	32.4	70.1	86.3	41.9	56.2	54.4	34
57	NI98439	75.0	64.5	39.1	67.5	58.8	44.4	58.3	58.2	7
58	NI97405	62.0	47.3	31.0	67.7	74.6	40.7	62.6	55.1	25
59	NI97435	58.1	47.9	28.4	86.0	79.0	38.1	61.8	57.0	13
60	2137	78.1	55.2	26.6	75.7	77.0	41.0	55.4	58.4	6

GRAND MEAN	67.4	53.7	29.5	64.3	67.7	38.8	58.8	54.3
CV	11.0	11.5	17.8	14.7	10.2	13.8	11.3	
LSD	10.0	10.3	7.1	15.8	11.5	9.0	9.0	

The 1999 Triplicate had 53 entries including 3 varieties grown as checks: Alliance, Arapahoe, and Jagger. The fifty experimental lines in this nursery had never been milled on the Buhler Laboratory Mill nor baked previously. Overall, the fifty entries milled well, with the exception of: NE98535. It received a mill rating of: Very Poor and had a flour yield of only 66.7%. One experimental line (NE98577) received a mill type score of: Good+ and had a flour yield of 72.5%. Additionally, this sample exhibited superior baking characteristics. The loaves baked from this entry received these scores: External: Very good + Crumb grain: Very good- Texture: Very good-. Another superior score was for the crumb grain color. It was noted to be: Bright White; a desirable characteristic. One other experimental line (NE98574) was noted to have superior baking qualities. Some entries; NE98454, NE98455, NE98468, NE98666 exhibited weak mixing tolerances on the Mixograph, and entry NE98493 had inferior baking properties.

Data for the 1998 NTN follow:

VARIETY	LINC.		CLAYCE		N.PLATTE		MCCOOK		SIDNEY		ALLIANCE		AVG.	
	bu/a		bu/a		bu/a		bu/a		bu/a		bu/a		bu/a	
NE97407	66.4	44	61.2	46	73.8	7	41.6	10	60.7	46	66.5	41	61.70	31
NE97415	72.1	18	65.5	21	61.5	53	28.1	59	59.2	51	68.9	34	59.23	51
NE97419	72.4	16	68.1	12	62.0	50	33.5	44	59.1	52	57.0	58	58.67	54
NE97421	66.7	42	64.9	22	67.9	21	37.0	32	69.1	13	69.1	32	62.46	24
NE97425	66.4	45	62.7	37	63.6	42	32.7	50	65.9	28	70.0	30	60.20	44
NE97426	65.9	49	60.8	48	62.8	46	38.0	25	68.9	14	83.9	3	63.36	20
NE97434	68.7	34	63.5	29	64.8	38	38.4	23	61.7	42	73.6	18	61.75	29
NE97436	66.1	48	59.6	52	65.5	33	35.4	40	63.0	37	77.9	8	61.27	36
NE97444	68.8	33	57.6	55	74.2	4	33.3	46	50.7	60	70.6	25	59.21	52
NE97465	71.3	22	66.8	18	72.2	10	45.3	3	58.5	54	93.4	1	67.91	1
NE97478	68.0	36	56.5	58	56.1	60	35.9	39	59.7	49	71.2	23	57.90	58
NE97481	65.1	51	59.3	53	63.6	44	42.3	8	61.0	45	61.1	52	58.71	53
NE97483	72.2	17	68.7	9	67.4	24	44.6	4	70.6	8	67.8	38	65.21	7
NE97487	69.9	29	67.6	15	60.1	55	33.2	48	55.8	57	61.8	50	58.06	57
ALLIANCE	71.9	19	61.7	42	67.5	23	47.3	2	67.2	17	79.8	5	65.91	6
NE97489	75.7	8	68.9	8	67.2	29	37.9	26	55.0	58	79.6	6	64.05	14
NE97491	66.8	41	63.5	30	65.4	34	37.1	31	61.5	43	66.6	40	60.15	45
NE97492	65.8	50	62.3	40	63.0	45	39.9	16	58.6	53	68.0	37	59.61	50
NE97494	68.1	35	62.6	38	66.4	30	38.9	20	56.0	56	74.1	16	61.00	39
NE97495	71.6	21	70.5	3	67.4	27	41.6	9	72.9	4	72.8	19	66.13	5
NE97496	72.9	14	64.4	26	64.4	40	38.9	19	63.6	35	59.0	57	60.54	41
NE97497	70.2	27	68.3	11	62.6	49	39.2	18	66.7	22	76.7	11	63.94	15
NE97498	64.2	54	58.4	54	63.6	43	41.0	11	57.2	55	77.5	10	60.31	42
NE97518	74.4	11	64.7	25	60.1	56	33.5	45	72.3	5	65.6	43	61.77	28
NE97519	70.5	26	69.0	7	64.5	39	40.3	14	61.0	44	60.8	53	61.00	38
NE97521	67.2	37	57.5	56	65.2	36	37.7	28	64.1	32	60.3	54	58.64	55
NE97531	66.1	46	69.5	4	68.8	18	39.7	17	66.6	23	68.7	35	63.23	21
NE97547	63.2	57	57.3	57	76.9	2	36.9	34	66.8	19	76.3	12	62.91	23
NE97548	63.7	56	63.4	31	63.8	41	38.7	22	65.9	27	62.6	48	59.68	48
ARAPAHOE	69.2	32	61.5	44	61.5	52	35.0	41	69.5	10	61.2	51	59.65	49

NE97553	69.4	31	69.2	5	73.0	9	36.4	36	68.5	15	70.4	29	64.48	12
NE97558	70.6	25	65.8	20	67.4	26	36.2	38	62.5	41	87.7	2	65.03	8
NE97559	73.5	13	66.6	19	70.9	13	44.2	6	63.9	34	69.3	31	64.75	10
NE97569	64.9	52	60.3	49	67.3	28	34.6	43	59.3	50	60.3	55	57.77	59
NE97592	63.0	60	67.9	14	68.5	19	40.5	13	62.7	39	68.6	36	61.85	27
NE97596	67.1	38	61.1	47	61.5	54	37.0	33	68.3	16	72.7	21	61.27	35
NE97612	75.1	9	71.3	1	67.5	22	40.9	12	66.1	26	63.5	45	64.07	13
NE97614	78.3	7	64.2	28	65.9	32	38.8	21	72.3	6	77.6	9	66.18	4
NE97619	79.2	6	61.5	43	61.7	51	32.6	51	62.8	38	66.9	39	60.78	40
NE97635	66.8	40	64.8	24	65.2	35	32.5	52	63.4	36	65.5	44	59.70	47
NE97637	63.2	58	62.9	36	68.4	20	34.6	42	66.4	24	74.9	15	61.71	30
NE97638	71.9	20	69.2	6	69.5	16	36.6	35	59.8	48	75.9	13	63.80	17
NE97664	63.0	59	64.3	27	73.7	8	40.0	15	53.6	59	72.7	22	61.20	37
NE97669	70.9	23	61.3	45	73.9	6	33.2	47	69.1	12	70.5	28	63.15	22
JAGGER	80.4	4	56.1	59	70.6	15	31.5	53	66.8	18	78.0	7	63.89	16
NE97670	70.7	24	67.4	16	65.1	37	37.5	30	60.4	47	70.6	26	61.96	26
NE97675	74.7	10	70.6	2	68.9	17	36.3	37	64.0	33	66.3	42	63.48	19
NE97676	70.1	28	62.4	39	62.8	47	37.5	29	66.7	21	62.3	49	60.31	43
NE97688	64.2	55	53.1	60	73.9	5	31.0	55	73.9	2	73.6	17	61.61	33
NE97689	73.8	12	67.9	13	74.6	3	37.9	27	64.4	31	80.2	4	66.47	3
NE97693	64.6	53	59.7	50	71.1	12	44.2	5	66.2	25	75.9	14	63.61	18
NE97698	69.8	30	63.0	33	70.9	14	47.7	1	65.3	29	70.6	27	64.54	11
NE97710	89.0	1	63.1	32	71.3	11	33.2	49	62.5	40	70.8	24	64.98	9
NE97713	67.0	39	63.0	34	66.3	31	30.4	56	73.7	3	69.0	33	61.56	34
NE97716	66.1	47	59.6	51	62.8	48	43.7	7	77.4	1	63.2	46	62.12	25
NI97410	72.5	15	67.1	17	57.1	59	28.4	58	69.2	11	55.4	60	58.27	56
NI97418	79.5	5	62.9	35	67.4	25	30.3	57	66.8	20	63.1	47	61.65	32
NI97423	81.1	3	68.6	10	57.9	58	26.7	60	70.0	9	55.7	59	60.02	46
NI97424	66.5	43	62.2	41	60.0	57	31.2	54	65.2	30	60.2	56	57.53	60
2137	82.4	2	64.9	23	77.9	1	38.0	24	71.4	7	72.8	20	67.88	2
GRAND ME	70.2		63.8		66.6		37.1		64.5		69.8		62.00	
LSD	9.86		9.91		7.93		10.18		12.44		10.35			

Data for the 1997 NTN follow:

VARIETY	LINC.	CLAYC.	N.PLAT	MCCOOK	SIDNEY	ALL.	AVG.	Rank
	Yield (bu/a)							
NE96435	40.10	52.02	50.28	75.05	36.51	50.49	50.74	1
NE96455	34.97	28.99	38.53	64.93	33.61	44.66	40.95	54
NE96458	38.58	21.93	44.17	65.70	36.71	46.04	42.19	48
NE96461	48.50	39.76	53.07	76.53	30.20	45.88	48.99	5
NE96462	35.99	34.72	31.30	67.30	41.37	42.54	42.20	47
NE96473	39.43	48.90	42.64	59.33	26.95	45.48	43.79	37
NE96476	42.07	30.12	24.63	62.19	29.21	38.26	37.75	59
NE96510	43.76	53.87	40.25	65.85	43.27	40.71	47.95	10
NE96515	43.37	40.82	36.41	62.40	32.94	47.26	43.87	36
NE96518	36.59	28.46	27.41	69.98	39.84	42.12	40.73	55
NE96520	40.04	41.42	42.00	62.78	17.14	47.87	41.87	51
NE96526	42.22	38.85	33.68	63.75	38.09	39.12	42.62	45
NE96566	32.29	37.05	30.09	70.32	23.13	47.42	40.05	56
NE96573	37.71	54.35	53.69	74.04	34.44	48.13	50.39	2
ALLIANCE	43.63	43.88	39.92	65.43	42.43	49.86	47.52	14
NE96577	40.83	40.55	38.09	65.87	35.96	43.12	44.07	33
NE96579	42.22	38.63	44.01	68.31	37.63	45.37	46.03	17
NE96580	38.22	41.89	44.97	62.84	36.82	44.70	44.91	27
NE96584	36.04	37.32	48.60	60.50	19.25	51.38	42.18	49

NE96585	42.72	27.97	42.38	60.13	31.74	44.28	41.54	52
NE96605	38.13	42.74	55.67	66.25	40.95	47.81	48.59	6
NE96607	46.13	46.16	51.51	62.13	36.99	42.94	47.64	12
NE96618	41.18	37.51	47.47	71.35	30.05	45.43	45.50	21
NE96621	34.75	44.43	38.93	69.41	37.34	42.50	44.56	30
NE96622	36.60	44.29	36.45	73.96	33.90	42.43	44.60	29
NE96623	36.92	47.50	40.72	67.43	34.21	45.01	45.30	22
NE96625	38.74	45.49	32.16	70.38	37.57	45.38	44.95	26
NE96627	37.02	47.19	44.41	72.36	46.00	41.99	48.16	7
NE96628	38.34	48.97	48.42	59.45	34.55	45.22	45.83	19
ARAPAHOE	41.52	55.57	43.56	70.99	48.03	41.55	50.20	3
NE96630	43.73	34.47	38.58	69.30	37.96	42.25	44.38	31
N396632	39.76	52.51	38.84	64.27	37.40	49.93	47.12	15
N396638	39.71	42.80	33.19	69.31	39.22	41.61	44.31	32
N396641	45.01	37.13	45.49	69.31	24.88	46.08	44.65	28
NE96644	38.65	41.49	46.02	69.28	28.00	46.76	45.03	24
NE96647	35.49	37.39	43.84	70.46	28.41	45.84	43.57	38
NE96649	35.44	41.81	40.39	72.13	49.49	45.98	47.54	13
NE96650	32.63	46.63	38.26	59.41	37.73	43.62	43.05	43
NE96652	40.25	52.96	45.57	71.35	36.40	41.31	47.97	9
NE96654	42.47	46.76	50.62	68.19	26.12	43.55	46.29	16
NE96658	40.48	42.50	36.43	62.34	34.28	42.56	43.10	42
NE96659	29.77	35.80	33.72	67.58	33.52	37.58	39.66	58
NE96661	32.47	55.54	38.88	51.52	36.49	39.92	42.47	46
NE96676	42.04	51.94	45.05	59.66	33.61	37.72	45.00	25
KARL92	39.18	29.51	33.87	59.41	29.98	46.72	39.78	57
NE96677	31.94	55.48	46.05	64.92	32.69	44.16	45.87	18
NE96679	37.21	41.72	35.12	63.41	37.88	42.09	42.90	44
NE96682	37.07	56.47	40.21	48.23	25.74	45.22	42.16	50
NE96690	42.29	48.53	40.54	61.35	43.00	35.95	45.28	23
NE96697	36.46	50.35	44.40	57.81	33.90	37.10	43.34	41
NE96700	28.89	34.19	44.23	62.93	49.88	40.64	43.46	40
NE96704	38.00	18.50	38.37	60.91	24.20	37.70	36.28	60
NE96722	42.45	21.71	42.52	67.12	43.72	46.77	44.05	34
NE96723	41.76	38.92	40.67	64.80	30.79	44.16	43.52	39
NE96727	35.76	38.49	36.86	59.52	49.52	43.40	43.93	35
NE96737	48.90	45.21	41.65	68.50	36.28	46.81	47.89	11
NE96740	41.76	19.01	36.66	60.25	47.32	43.42	41.40	53
NE96744	35.58	39.36	52.81	55.26	49.24	41.72	45.66	20
NE96747	37.35	45.61	52.43	66.15	40.55	46.20	48.05	8
PRONGHORN	38.29	48.40	45.88	69.83	45.71	50.92	49.84	4
GRAND MEAN	38.99	41.54	41.54	65.36	35.84	44.04	44.55	
CV	10.63	12.80	22.84	6.72	16.20	7.99		
LSD	5.61	7.20	12.85	7.34	7.86	4.76		

Nineteen lines were advanced to the Nebraska Intrastate Nursery which is slightly below normal for advancement from this nursery. The low number is in part due to a more normal year for grain protein quality and some lines which previously appeared to be adequate for quality were considered as being deficient.

6. Regional Nurseries

The Southern Regional Performance Nursery (SRPN) and Northern Regional Performance Nursery (NRPN) were harvested at Lincoln, Clay Center (SRPN only), North Platte, and Alliance. Yields were as follows:

Data for the SRPN:

Entry	Variety	Yield (bu/a) Lincoln	Clay Center	N. Platte	Alliance	State Average	State Rank
1	CI1442	39.6	15.8	47.6	45.7	37.2	43
2	CI13996	41.7	15.8	42.4	49.5	37.3	42
3	PI495594	68.8	22.9	59.3	57.5	52.1	30
4	OK94P549-2C	69.6	29.0	58.2	54.6	52.9	26
5	OK95616-14C	79.4	38.0	54.8	53.9	56.5	12
6	OK95571	64.3	26.9	61.6	60.7	53.3	22
7	OK96717	78.4	47.3	75.2	51.8	63.2	1
8	OK95548-26C	61.0	40.9	58.2	49.0	52.3	29
9	TX93D2066	71.5	29.1	63.3	48.8	53.1	24
10	TX95D8283	70.3	37.9	65.9	53.6	56.9	10
11	TX90A9528	59.4	23.2	79.1	60.0	55.4	13
12	TX94V5922	65.7	27.8	62.3	40.5	49.1	37
13	TX95V4339	57.2	31.0	60.3	47.0	48.9	38
14	TX95V5905	73.6	35.7	59.1	41.7	52.5	27
15	TX97V4311	62.9	18.4	56.8	38.0	44.0	41
16	CO940611	73.9	37.1	45.4	53.0	52.4	28
17	CO950043	71.7	36.6	67.1	64.8	60.0	6
18	KS95HW62-6	71.6	32.0	64.6	62.0	57.6	9
19	KS95H167-3	76.4	30.1	59.4	49.4	53.8	19
20	KS96HW10-3	53.1	16.2	56.1	54.0	44.9	40
21	KS96HW115	74.6	28.1	62.3	47.3	53.1	25
22	KS96HW94	67.5	29.0	54.1	51.3	50.5	34
23	G96047	63.1	39.5	61.2	51.2	53.8	20
24	G96134	71.0	27.4	55.6	48.6	50.6	33
25	G96135	69.4	41.4	51.6	51.9	53.6	21
26	G96044	60.5	23.2	60.0	46.8	47.6	39
27	NE95510	57.5	38.3	59.8	48.7	51.0	32
28	NE96573	61.9	36.8	60.7	58.6	54.5	16
29	TK1269	0.0	0.0	28.4	4.2	8.1	45
30	TB1071	0.0	0.0	28.2	15.1	10.8	44
31	T108	82.2	34.5	54.0	48.1	54.7	15
32	T111	74.0	37.7	60.1	55.4	56.8	11
33	T112	62.6	39.2	60.4	50.9	53.3	23
34	T114	67.8	30.1	53.9	45.7	49.4	36
35	W95-385	63.6	36.6	63.3	53.5	54.3	17
36	W95-392	58.9	30.8	62.8	48.1	50.2	35
37	W95-091	78.1	41.2	62.4	49.6	57.8	8
38	W94-480W	78.1	24.7	59.5	57.0	54.8	14
39	W95-610W	66.8	30.6	72.7	45.4	53.9	18
40	XH1888	79.0	42.7	60.2	59.9	60.4	5

41	XH9806	77.9	45.4	74.2	53.1	62.6	2
42	XH9815	76.0	31.1	67.1	63.0	59.3	7
43	89180B-2-1-2	70.2	44.9	71.4	57.7	61.0	4
44	HBK0630-4-5	77.6	52.4	64.7	51.7	61.6	3
45	NW97S151	48.9	32.3	70.6	54.4	51.6	31
	GRAND MEAN	64.4	31.3	59.5	50.1		
	CV	9.2	22.5	20.6	17.4		
	LSD	8.0	9.6	16.6	11.8		

Data for the NRPN:

ENTRY	VARIETY	Lincoln	N. Platte	Alliance	State Average	State Rank
1	CI1442	28.6	35.2	44.9	36.2	30
2	CI17439	47.8	36.8	32.6	39.1	29
3	PI511307	62.3	65.9	43.1	57.1	2
4	PI584997	57.3	47.8	40.3	48.5	23
5	ND9257	49.7	49.4	49.2	49.4	21
6	ND9304	41.6	55.1	43.4	46.7	26
7	ND9419	44.6	51.8	45.0	47.1	25
8	ND9460	59.4	52.6	56.7	56.2	5
9	ND9560	53.9	41.9	52.9	49.6	20
10	SD95218	51.3	52.7	52.3	52.1	15
11	SD94149	58.1	55.2	47.9	53.7	8
12	SD3267	42.0	54.7	46.3	47.6	24
13	SD95203	63.7	62.5	41.3	55.8	6
14	SD94241	35.1	55.6	43.5	44.7	27
15	NE94654	45.3	63.0	50.6	52.9	12
16	NE94589	48.9	56.1	51.7	52.2	14
17	NE95473	56.0	53.0	44.9	51.3	17
18	NE95553	50.4	58.4	48.4	52.4	13
19	NE96435	52.5	58.5	45.2	52.1	16
20	NE95510	50.7	56.0	53.4	53.4	10
21	NE96632	42.9	44.5	45.6	44.3	28
22	NE96649	60.0	58.1	52.5	56.8	3
23	NW97S195	43.3	56.4	46.1	48.6	22
24	N95L1226	53.4	64.5	42.4	53.4	9
25	N95L1229	55.7	64.1	40.1	53.3	11
26	XH1888	68.1	57.8	53.6	59.8	1
27	XH9806	72.3	47.2	49.8	56.4	4
28	NH9803	37.2	62.8	50.0	50.0	19
29	T194	59.9	49.0	43.7	50.9	18
30	CULVER	60.7	56.5	44.7	53.9	7
	GRAND MEAN	51.8	54.1	46.7	50.9	
	CV	15.6	15.0	17.7		
	LSD	11.0	11.1	11.3		

In these regional nurseries, the hybrids (XH, XNH, and WX lines) continue to perform well. In the SRPN, few Nebraska experimental lines are entered because they tend to be too late for that nursery. The better experimental lines for Nebraska tend to be entered in the NRPN where they performed well. However, high yielding early lines are a need for Nebraska and increased efforts in selecting these types are needed.

7. Multiple-Location Observation Nursery

Six replications (locations) of this nursery were harvested and used for selection. Due to the size of this nursery, spatial variation continues to be a concern at many locations. Enhanced statistical analyses for these trials continue to be sought. Fifty lines (including three from the irrigated nursery and four lines from the former Dr. C. J. Peterson's breeding efforts) were advanced to the Nebraska Triplicate Nursery. In reviewing the pedigrees of the lines in this nursery, it is apparent that most of the elite germplasm involves very narrow crosses (e.g. Nebraska x Nebraska lines or Nebraska x regional lines x Nebraska lines). The effective use of germplasm introductions seems to require at least two cycles of selection (the first selections from crosses involving introductions lead to parents and crosses with those parents may lead to varieties).

8. Early Generation Nurseries

a. Single-plot Observation Nursery

Fifteen hundred sixty-five lines including checks were evaluated at Lincoln in 1999. Of this group, 442 lines were harvested and most were submitted for Quadrumat Junior milling, flour protein content, and dough mixing properties. This nursery was a great improvement over the previous observation nursery in 1998 which was hurt by our 1997 headrow nursery which was planted into extremely droughty soils and there was insufficient moisture throughout the growing season to develop vigorous plants. The 1999 observation nursery included the diversity of plant types that is needed for the diversity of growing conditions in Nebraska. As in the past, the turn-around time in the Wheat Quality Laboratory was excellent (all quality evaluations completed by the end of August). On the basis of agronomic and quality performance, 285 lines were selected for further testing (10 of which came from the red wheat breeding efforts of Dr. C. J Peterson).

b. Headrow Nursery

Over 40,000 headrows were planted at Mead. In general, the headrow nursery had an excellent start and finished about average. We were able to plant the nursery in early September (while another crew was planting North Platte and Clay Center). This was a tremendous benefit as the lines were planted following spring oats, into good moisture and had excellent fall growth. At finish, there were a number of wind and rainstorms which tended to lodge very good headrows. Fifteen hundred and nineteen lines and check were selected for advancement. Of these lines over 200 were white and the remaining 1300 were red.

a. F3 bulk hybrids

The F3 bulk hybrid nursery contained 666 bulks and check plots and was planted at Mead and Sidney. Most bulks survived the winter and were good for selection. Heads were selected from the Mead bulks and the seed quality would be considered as average. The number of F3 bulks is larger than normal due to our planting segregating red and white F3 bulks. Over 40,000 head rows were selected for fall planting. The headrows were planted early into good moisture while we were planting our western nurseries. Their emergence and stand was excellent. The project goal remains to have sufficiently good segregating F3 material to select about 40 - 45,000 headrows.

b. F2 bulk hybrids

The F2 bulk hybrid nursery contained 808 bulks and check plots. These bulks generally survived the winter, but some were winterkilled (those involved spring wheat parents) and some were damaged by rodents. As in the past, we continue to share our bulks with other programs (Colorado State University and Cargill Seeds, Inc.) and receive bulks from other programs. This germplasm sharing should continue as many more crosses are made among breeding programs than can be fully evaluated (i.e. my crosses are evaluated in Nebraska, but could have utility elsewhere if they were evaluated).

Due to the large number of bulks, only 600 were advanced as individual bulks for further consideration from our program. Those bulks that were not advanced were combined to form a large bulk that was planted in hopes we wold not lose any valuable germplasm. This is a departure from our past breeding system, but was implemented to insure more resources are being used for those populations having the greatest potential. An additional 400 bulks were advanced from the USDA breeding effort, so over 1000 F_3 bulks are planted in the field.

9. Winter Triticale Nursery

The triticale nurseries this year were above average at Lincoln and lost to hail at Sidney. Mead was quite variable due to winter injury. Visual selection was used to select early generation lines and head rows for advancement. The key to improved triticale varieties remains access to improved triticale germplasm and efforts continue to increase germplasm diversity. Triticales with high grain and forage yield potential are available and may be useful as a feed grain or forage crop. Triticale research has replaced our research on feed wheat. Two lines NE96T422 and NE96T441 are under large scale increase for possible release as forage triticales. Of the two, NE96T422 is better adapted to Nebraska and Resource Seeds Incorporated may have an interest in NE96T441 for forage production outside Nebraska. A number of good grain types have been developed and market development will need to be considered.

The data from the 1999 Triticale Variety Trial are:

			----------Yield----------							
			bu/a	bu/a	bu/a	AVG.				
ENTRY	VARIETY	TYPE	Lincoln	Mead	Average	Rank	HTL	HDL	HTM	HDM

1	PRESTO	G**	69.5	31.3	50.4	22	47.0	24.5	49.0	25.5
2	TSW250783	G	72.9	37.2	55.1	17	44.0	25.0	48.5	27.0
3	NE92T422	G	64.7	33.3	49.0	25	46.5	24.0	48.5	23.5
4	NE95T423	G	64.1	63.1	63.6	7	49.0	24.5	49.5	24.5
5	NE95T424	G	69.8	51.7	60.7	10	49.5	24.5	48.5	24.5
6	NE95T426	G	83.5	75.6	79.6	1	47.0	23.0	47.0	24.0
7	NE95T427	G	82.4	68.0	75.2	3	50.0	22.5	48.0	25.0
8	NE95T436	G	64.3	34.2	49.3	24	49.5	24.5	53.0	25.5
9	NE96T413	G	72.3	34.6	53.4	20	50.5	24.5	50.5	25.0
10	NE96T420	G	72.2	60.8	66.5	5	49.0	24.5	49.5	24.5
11	NE96T422	F	56.1	34.5	45.3	27	60.0	29.0	63.5	30.0
12	NE96T431	G	73.6	72.1	72.9	4	47.0	24.0	48.5	25.5
13	NE96T441	F	48.1	30.3	39.2	28	57.5	29.5	61.5	30.0
14	NE97T432	G	69.3	23.0	46.1	26	47.5	24.5	48.0	25.0
15	NEWCALE	G	64.9	43.7	54.3	19	50.0	19.5	49.5	25.5
16	NE97T433	G	65.5	43.3	54.4	18	46.0	23.5	50.0	27.0
17	NE98T403	G	66.6	58.1	62.4	9	46.5	24.5	49.0	25.5
18	NE98T404	G	67.2	53.4	60.3	11	48.5	24.5	49.5	25.5
19	NE98T405	G	83.4	27.6	55.5	16	50.0	22.0	49.5	25.0
20	NE98T413	G	77.0	55.8	66.4	6	51.5	23.0	51.0	25.5
21	NE98T424	G	75.2	81.8	78.5	2	53.5	23.0	53.5	26.0
22	NE98T425	G	70.3	56.7	63.5	8	50.5	24.5	50.0	25.5
23	NE98T426	G	57.5	41.7	49.6	23	51.5	23.5	50.5	25.5
24	NE98T427	G/F	70.2	41.5	55.9	15	52.0	25.0	53.5	27.5
25	NE98T428	G	66.9	50.0	58.4	13	53.0	25.0	51.5	26.5
26	NE98T429	G	60.1	18.3	39.2	29	58.0	25.0	59.5	27.5
27	NE98T448	G	67.5	50.9	59.2	12	52.0	25.0	53.5	26.5
28	NE98T450	G	63.4	51.5	57.5	14	53.0	25.0	53.5	27.5
29	ARAPAHOE	CG	52.8	53.1	52.9	21	42.5	23.5	43.5	25.5
30	TRICAL	CF	35.8	20.9	28.4	30	57.0	31.0	63.5	31.0
	GRAND MEAN		66.9	46.6	56.8		50.3	24.5	51.5	26.1
	CV		14.5	33.9			3.9	3.0	3.1	3.4
	LSD		13.2	26.8			3.3	1.3	2.8	1.5

*using a 60 lbs/bu for easy comparison to winter wheat yields. The actual standard for triticale is a 48 lbs/bu

**G is grain type and F is forage type.

The data from the 1998 trial were:

VARIETY	Lincoln				Sidney	Avg.	Rank		
	Ht (in)	HD	Yld (bu/a)*	Lodg	Yld (bu/a)*	bu/a*	State	Linc.	Sidn.
1 PRESTO	47.5	19.5	66.2	0	63.2	64.68	5	4	8
2 TSW250783	46.5	21.0	71.9	0	75.6	73.71	1	1	1
3 NE92T422	47.5	20.0	60.8	0	60.1	60.47	12	11	12
4 NE94T416	48.5	23.5	37.6	0	41.1	39.36	29	29	27

5	NE95T423	47.5	20.0	63.5	0	62.8	63.15	8	6	9
6	NE95T424	48.5	20.0	62.7	0	59.2	60.95	11	8	13
7	NE95T426	44.5	19.5	63.1	4	68.1	65.60	4	7	4
8	NE95T427	46.5	19.0	57.0	1	67.1	62.03	10	15	6
9	NE95T436	48.5	23.0	51.6	0	58.4	55.00	18	21	15
10	NE96T404	46.5	22.5	53.7	0	54.1	53.93	20	20	19
11	NE96T413	49.5	20.5	68.5	0	67.3	67.87	3	3	5
12	NE96T420	46.5	21.0	54.1	0	74.3	64.17	6	19	2
13	NE96T422	60.5	25.0	42.8	2	38.1	40.45	28	28	29
14	NE96T431	46.5	19.5	71.1	0	66.7	68.87	2	2	7
15	NEWCALE	44.0	19.0	51.0	2	46.5	48.75	25	24	23
16	NE96T440	47.0	21.5	49.0	0	47.6	48.29	26	26	21
17	NE96T441	56.5	25.0	44.8	1	38.4	41.58	27	27	28
18	NE97T404	48.5	19.0	54.2	2	44.2	49.21	24	18	25
19	NE97T407	44.0	18.0	61.9	1	43.8	52.80	21	9	26
20	NE97T416	48.0	22.0	58.3	2	54.5	56.40	16	14	18
21	NE97T425	48.5	19.5	61.3	3	53.9	57.57	14	10	20
22	NE97T426	46.0	20.0	51.1	1	59.0	55.05	17	23	14
23	NE97T432	45.5	20.5	59.3	3	68.4	63.83	7	12	3
24	NE97T433	46.0	21.0	63.7	2	60.9	62.31	9	5	10
25	NE97T435	47.0	21.0	50.9	2	47.6	49.25	23	25	22
26	NE97T452	45.5	19.5	55.4	0	57.9	56.67	15	17	17
27	NE97T454	47.5	20.0	58.5	0	60.3	59.37	13	13	11
28	NE97T457	53.0	20.0	55.9	6	44.3	50.13	22	16	24
29	ARAPAHOE	40.0	21.0	51.2	0	58.3	54.76	19	22	16
30	TRICAL	57.5	26.5	28.6	3	15.7	22.14	30	30	30
	GRAND MEAN	48.0	20.9	56.0	1	55.2	55.61			
	CV	3.40	2.30	10.63	0	15.86				
	LSD	3.34	0.98	9.73	0	14.32				

*using a 60 lbs/bu for easy comparison to winter wheat yields. The actual standard for triticale is a 48 lbs/bu

1997 Triticale Results:

VARIETY	Linc.	Mead	Sidney	Avg.	Rank
		bu/a*			
PRESTO	37.55	24.00	49.12	36.89	12
NE90T413	37.88	18.03	34.58	30.16	23
TSW250783	37.44	27.55	53.72	39.57	5
NE92T422	37.09	33.95	50.57	40.54	4
NEWCALE	27.83	19.45	43.22	30.17	22
NE94T407	37.44	22.88	50.10	36.81	13
NE94T416	34.66	18.33	62.80	38.60	7
TRICAL	24.82	17.50	32.90	25.07	29
NE95T423	38.76	24.33	48.07	37.05	10
NE95T424	38.98	22.15	51.70	37.61	9
NE95T426	47.59	29.38	48.65	41.87	2

NE95T427	37.62	18.25	61.60	39.16	6
NE95T436	34.61	24.35	55.22	38.06	8
ARAPAHOE	31.74	19.68	42.05	31.15	19
NE96T404	24.61	28.48	50.02	34.37	15
NE96T410	25.97	21.80	47.07	31.61	18
NE96T411	31.06	31.15	27.30	29.84	24
NE96T412	32.16	22.23	38.15	30.85	20
NE96T413	34.92	35.88	58.55	43.12	1
NE96T418	21.55	18.88	40.15	26.86	28
NE96T420	36.40	20.68	53.77	36.95	11
NE96T421	32.47	22.23	42.45	32.38	17
NE96T422	34.80	16.53	30.75	27.36	25
NE96T423	24.01	22.63	34.33	26.99	27
NE96T424	28.09	14.43	20.88	21.13	30
NE96T429	30.77	18.30	50.93	33.34	16
NE96T431	42.74	16.80	49.68	36.40	14
NE96T440	37.95	23.33	61.60	40.96	3
NE96T441	33.75	22.68	25.48	27.30	26
NE96T451	28.96	14.78	47.18	30.30	21
GRAND MEAN	33.47	22.35	45.42	33.75	
CV	9.40	28.75	23.78		
LSD	4.29	10.92	14.74		

*using a 60 lbs/bu for easy comparison to winter wheat yields. The actual standard for triticale is a 48 lbs/bu.

10. Wheat Transformation and Tissue Culture Studies

Due to a successful grant writing efforts (both within the university and for nationally competitive grants; approximate funding is $2,000,000 over five years), a team of scientists (Dr. A. Mitra, Dr. J. van Etten, Dr. R. French, Dr. P. Staswick, Dr. J. Morris, Dr. T. Elthon, Dr. P. Blum, Dr. H. Cerutti, Dr. K. Gill, Dr. T. Clemente, and Dr. Baenziger) at the University of Nebraska has developed a major effort on gene expression in plants with an emphasis on wheat and soybean transformation. In wheat, the key goals for transformation are improved transformation methods and disease and stress (mainly heat) resistance. Dr. Clemente and Ms. Shirley Sato lead the wheat transformation efforts. Numerous transgenic plants have been created using the particle bombardment technique and considerable progress has been made developing an *Agrobacterium* facilitated method. One of the main disease resistances efforts currently being studied is the 2-5A system, a key research area of Dr. Mitra, which may provide broad-spectrum resistance to RNA virus (such as wheat streak mosaic virus).

Mr. Todd Campbell, a graduate student, is genetically characterizing 2-5A transgenic plants. Twenty-five independently transformed wheat plants were produced by microprojectile bombardment of 1080 immature embryos with a three-plasmid system. One of his more interesting findings is that that while co-transformation is common (in this research, genes on three plasmids were inserted 36% of the time), co-insertion is less common (i.e. the three plasmid did not always

insert at the same site). Two of nine transgenic families containing all three plasmids were characterized for the segregation of the two genes of interest in T_1, T_2, and T_2 testcross generations using PCR. These data suggest that the two genes of interest are linked in both families studied. Based on the inheritance of the two genes of interest, one transgenic family would be desirable for use in a breeding program because it contains tightly linked genes, whereas the other family studied would not be desirable for use in a breeding program because the two genes segregate aberrantly or may have a second copy of one of the genes segregating in the background. Our future plans include further genetic characterization of transgenic plants, developing optimized transgenes for expression in wheat, and adding possible fungicidal genes as part of the US Wheat and Barely Scab Initiative research (cooperative project among Drs. Mitra, M. Dickman, Clemente, and Baenziger). The four genes (which may affect scab disease development), we wish to insert into wheat encode: a) CED9, b) IAP (inhibitor of apoptosis—programmed cell death), c) lactoferrin and a related derived protein, lactoferricin, and d) oxalyl-CoA- decarboxylase. With the exception of CED9, we have created over 10 events for the other genes. The T_1 seed has been harvested and is getting ready for plating for seed increase and testing. We also wish to insert both lactoferrin and oxalyl-CoA-decarboxylase in hopes the two genes combined may have enhanced antifungal properties. These four genes were chosen because these genes in transgenic tobacco plants have shown potential for combating economically important fungal diseases of crop plants. In addition, these four genes represent distinctly different target specificities (modes of action).

Mr. Kamil Haliloglu, in cooperation with Ms. Sato, Drs. Clemente and Mitra, is conducting research on improving *Agrobacterium* mediated transformation of wheat using immature embryos. Mr. Kim Kyung-moon, competed his Ph.D. degree, and was able to improve our anther culture systems and to transform microspore-derived cells. Plant transformation is considered a key technology for modern crop improvement.

11. Chromosome Substitution Lines

This research was undertaken with the expectation as we learned more about the wheat genome, we would be able to develop better breeding strategies. Dr. Mohammed Maroof Shah, a former graduate student, completed the data analysis of the field evaluations of the recombinant inbred chromosome lines (RICLs) for Cheyenne (CNN)-Wichita (WI) chromosome 3A lines. As in our previous studies, CNN(WI3A) had significantly higher grain yield, and kernel weight CNN. CNN(WI3A) was also significantly earlier flowering than CNN. The parent lines were not different from each other for grain volume weight, which may reflect the fewer environments in which we have completed our measurements for this trait. Hence the quantitative trait loci (QTLs) for grain yield on chromosome 3A, despite having a significant G x E interaction, have been identified in 8 (Berke et al., 1992a), 4 (Yen et al., 1997), and now in 7 environments (Shah et al., 1999 and 2000). Unfortunately, Shah was not able to identify a QTL for grain yield. In follow-up studies using additional RICLs (a total of 98 RICLs) and additional replications, Mr. Todd Campbell with help from Drs. Shah, Gill, Nettleton, and Eskridge, was able to identify a QTL for grain yield on chromosome 3A. The QTL is very near the anthesis gene on that chromosome and we are most interested to determine if the QTLs for grain yield and anthesis date are linked or are the same ones. A putative second QTL for gain yield was identified further along the chromosome, but permutation statistics indicate it will further confirmation. In the next year we will concentrate on develop additional markers to fill the map gaps and to study QTLs.

12. White Wheat

Dr. Bob Graybosch, USDA-ARS and I continue our orderly transfer of white wheat germplasm to the state wheat breeding. This year, the F_1s (over 400), F_2s (about 250), F_3s (over 400), and headrows (approximately 9,000) were transferred. The current elite lines will continue to be advanced by Dr. Graybosch until they are released or dropped. The cooperation has been excellent and the goal will be to continue the cooperative USDA-University of Nebraska wheat improvement effort, while building a unified cultivar release program. The goals of the white wheat breeding effort will continue to be those of needed by the market and well recognized by Dr. Peterson. Specifically white wheats need to be truly white, dual purpose (capable of making noodles or bread), and should not discolor in fresh noodle products. NuPlains is an excellent example of a cultivar with these characteristics.

A small effort will continue in developing purple and blue wheats for unique markets. In our program we have identified a high yielding purple, softer wheat. A clearly identified (marked) soft wheat may have utility for organic or conventionally grown soft wheat production in non-traditional production areas. Blue wheat can also be used as a marker for natural and induced outcrossing, and potentially as way of determining the level of stress in a field (the blue color forms late in the seed development and stress may end kernel development before the blue color is completed).

13. Collaborative Research on Wheat Diseases

Dr. John Watkins, Department of Plant Pathology, and his staff continue to inoculate our experimental lines with wheat stem rust, wheat leaf rust, and as time permits with wheat streak mosaic virus. The greenhouse tests were excellent. They will also take leadership for screening lines in our transgenic and breeding efforts for scab resistance. Unfortunately, in the field, the weather was such that we did not have a successful stem rust field inoculation.. John's efforts to determine the virulence patterns of leaf rust in Nebraska have greatly helped understand this important disease and why some previously resistant lines became susceptible and other previously susceptible lines are becoming for resistant. His efforts are closely coordinated with Dr. Don McVey, USDA-ARS, Cereal Disease Lab, who provides stem rust inoculum and who also tests our lines with a set of stem rust races to identify the resistance genes in those lines.

Work continues on introgressing the resistance from *Agropyron* (the first real resistance/tolerance to wheat streak mosaic virus developed by Dr. Joe Martin, Kansas State University at Hays, Kansas and his co-workers) into adapted wheat varieties. A number of lines which may have this source of resistance were given to Bob Graybosch who in cooperation with Drs. Martin, French, and Stenger are testing them in the field in Lincoln, NE and Hays, KS.

14. Considerations on Nursery Sites

We continue to study the best way to test lines in Nebraska. We have eight testing sites, 2 in the panhandle (Sidney and Alliance), 3 in the southwest district (Grant, North Platte, and McCook), 1 in the southcentral district (Clay Center), and 2 in eastern Nebraska (Lincoln and Mead). To limit the number of plots that need to be planted and harvested, the 3 southwestern testing sites are based on trials with two replications, whereas the other sites have 4 replications with the exception of Mead with two replications.

North Platte remains the testing site for the regional nurseries and graduate student research. Hence we have similar sized nurseries at North Platte, McCook, and Grant. The land at McCook and Grant is very uniform and we believe two replication trials should provide excellent performance data. Efforts continue to develop better analytical methods for data analysis. With more information becoming available on karnal bunt, it is our hope that the southcentral site will again use a sustainable farm to increase our linkages with these emerging farming groups.

15. Global Change Research

One of the newer areas that the project hopes to become involved in is global change scenarios. A large, interdisciplinary effort involving crop modeling (Dr. A. Weiss), crop physiology and production (Dr. T. Arkebauer, Dr. J. Maranville, Dr. Drew Lyon, Dr. Madhavan), cereal chemistry, biometrics (Dr. K. Eskridge), economics (Dr. G. Helmers), and plant breeding (Dr. Baenziger) has been formed. The goal of this group will be to develop experimental techniques that will allow us to predict what may occur under various global change scenarios (e.g. global warming, elevated CO_2, etc.) and to identify germplasm that may ameliorate these changes. We built at Mead, the first "field chambers" in the Great Plains to study enhanced CO_2 and warming scenarios. Unfortunately, the plastic film, chosen for its durability and light transmission properties, did not survive our first windstorm. We are now working on developing smaller and more durable chambers. The benefit of this research is that it allows the breeding program to work with a highly interdisciplinary team who can provide insight into future breeding objectives. While this may seem too future oriented, it should be recognized that with the variable climate of Nebraska, many of the possible scenarios (e.g. drought or heat stress, or rapid weather change) occur annually in one or another part of Nebraska. The initial research was funded by the National Institute for Global Environmental Change (NIGEC) and the National Science Foundation (NSF), but it has become difficult to secure additional funding. The work of Al Weiss is providing extremely useful information on wheat growth and development and how plants respond to the environment.

IV. GREENHOUSE RESEARCH

The F_1 wheat populations were grown only in the Lincoln Greenhouses to avoid possible losses to winterkilling. Over 600 F_1 populations were grown. This is higher than normal and translates to over 650 F_2 plots including checks planted in 1999-2000. An additional 600+ wheat crosses were made for breeding purposes including improving the genetic male sterile population (first planted in 1990). Some crosses were made for genetic studies. In the triticale program, over 70 crosses were made.

V. PROPRIETARY RESEARCH

With the advent of plant biotechnology and hybrid wheat, the necessity and desirability of interacting with commercial companies has increased. With the dropping of the hybrid wheat development efforts in HybriTech, our collaboration for the identification of hybrid parents has ended. We continue to negotiate with an agricultural chemical company for the commercial use of their herbicide tolerant wheat germplasm. We have received the germplasm and have rapidly introgressed the trait into our germplasm and are close to finalizing an agreement on the research terms of use. This germplasm is potentially quite useful as the herbicides have residual activity and control most grassy

weeds (i.e. jointed goat grass, downy brome, cheat grass). Herbicide tolerance will also allow greater flexibility for cropping rotations and will involve our dryland-cropping specialists, particularly Dr. Drew Lyon.

We completed the negotiations with a commercial seed company for the exclusive release of our winter barley germplasm with a research fee clause. It is expected our forage triticale germplasm will be released to some form of a consortium on a research fee basis, also. Wheat cultivars will continue to be released without research fee agreements.

With the current level of private sector investments in research, additional public-private interactions are to be expected. A key goal will be to develop working relationships that benefit the producer, the customer, and the public good.

VI. Spring-Sown Wheat Research

A small spring-sown wheat breeding effort was initiated in 1997. We have been very fortunate to work closely with Dr. Jackie Rudd of South Dakota State University graciously shared his elite trial and 30 bulks for our evaluation. In addition, we are making about 40 crosses each year to develop germplasm with good adaptation for our Nebraska environments. We have normally grown the spring wheat trials (planted and harvested by Dr. D. Baltensperger) at Sidney, but are considering moving the trials to Alliance, where the cool nights seem to provide better growing conditions for spring wheat. With the addition of the white wheat breeding efforts to the state-breeding program, a decision was made to transfer the leadership of the spring wheat efforts to Dr. D. Baltensperger as he is the one closest to the needs of the program. Crosses will continue to be made at Lincoln.

VI. ALLIED RESEARCH

The wheat breeding or variety development project is only one phase of wheat improvement research at the University of Nebraska-Lincoln. The project interacts and depends on research in wheat germplasm development, wheat quality, wheat nutritional improvement, wheat cytogenetics, plant physiology and production practices, and variety testing. Much of the production research is located at the research and extension centers. All components are important in maintaining a competitive and improving wheat industry in Nebraska. The allied research is particularly necessary as grain classification and quality standards change and as growers try to reduce their production costs.

The program also depends on interactions and collaborations with the Wheat Board, Nebraska Wheat Growers Association, regional advisory boards, Foundation Seeds Division, Nebraska Crop Improvement Association, the milling and baking industry, and other interested groups and individuals. The Nebraska Wheat Quality Laboratory cooperates closely with the Wheat Quality Council and baked the large-scale cooperator samples. Numerous groups have visited the laboratory and participated in discussions on quality and marketing. Through these interactions, the program is able to remain focused and dedicated to being a premier provider of quality varieties, information, and technologies to help maintain the Nebraska Wheat Industry.

Summary

The 1999 Nebraska Wheat Crop was estimated at 86,400,000 bu, which represented a 48 bu/a state average yield on 1,800,000 harvested acres. 2,000,000 acres were planted to winter wheat. The planted acres were down due to the low price for wheat. Most of our normal production stresses, winterkilling, blowing, drought, and heat were minimal in most of the state. The main diseases were foliar blotches and leaf rust in the southern Nebraska. Insects (Russian wheat aphid and Hessian fly) were relatively minor.

Arapahoe continued to be the most widely grown wheat in Nebraska in 1999. Producers are rapidly accepting Alliance and Niobrara. The acreage of tall wheats is increasing. Wesley, Alliance, Culver, and 2137 performed well across the state, as did the newly released Millennium.

Three new cultivars, Cougar, Millennium, and Nuplains, were formally recommended for release in 1999. Cougar is a hard red winter wheat (*Triticum aestivum* L.) cultivar developed cooperatively and jointly released by the Nebraska Agricultural Experiment Station and the USDA-ARS. Cougar was selected from the cross NE85707/Thunderbird. The pedigree of NE85707 is Wrr*5/Agent//Kavkaz/4/ NE63218/KY58/3/ NTH/2*CMTH//PNC/*2 CNN. Cougar was released primarily for its having a very long coleoptile (similar to Scout 66) with exceptional straw strength (superior or equal to 2137 and Wesley). It has excellent test weight and kernel size. Similar to Thunderbird its yield level is lower except where its coleoptile length and standability are needed. Cougar is an awned, white-glumed cultivar. Its field appearance is most similar to 'Thunderbird' and ‘Big Dawg’. In two years of testing in Nebraska cultivar performance trials, it has performed competitively in the southeast, southcentral, and southwestern Nebraska, areas where historically Thunderbird also performed well. In this region (17 environments), Cougar had a yield of 61.0 bu/a (4100 kg/ha) which was lower than Wesley (69.9 bu/a, 4700 kg/ha) and 2137 (68.9 bu/a, 4630 kg/ha) but superior to Pronghorn (56.8 bu/a, 3820 kg/ha), the only other modern, long coleoptile wheat in the trial. The main advantage Cougar has when compared to most other available wheat cultivars, within its area of adaptation, is its long coleoptile, exceptional straw strength, good grain volume weight and kernel size, and competitive grain yields.

Millennium is a hard red winter wheat cultivar developed cooperatively by the Nebraska Agricultural Experiment Station and the USDA-ARS. It was jointly released in 1999 by the developing institutions and South Dakota Agricultural Experiment Station. Millennium was selected from the cross Arapahoe/Abilene//NE86488. The pedigree of NE8648 is Colt/3/Warrior 5*/Agent//Kavkaz. Millennium was released primarily for its superior adaptation to dryland wheat production systems in Nebraska (except southeastern Nebraska) and similar growing areas in South Dakota and adjacent states. In two years of testing in Nebraska cultivar performance trials, it has performed extremely well throughout most of Nebraska, but it is best adapted to southwestern and western Nebraska. The average dryland yield of Millennium (26 environments) was 4200 kg/ha (62.5 bu/a) which compares favorably to Alliance (4150 kg/ha, 61.7 bu/a), Culver (4190 kg/ha, 62.3 bu/a) and Niobrara (4160 kg/ha, 61.9 bu/a). Millennium also performed quite well under irrigation (5760 kg/ha, 85.6 bu/a), though would not be considered a high management wheat due to its height being a taller semi-dwarf with good, but not exceptional straw strength under irrigation. The main advantages Millennium has when compared to most other available wheat cultivars, within its area of adaptation, is its high grain yield, ability to yield well under favorable production conditions, and broad adaptation in dryland production systems.

Nuplains is the first hard white winter wheat developed by the USDA-ARS and the Nebraska Agricultural Experiment Station. It is a high yielding semi-dwarf wheat with adapted to dryland and irrigated production. Nuplains is well suited to higher yielding dryland conditions and should be an excellent companion wheat for Trego, a dryland white wheat recently released by Kansas, which seems to be better adapted to more stressful and lower yielding conditions.

Two experimental lines, NE94654 (Arapahoe/Abilene//Arapahoe) and NE95473 (unknown Russian parent/Arapahoe) are under large-scale increase for possible release in 2000. Both lines are similar to Arapahoe, but tend to have better agronomic performance.

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