IMPROVING WHEAT VARIETIES FOR NEBRASKA

2000 STATE BREEDING AND QUALITY EVALUATION REPORT

Report to the

NEBRASKA WHEAT DEVELOPMENT, UTILIZATION
AND MARKETING BOARD

P. S. Baenziger, M. J. Shipman, and D. D. Baltensperger

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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 and Horticulture 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 1999-2000 NEBRASKA WHEAT CROP

1. Growing Conditions

The 1999-2000 crop was planted into variably moist soils. Much of the western wheat crop was planted into adequate moisture, while much of the central and eastern crop was planted into dry soils. Planting was generally on time. The winter was exceptionally mild and there was little or no winterkilling due to cold temperatures anywhere in the normal winter wheat production areas. In the spring, moisture was adequate to above average in most of the Panhandle. Drought was severe in southwestern to eastern Nebraska. While the severe drought lessened in some of the stricken areas, in most of the stricken areas, the drought proceeded through harvest. The harvest was the earliest in the last fifteen years in much of Nebraska. Overall, early, winter tender wheats which often are winterkilled did well. The general dryness led to relatively few foliar diseases (e.g. rusts, blotches, etc.) and the main rust that was present was stem rust. The warm fall favored wheat streak mosaic virus in some areas. In general, Alliance, Culver, Millennium, Wesley, and 2137 performed well across the state, as did the newly released Wahoo (described below, formerly NE94654).

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2. Diseases

Foliar diseases are highly dependent on moisture. Usually they are most prevalent in eastern Nebraska. However, as the drought stricken area was southwest and eastern Nebraska, few foliar diseases were found. Stem rust on the leaf was common, but below damaging levels. Stem rust requires higher temperatures than other rusts, so in a way, the drought saved eastern Nebraska from a severe stem rust epidemic. In western Nebraska, the warm fall favored wheat streak mosaic virus spread, especially among early planted dryland wheat. Some fields were severely damaged by wheat streak mosaic virus, but in general, the drought was the most severe limitation on wheat production in 1999-2000. 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. Fortunately, the concerns about karnal bunt

becoming a major disease in the Great Plains have lessened and for whatever reason, no karnal bunt has been found in Nebraska. 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 2000. 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 2000 Nebraska Wheat Crop was estimated at 59,400,000 bu, which represented a 36.0 bu/a state average yield on 1,650,000 harvested acres. 1,800,000 acres were planted to winter wheat. The crop was much lower than the 1999 crop (86,400,000 bu from 1,800,000 harvested acres with a 48 bu/a state average yield), 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 (which also affects disease pressure).

5. Cultivar Distribution

Arapahoe continues to be the most popular and widely grown variety (19.8% of the state) in 2000. Arapahoe has been a highly successful variety and is slowly losing acreage to our and other more recent releases. Alliance is the second most widely grown variety followed by Niobrara and 2137. Alliance is probably the variety having the greatest impact since the release of Arapahoe, but its impact will be more localized as Alliance does not have the broad adaptation in eastern Nebraska that Arapahoe had. It is expected that the Arapahoe acreage will eventually be divided by three modern releases, Millennium, Culver, and Wahoo.

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 73% of the state acreage. Other public varieties occupied 17% and private varieties occupied 10% of the state acreage.

In looking at the variety survey, one area of concern is the increasing production of stem rust susceptible wheats. Currently, the popular 2137, Karl/Karl 92, and Buckskin are susceptible to stem rust. They cumulative occupy 15.5% of Nebraska's acreage. Buckskin is grown in region with low risk for stem rust, but 2137 and Karl/Karl 92 are grown in the high risk stem rust areas.

NEBRASKA—WHEAT VARIETIES
ESTIMATED PERCENTAGES PLANTED TO EACH VARIETY, 1994-2000

Percent

Variety	1994	1995	1996	1997	1998	1999	2000
2137	-----	-----	-----	-----	1.4	3.6	8.2
Agripro Abilene	3.0	4.1	4.2	2.2	2.4	2.7	2.7
Agripro Laredo	-----	1.2	1.1	-----	-----	----	----
Agripro Ogallala	-----	-----	2.2	1.5	1.6	1.2	1.4
Agripro Thunderbird	10.0	7.8	5.9	5.7	3.5	3.9	2.8
Agripro Tomahawk	3.9	3.1	2.9	2.5	2.6	1.6	1.0
Akron	-----	-----	-----	-----	-----	1.6	1.5
Alliance	-----	-----	2.7	7.3	8.4	10.4	15.1
Arapahoe	32.9	33.6	31.7	30.1	28.3	25.0	19.8
Buckskin	5.5	4.0	5.8	6.0	6.5	5.0	2.9
Centura	11.1	8.0	9.2	9.8	7.7	7.7	6.9
Ike	-----	-----	1.6	1.3	1.5	-----	-----
Jagger	-----	-----	-----	-----	-----	1.1	2.9
Karl/Karl 92	3.8	6.9	7.3	6.9	6.6	5.5	4.4
Niobrara	-----	-----	1.4	6.5	7.5	11.4	10.3
Pronghorn	-----	-----	-----	-----	4.6	7.8	6.9
Redland	6.3	4.3	3.4	1.2	1.0	-----	-----
Scout & Scout 66	1.6	3.4	2.4	1.6	2.3	1.0	-----
Siouxland	6.4	4.0	4.7	3.2	1.2	1.1	1.5
Vista	-----	4.6	3.6	4.6	3.9	2.1	2.7
Windstar	-----	-----	-----	-----	-----	1.3	1.6
Other Public Varieties	6.0	5.9	4.9	5.4	5.9	4.1	5.4
Other Private Varieties	3.3	1.9	0.8	3.1	1.9	1.9	2.0

6. New Cultivars

In 2000, one new cultivar was recommended for release. Wahoo is a hard red winter wheat (*Triticum aestivum* L.) cultivar developed cooperatively by the Nebraska Agricultural Experiment Station and the USDA-ARS. It will most likely be jointly released in 2001 by the developing institutions and Wyoming Agricultural Experiment Station. Wahoo was selected from the cross Arapahoe/Abilene//Arapahoe. Wahoo was released primarily for its superior adaptation to rainfed wheat production systems in eastern Nebraska and broad adaptation to rainfed wheat production systems in Wyoming and Nebraska.

Wahoo is an awned, white-glumed cultivar. Its field appearance is most similar to 'Arapahoe'. After heading, the canopy is moderately open and upright. The flag leaf is erect and twisted at the boot stage. The foliage is green with a waxy bloom at anthesis. The leaves are pubescent. The spike is tapering in shape, mid-long, and middense. The glume is midlong and narrow, and the glume shoulder is narrow and square. The beak

is medium to long 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 large brush of medium length**,** rounded cheeks**,** midsize germ**,** and a midwide and shallow crease.

Wahoo was performance tested as NE94654 in Nebraska yield nurseries starting in 1995 and in the Northern Regional Performance Nursery in 1998 and 1999, and in Nebraska cultivar performance trials in 1999 and 2000. 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 eastern Nebraska. It also preformed well in Wyoming. The average Nebraska rainfed yield of Wahoo (27 environments) was 3620 kg/ha (53.8 bu/a) that compares favorably to Alliance (3550 kg/ha, 52.7 bu/a), Culver (3510 kg/ha, 52.2 bu/a) and Millennium (3580 kg/ha, 53.3 bu/a). In Wyoming (9 environments) it averaged 2590 kg/ha (38.6 bu/a) which was superior to Buckskin (2390 kg/ha, 35.6 bu/a) and Pronghorn (2380 kg/ha, 35.4 bu/a). Wahoo has not performed well under irrigation and is not recommended for use in irrigated productions systems. Wahoo was tested in the Northern Regional Performance Nursery in 1998 and 1999. It ranked 16th of 28 entries in 1998 (17 environments) and 6th of 29 entries in 1999 (18 environments) and averaged 225 kg/ha (3 bu/a) higher yielding than 'Abilene'. The main advantages Wahoo has when compared to most other available wheat cultivars, within its area of adaptation, is its high grain yield and broad adaptation in rainfed production systems.

Other measurements of performance from comparison trials show that Wahoo is medium in maturity, about 0.5 d earlier flowering than Arapahoe and similar but slightly later than Wesley. However, Wahoo tends to be more variable in its flowering date than either Arapahoe or Wesley. Wahoo has a longer length coleoptile (53 mm) for a semi-dwarf wheat, longer than Arapahoe (50 mm), and Millennium (43 mm); but shorter than Cougar (76 mm), a semi-dwarf line with a different semi-dwarfing gene that does not affect coleoptile length. The mature plant height of Wahoo (36 in, 92 cm) is 2 in (5 cm) shorter than Arapahoe and 2 in (5 cm) taller than Wesley. Wahoo has moderate straw strength, similar to Arapahoe, but lower than Wesley, Alliance, and Millennium. The winter hardiness of Wahoo is good to very good, similar to Abilene and comparable to other winter wheat cultivars adapted and commonly grown in Nebraska.

Wahoo is moderately resistant to stem rust (caused by *Puccinia graminis Pers. : Pers. f. sp. tritici* Eriks & E. Henn; most likely containing *Sr6* and *Sr24*), leaf rust (caused by *P. triticina* Eriks.; most likely contains *Lr16, Lr24,* and possibly other leaf rust resistance genes)**,** 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, wheat streak mosaic virus, and barley yellow dwarf virus. Wahoo is a genetically lower in grain volume weight (57.2 lbs/bu, 73.8 kg/hl) similar to Arapahoe and Wesley, but lower than Culver, Millennium, Alliance, and Pronghorn. The milling and baking properties of Wahoo were determined for six 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 Wahoo was similar to Scout 66 and lower than Arapahoe. The average flour extraction on the Buhler Laboratory Mill for the Wahoo was similar to Scout 66, and higher than Arapahoe. The flour ash content was higher than both check varieties. The average flour protein content was less than both check varieties. Dough mixing properties of Wahoo were similar to Arapahoe and stronger than Scout 66. Average baking absorption was slightly less than the check varieties. The average loaf volume of Wahoo was similar to Scout 66, and less than Arapahoe. 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 Wahoo should be acceptable to the milling and baking industries. In preliminary noodle quality tests, noodles made from Wahoo discolor less over time than noodles made from flour from most other hard red winter wheat varieties. Noodle discoloration is an undesirable trait in the marketplace.

In positioning Wahoo, based on performance data to date, it should be well adapted to most rainfed wheat production systems, with average or above average yield potential in most of Nebraska. It has performed exceptionally well in eastern Nebraska and should be grown there as a medium maturity wheat variety. It should perform well in similar growing areas in adjacent states. Where it is adapted, Wahoo should

be a good replacement for Arapahoe as it has a higher yield potential, similar straw strength, and similar disease and insect resistances. Wahoo is genetically complementary to 2137, Alliance, Jagger, Pronghorn, and Windstar. It is non-complementary to Arapahoe (one of its parents), Culver, Millennium, Niobrara, and Vista.

Wahoo has been uniform and stable since 1999. Less than 0.5 % of the plants were rogued from the Breeder's seed increase in 1999. 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. Wahoo will be submitted for registration and plant variety protection under P. L. 10577 with the certification option.

III. FIELD RESEARCH

1. Increase of New Experimental Lines

Based on last year's results and our recent releases, no lines were advanced for large scale increase at the Nebraska Foundation Seed Division for possible release in 2001.NE95510 and NE 95473 were dropped from further consideration.

Five lines were advanced to small scale increases at the Nebraska Foundation Seed Division. They are:

NE97426	BRIGANTINA/2*ARAPAHOE
NE97465	SD3055/KS88H164//NE89646 (=COLT*2/PATRIZANKA)
NE97638	NE90614 (=BRL/4/PKR*4/AGT//BEL.198/LCR/3/NWT/BRL)/NE87612 (=NWT//WRR*5/AGT/3/NE69441)
NE97669	VISTA/KS87H6//ARLIN
NE97689	NE90614 (=BRL/4/PKR*4/AGT//BEL.198/LCR/3/NWT/BRL)/NE87612 (=NWT//WRR*5/AGT/3/NE69441)

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 Cougar, Culver, Millennium, Nuplains, Wahoo, and Wesley 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 2000. Ten dryland, two irrigated, and one ecofallow nurseries were harvested for yield data.

In 2000, the top ten entries for dryland production were:

Entry	Average Yield	Entry	Average Yield
	bu/a		bu/a
Wahoo	48.8	Culver	47.0
Trego	48.3	NUPLAINS	46.9
Alliance	48.0	NW97S343	46.9
NIOBRARA	47.2	2137	46.8
Millennium	47.1	NW97S154	46.5

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

Of the lines tested in all locations except the irrigated test, Turkey had the lowest grain yield (34.4 bu/a) which was as expected when winterkilling is relatively minor. The yield of the nurseries is lower than in previous years indicative of the more adverse growing conditions and higher than the state average yield indicating our nurseries tend to be better production areas than parts of the state.

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 2000 were:

Entry	Average Yield	Entry	Average Yield
	bu/a		bu/a
XH9801	108	GM1002	104
AP7510	107	QT7406	104
XH3207	107	QT7588	103
XH7463	105	NW97S278	102
XH9815	105	XH9806	102

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 data this year showed the benefits of hybrid wheat under favorable conditions. Only two of the top ten lines were varieties and the remaining eight were hybrids. However, in 1999, a number of experimental lines performed well, as did a number of released cultivars, while the hybrids performed relatively poorly (that is did not greatly exceed the yield of the experimental lines and cultivars). The access to hybrid wheats will be greatly reduced due to the scaling back of Hybritech Seed Co and their dropping the hybrid wheat development program.

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 2000 are:

Entry	VARIETY	Lincoln bu/a	Alliance bu/a	Dryland Avg bu/a	Rank	SidneyIRR bu/a	RankS	Test weight lbs/bu	State Avg. bu/a	Rank
1	NI00401	43.45	52.04	47.75	45	98.59	19	57.40	64.69	29
2	NI00402	42.85	54.02	48.44	43	86.36	30	54.40	61.08	39
3	NI00403	46.03	63.10	54.57	27	58.84	49	59.15	55.99	47
4	NI00404	58.60	61.64	60.12	4	73.37	43	57.60	64.54	30
5	NI00405	40.20	45.59	42.90	49	68.78	47	53.15	51.52	50
6	NI00406	53.38	45.22	49.30	41	100.12	18	56.10	66.24	24
7	NI00407	46.16	51.62	48.89	42	84.07	33	59.40	60.62	41
8	NI00408	57.77	55.43	56.60	17	80.25	34	50.75	64.48	31
9	NI00409	53.71	52.05	52.88	33	76.42	38	53.80	60.73	40
10	NI00410	54.75	61.94	58.35	8	90.18	28	55.60	68.96	16
11	NI00411	50.16	62.99	56.58	18	77.19	36	54.10	63.45	34
12	NI00412	56.12	52.36	54.24	28	56.56	50	55.40	55.01	49
13	NI00413	48.09	47.42	47.76	44	110.05	7	61.65	68.52	19
14	NI00414	59.32	65.10	62.21	2	93.23	21	55.20	72.55	10
15	NI00415	39.56	51.15	45.36	48	100.88	15	57.05	63.86	33
16	NI00416	55.64	55.81	55.73	23	100.88	17	55.15	70.78	12
17	NI00417	54.70	60.86	57.78	10	89.41	29	58.15	68.32	20
18	NI00418	43.11	48.63	45.87	47	74.89	39	56.00	55.54	48
19	NI00419	48.62	57.62	53.12	32	92.47	22	58.10	66.24	25
20	NI00420	52.29	49.02	50.66	39	90.94	26	57.60	64.08	32
21	NI00421	58.80	64.44	61.62	3	100.88	16	54.05	74.71	4
22	NI00422	52.78	59.26	56.02	20	90.95	24	56.05	67.66	21
23	NI00423	57.09	50.94	54.02	29	62.67	48	54.30	56.90	46
24	NI00424	51.63	56.07	53.85	30	90.18	27	52.70	65.96	26
25	NI00425	56.21	54.40	55.31	25	76.43	37	52.85	62.35	37
26	NI00426	55.12	43.89	49.51	40	73.37	42	56.75	57.46	45
27	NI00427	58.91	56.43	57.67	11	72.60	44	47.70	62.65	35
28	NI00428	57.05	44.55	50.80	38	71.84	45	54.35	57.81	44
29	NI00429	54.92	59.78	57.35	14	90.95	25	51.35	68.55	18
30	NI00430	61.59	55.60	58.60	7	80.25	35	47.60	65.81	27
31	NI00431	47.63	46.42	47.03	46	104.70	10	53.10	66.25	23
32	NI00432	39.63	35.41	37.52	50	108.52	8	58.65	61.19	38
33	NI00433	54.76	64.00	59.38	6	114.64	2	57.55	77.80	2
34	NI00434	61.39	58.31	59.85	5	101.64	14	55.80	73.78	7
35	NI00435	52.70	61.61	57.16	15	91.71	23	55.55	68.67	17
36	NI00436	72.30	62.49	67.40	1	101.64	13	59.00	78.81	1
37	NI00437	57.97	57.17	57.57	12	112.34	4	56.95	75.83	3
38	NI00438	55.84	48.91	52.38	34	102.40	12	59.85	69.05	15
39	NI00439	55.87	47.41	51.64	36	114.64	1	54.85	72.64	9
40	NI99410	66.41	48.73	57.57	13	85.59	31	55.50	66.91	22
41	NI99411	59.50	53.06	56.28	19	102.41	11	53.65	71.66	11
42	NI99416	42.50	64.92	53.71	31	104.70	9	58.30	70.71	13
43	NI99428	57.23	59.04	58.14	9	71.07	46	53.40	62.45	36
44	NI99429	53.75	58.18	55.97	21	84.07	32	52.95	65.33	28

45	NI99432	47.71	54.58	51.15	37	74.13	41	54.30	58.81	43
46	NI98427	51.98	51.94	51.96	35	74.13	40	54.25	59.35	42
47	NI98438	44.63	69.43	57.03	16	96.30	20	55.40	70.12	14
48	WESLEY	62.41	48.59	55.50	24	113.10	3	59.95	74.70	5
49	2137	52.74	58.73	55.74	22	110.81	5	56.80	74.09	6
50	ABILENE	56.53	53.06	54.80	26	110.81	6	60.95	73.47	8
	Average	53.24	54.82			89.86		55.60		
	CV	7.83	7.84			13.79		3.47		
	LSD	7.00	7.21			16.10		2.51		

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	

As in the past, Wesley and 2137 continued to perform under dryland (mainly the eastern locations) and irrigated conditions in 2000. A few lines were able to perform well under both conditions which indicates highly desirable lines. In 2000, ten lines were continued for further testing in the irrigated nursery, and five lines were advanced to the Nebraska Triplicate Nursery (NTN). In reviewing the results, we kept more line form this nursery than in the past. In 1999, three lines from this nursery were advanced to the NTN and eight lines were retained for further testing in the irrigated nursery. One concern that we have is that relatively few lines seem to perform well for two consecutive years in the irrigated trials. As such, we have decided to be slightly less stringent on our selection strategy because the year-to-year variation may reflect the limited number of replications we have in this trial and field position effects. Progress continues to be made in developing the necessary germplasm to have truly adapted irrigated wheats for Nebraska.

The results of the irrigated nursery in 1998 are:

ENTRY	VARIETY	Lincoln	N.Platte	Alliance	Dryland Avg.	Rank	Irrigated-Sidney	Rank
		bu/a	bu/a	bu/a	bu/a	Dryland	bu/a	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	

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 six locations. Grant was lost to volunteer wheat (due to a previous drought), drought, and wheat streak mosaic virus. North Platte was lost to drought and wheat streak mosaic virus. Most trials had four replications, but McCook and Mead had two replications. With the exception of McCook where drought was severe, most nurseries would be considered as being average to above average. In particular, the nurseries at Lincoln, Sidney and Alliance were good. Mead benefited by being irrigated in the fall, 1999 to overcome very dry conditions. Alliance, Culver, and Wesley performed very well among the released varieties, but a number of excellent experimental lines are progressing towards future release. The results for the 2000 NIN are:

Yield (bu/a)

ENTRY	VARIETY	Lincoln	Mead	ClayCen	McCook	Sidney	Alliance	**State Avg.**	**St. Rank**
1	**ARAPAHOE**	**52.6**	**62.5**	**37.6**	**14.7**	**57.9**	**58.3**	**47.26**	**56**
2	**NIOBRARA**	**60.1**	**69.2**	**48.3**	**20.9**	**62.0**	**64.6**	**54.17**	**22**
3	NE94654	66.8	78.7	46.0	26.2	66.7	60.6	**57.48**	**5**
4	NE95473	62.2	68.7	46.5	33.9	63.4	58.2	**55.48**	**12**
5	NE95510	58.4	64.8	49.7	27.3	59.3	67.5	**54.49**	**19**
6	NE95553	59.0	61.9	39.4	21.1	53.3	49.1	**47.29**	**55**
7	NE96579	67.7	72.2	45.7	20.0	61.2	56.7	**53.90**	**24**
8	NE96649	54.2	61.4	39.8	15.8	59.1	62.5	**48.79**	**51**
9	NE96654	56.1	58.8	42.1	19.9	51.5	55.5	**47.32**	**54**
10	NE96737	58.2	67.3	44.5	30.5	62.6	63.0	**54.35**	**20**
11	**ALLIANCE**	**56.4**	**62.7**	**41.3**	**32.7**	**67.1**	**69.4**	**54.93**	**16**
12	**WINDSTAR**	**53.5**	**59.6**	**47.1**	**22.6**	**57.4**	**65.6**	**50.95**	**37**
13	NE97426	62.2	62.3	46.7	20.2	61.7	64.8	**52.98**	**28**
14	NE97465	63.7	68.0	43.4	19.3	54.6	59.2	**51.36**	**34**
15	NE97489	58.4	57.8	42.1	24.8	54.8	59.5	**49.57**	**45**
16	NE97558	43.6	61.7	46.5	27.1	53.4	60.9	**48.85**	**50**
17	NE97612	63.6	63.6	45.4	28.3	51.7	47.1	**49.94**	**42**
18	NE97638	61.2	67.8	47.6	35.5	65.1	70.7	**57.99**	**4**
19	NE97669	53.9	64.9	42.7	30.9	67.8	60.5	**53.45**	**25**
20	NE97670	56.0	58.1	48.2	23.7	60.2	55.4	**50.26**	**41**
21	**COUGAR**	**48.1**	**56.0**	**45.0**	**19.4**	**50.5**	**55.5**	**45.74**	**57**
22	**PRONGHORN**	**57.5**	**53.1**	**38.6**	**22.8**	**56.1**	**58.4**	**47.75**	**52**
23	SCOUT66	51.2	47.7	36.8	23.9	52.8	54.6	**44.49**	**59**
24	NE97675	50.9	69.5	44.3	26.7	55.1	51.5	**49.66**	**44**
25	NE97689	51.8	79.3	48.4	39.7	72.7	70.3	**60.37**	**1**
26	NI97423	51.5	66.2	46.6	18.3	59.2	54.8	**49.42**	**47**
27	N97V121	60.2	69.8	52.5	36.2	61.7	64.4	**57.47**	**6**

28	NE98410	54.2	64.9	41.2	27.0	54.9	56.6	**49.81**	**43**
29	NE98416	59.4	61.9	40.8	30.8	60.4	54.8	**51.35**	**35**
30	**WESLEY**	**67.8**	**65.7**	**52.4**	**32.1**	**57.8**	**60.5**	**56.05**	**8**
31	**CULVER**	**61.1**	**67.8**	**43.5**	**33.3**	**64.2**	**61.2**	**55.18**	**14**
32	**MILLENNIUM**	**57.2**	**69.6**	**50.1**	**23.2**	**62.7**	**62.3**	**54.18**	**21**
33	NE98424	67.8	65.8	47.0	23.0	63.6	60.9	**54.68**	**18**
34	NE98425	57.7	60.4	51.2	29.7	59.7	58.3	**52.82**	**29**
35	NE98445	59.9	68.4	45.4	34.6	57.5	46.7	**52.07**	**32**
36	NE98466	63.1	72.4	44.2	30.3	65.2	54.6	**54.94**	**15**
37	NE98471	63.0	70.6	49.4	38.8	62.9	70.9	**59.24**	**2**
38	NE98476	49.9	63.7	40.5	27.2	57.2	57.4	**49.33**	**48**
39	NE98502	48.9	52.7	38.6	29.7	54.2	62.1	**47.68**	**53**
40	NE98503	63.7	67.1	45.4	28.4	66.9	63.3	**55.80**	**9**
41	NE98530	52.8	71.4	43.0	17.7	61.0	51.6	**49.56**	**46**
42	NE98564	55.2	69.3	46.0	25.0	60.1	64.8	**53.39**	**26**
43	NE98574	59.8	64.8	40.9	31.0	59.3	48.9	**50.79**	**38**
44	NE98589	53.9	70.4	45.8	32.6	64.0	65.5	**55.36**	**13**
45	NE98594	52.8	67.8	48.3	24.1	57.5	60.1	**51.75**	**33**
46	NE98602	53.5	64.9	46.0	23.7	60.6	56.0	**50.78**	**39**
47	NE98632	69.7	76.7	51.1	21.2	63.3	68.0	**58.33**	**3**
48	NE98646	60.8	65.0	45.3	24.8	63.7	59.7	**53.23**	**27**
49	**BUCKSKIN**	**39.5**	**47.7**	**36.3**	**20.6**	**49.7**	**53.0**	**41.13**	**60**
50	**CHEYENNE**	**52.7**	**59.2**	**33.2**	**23.1**	**49.1**	**51.0**	**44.70**	**58**
51	NE98684	50.7	64.8	43.7	37.0	67.8	69.7	**55.60**	**11**
52	NE98691	55.5	65.4	45.3	18.0	57.4	53.2	**49.15**	**49**
53	NE98692	58.7	72.2	49.4	26.9	61.7	65.5	**55.73**	**10**
54	NE98714	55.6	61.0	50.1	19.6	69.1	59.1	**52.41**	**30**
55	NI98418	56.2	58.1	47.3	31.0	67.8	69.1	**54.92**	**17**
56	NI98438	54.3	64.1	43.7	18.8	63.7	57.5	**50.35**	**40**
57	NI98439	60.2	69.1	51.4	28.5	68.7	62.1	**56.66**	**7**
58	NI97405	63.4	64.1	45.0	28.7	59.8	62.7	**53.96**	**23**
59	NI97435	46.0	67.2	44.4	22.0	62.4	65.0	**51.16**	**36**
60	NI99412	59.6	72.3	49.6	17.6	60.4	54.9	**52.40**	**31**
	Average	57.05	64.99	44.97	26.03	60.22	59.76	52.17	
	CV	17.18	8.33	12.34	20.94	8.68	10.32	13.49	
	LSD	11.46	9.05	6.49	9.11	6.11	7.21	8.44	

Fifty-nine entries were received and analyzed from the 2000 NIN. Included is this group were eleven varieties used as checks. The wheat protein of the entire nursery (on a 14% moisture base) ranged from: 11.80% (NE98503 to 14.60%(NE93496 which was released as Cougar). Three entries were noted to have superior quality characteristics. NE 96737 had strong mixing properties and bread quality scores of: Good+(External) ; Very good- (Crumb grain); and Good+ (Texture quality). NE98418 had a "bright white" crumb color (a desirable quality trait.). The bread scores for this entry were also superior: Good+(External); Very good (Crumb grain); and Very good- (Texture quality.) NE 98439 also had desirable bread-baking characteristics.

Three experimental lines were noted to have less desirable quality potential and have been dropped from further consideration for possible release. NE96654 was scored as a "poor milling type"; with an undesirable

mill flour yield of 67.5%. NE 98692 was noted to be very sticky out of the mixer; with a poor mixograph tolerance score of '1'. (Score range is: 0 (very weak) to 7 (very strong). NI 97435 produced sticky doughs. Sticky dough is undesirable in mechanized commercial bread production systems.

NE94654 produced good Asian-type noodles, with a low discoloration rate (desirable trait). This experimental line was voted for release in 2000. The name of this variety is: Wahoo. Low noodle discoloration will be given increasing emphasis in the future as it is a key trait for the Asian noodle market.

The additional forty-two experimental lines had acceptable quality characteristics and were advanced or discontinued on the basis of their agronomic performance.

Twenty-one experimental lines were retained for continued testing in the 2001 NIN. Twelve released or soon to be released lines were also retained to represent the primary varieties grown in Nebraska.

The results for the 1999 NIN are:

		yield (bu/a)								State
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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		

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	

5. Nebraska Triplicate Nursery:

The same comments about the NIN data apply to the Nebraska Triplicate Nursery (NTN). Alliance and 2137 and number of experimental lines had very good years. Data for the 2000 NTN follow:

		Yield (bu/a)							
ENTRY	VARIETY	Lincoln	Mead	Clay Cen	McCook	Sidney	Alliance	Average	**Rank**
1	NI99412	64.5	93.2	44.3	26.9	78.9	57.2	60.82	**5**
2	NI99416	58.1	69.9	46.4	34.7	89.9	61.0	60.02	**6**
3	NI98414	51.4	78.0	45.7	28.6	89.4	57.3	58.40	**18**
4	NE99404	50.9	69.3	40.1	34.9	68.3	55.3	53.14	**49**
5	NE99405	55.8	64.8	42.1	33.0	70.3	40.5	51.07	**56**
6	NE99406	55.6	68.4	43.5	38.7	82.6	45.6	55.72	**36**
7	NE99407	48.6	54.1	43.7	35.5	85.8	58.0	54.28	**43**
8	NE99410	56.7	65.1	45.0	38.4	87.7	67.1	60.01	**7**
9	NE99411	51.7	67.9	43.8	29.7	71.6	49.7	52.40	**54**
10	NE99413	48.5	66.6	44.2	22.3	72.6	49.7	50.65	**57**
11	NE99417	47.0	60.4	35.5	31.1	74.2	47.1	49.23	**60**
12	NE99418	56.4	70.5	38.7	35.9	73.8	57.9	55.54	**37**
13	NE99424	52.7	81.1	46.4	35.8	82.9	50.7	58.26	**21**
14	NE99428	58.1	71.6	39.8	30.5	80.3	52.4	55.45	**39**
15	ALLIANCE	58.2	74.9	44.2	35.4	89.1	55.1	59.48	**9**
16	NE99430	43.0	74.4	40.7	29.0	84.2	51.5	53.78	**47**
17	NE99431	55.3	74.7	37.8	34.8	71.8	54.4	54.79	**42**
18	NE99437	43.9	68.0	43.9	36.8	74.7	57.8	54.17	**45**
19	NE99441	64.2	60.4	36.1	32.7	76.1	48.9	53.06	**51**
20	NE99443	48.4	68.5	40.3	33.6	87.9	60.1	56.46	**33**
21	NE99445	57.1	76.8	50.0	34.5	91.0	57.2	61.08	**4**
22	NE99464	63.9	60.5	47.7	37.9	78.7	52.0	56.78	**31**
23	NE99469	61.6	66.5	44.7	34.3	85.6	63.5	59.37	**11**
24	NE99471	54.1	67.7	38.1	29.3	77.3	59.0	54.25	**44**
25	NE99489	60.9	68.1	46.7	33.1	85.3	61.5	59.27	**13**
26	NE99495	55.7	78.3	45.8	38.7	87.7	50.4	59.43	**10**
27	NE99496	51.6	69.5	39.8	39.1	81.1	56.3	56.23	**35**
28	NE99504	50.8	77.5	37.0	35.4	80.5	58.2	56.57	**32**
29	NE99508	55.3	68.3	45.2	34.3	76.5	58.5	56.37	**34**
30	PRONGHORN	49.7	63.9	38.8	27.0	75.0	62.2	52.77	**52**
31	NE99510	65.2	77.8	42.8	34.3	81.8	55.7	59.59	**8**
32	NE99512	54.9	71.8	41.8	28.1	72.0	55.9	54.10	**46**
33	NE99513	60.3	69.7	42.5	40.5	78.2	60.6	58.64	**17**
34	NE99521	53.6	71.1	52.3	28.6	78.8	56.5	56.82	**30**
35	NE99529	57.0	81.5	46.3	31.7	79.2	49.0	57.44	**27**
36	NE99533	57.4	86.4	54.6	46.7	85.1	60.2	65.06	**1**
37	NE99534	47.4	72.7	36.9	34.3	68.1	53.8	52.19	**55**
38	NE99541	59.0	67.6	38.6	31.2	82.3	53.0	55.29	**40**
39	NE99542	53.5	71.6	40.0	37.7	87.6	59.9	58.39	**19**
40	NE99543	60.2	76.4	43.3	37.9	87.4	64.0	61.54	**3**
41	NE99552	61.3	73.9	44.0	24.3	84.7	61.5	58.29	**20**
42	NE99554	54.0	80.2	44.2	34.4	75.6	58.9	57.88	**23**
43	NE99555	45.6	74.9	40.3	30.1	81.0	48.2	53.35	**48**
44	NE99559	56.3	75.6	45.1	23.8	80.7	51.2	55.45	**38**
45	2137	59.2	77.8	46.1	36.0	84.1	51.5	59.13	**14**

46	NE99575	55.9	67.5	38.6	34.2	97.3	62.2	59.28	**12**
47	NE99578	57.9	65.2	46.0	35.3	88.4	55.7	58.07	**22**
48	NE99579	57.4	81.7	44.2	27.9	82.3	52.3	57.64	**24**
49	NE99585	51.2	87.1	52.2	31.7	78.1	45.4	57.60	**25**
50	NE99604	55.8	65.5	41.3	20.8	66.3	49.8	49.91	**59**
51	NE99617	56.3	70.6	37.4	28.6	85.6	64.9	57.23	**28**
52	NE99626	53.7	70.9	36.8	18.8	68.7	55.1	50.65	**58**
53	NE99636	53.6	67.4	39.1	27.9	79.6	51.1	53.13	**50**
54	NE99656	49.8	72.0	43.9	30.6	87.9	61.1	57.56	**26**
55	NE99669	56.2	71.7	44.1	28.5	75.2	56.0	55.28	**41**
56	NE99675	67.8	82.9	39.5	22.4	86.1	53.8	58.73	**15**
57	N99L011	51.3	73.8	43.4	34.9	80.9	56.9	56.86	**29**
58	N99L012	69.6	78.1	41.0	36.9	89.1	55.0	61.63	**2**
59	N99L031	48.5	71.2	40.4	19.5	89.4	46.6	52.59	**53**
60	N99L033	64.8	76.2	47.1	35.4	68.5	60.0	58.67	**16**
	Average	55.4	72.2	42.8	32.3	80.7	55.4		
	CV	10.2	6.5	7.5	11.4	7.0	9.4		
	LSD	7.7	7.8	4.4	6.2	7.6	7.1		

Fifty-three entries were received from the 2000 Triplicate Nursery. This is the initial year of large-scale analyses for this group of samples. The group included two varieties as checks: Alliance and Pronghorn. The wheat protein (on a 14% moisture base) for the entire group ranged from: 11.10% (NE99543) to 14.55% (NE99404). Four entries had superior quality characteristics. The promising lines are: NE 99417. This line exhibited strong mixing properties with good bread-quality scores. NE99489; NE99508; and NE99585 had outstanding bread-baking quality traits. Good+(External); Very good- (Crumb grain); Very good- (Texture quality). Three entries were dropped because of poor quality characteristics. These are: NE99428 and NE99430 were very poor milling types; with low mill-flour yields of 65.6% and 66.3% respectively. NE99617 had inferior dough-handling properties; very yellow crumb grain color; and weak tolerance to mixing.

The additional forty-four entries had acceptable quality characteristics. These lines were advanced or dropped on the basis of agronomic performance.

Twenty-three lines were advanced for further testing in the 2001 NIN.

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		

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			

6. Regional Nurseries

The Southern Regional Performance Nursery (SRPN) and Northern Regional Performance Nursery (NRPN) were harvested at Lincoln, Clay Center (SRPN only), Sidney, and Alliance. Yields were as follows: Data for 2000 SRPN:

		----------Yield (bu/a)----------					
ENTRY	VARIETY	Lincoln	Clay Center	Sidney	Alliance	Average	Rank
1	CI 1442	30.0	41.8	59.4	63.8	48.76	37
2	CI 13996	34.2	39.1	53.1	62.1	47.12	42
3	PI 495594	59.6	47.4	60.0	57.6	56.12	5
4	TX94V5922	57.4	49.9	58.0	49.8	53.74	14
5	TX95V4339	56.6	51.5	53.3	65.0	56.60	4
6	TX95V5905	51.0	45.5	58.2	49.0	50.91	29
7	TX97V4311	40.4	47.9	65.4	67.8	55.37	7
8	TX93D2066	48.2	40.6	64.0	48.7	50.39	32
9	TX95D8283	53.2	27.7	59.3	45.8	46.52	44
10	TX97D6377	66.3	38.5	65.8	50.8	55.35	8
11	TX91A333	62.9	43.5	56.6	47.9	52.72	19
12	TX95A3091	55.0	44.2	57.3	46.2	50.66	30
13	OK94P549-2C	48.2	41.8	61.0	59.8	52.72	20
14	OK96717	50.4	46.6	58.4	50.1	51.37	26
15	OK97508	42.7	49.6	59.0	53.8	51.27	27
16	OK98637	53.9	43.2	58.7	55.2	52.74	18
17	OK95G703-98-61416	57.7	23.1	58.4	55.6	48.69	38

18	OK98G502W	49.3	43.8	56.4	55.3	51.23	28
19	T117	63.0	44.3	52.4	41.9	50.40	31
20	T118	46.1	31.3	44.3	34.2	38.99	45
21	T119	54.0	37.4	58.4	50.5	50.06	33
22	T120w	47.7	41.4	55.7	47.6	48.10	39
23	KS920709-b-5-2	57.1	41.8	49.3	51.0	49.79	36
24	KS94U275	57.7	48.3	58.4	51.8	54.04	12
25	KS920946-b-15-1	48.7	46.9	58.9	56.2	52.68	21
26	KS96HW115	53.2	34.5	57.8	46.0	47.86	40
27	H9520428	54.8	52.4	54.2	70.4	57.96	1
28	WX96-0507	58.5	49.1	58.4	63.3	57.32	3
29	WX97-1711	52.3	39.5	62.9	69.0	55.95	6
30	WX97-3207	55.7	48.3	60.8	53.0	54.46	10
31	CO940610	61.1	43.5	57.1	56.6	54.57	9
32	CO940611	49.8	45.8	68.9	51.9	54.10	11
33	CO950043	66.6	48.8	61.8	54.1	57.82	2
34	CO960026	54.9	33.4	66.9	60.2	53.84	13
35	CO960223	55.9	43.2	63.2	46.9	52.31	24
36	CO960603	51.7	41.6	54.4	39.7	46.87	43
37	NE95510	54.4	39.3	60.2	56.5	52.59	22
38	NE97426	56.6	40.1	60.2	53.0	52.48	23
39	NI97435	49.2	43.5	56.4	65.5	53.62	15
40	NE97465	57.8	45.5	56.3	52.3	52.96	16
41	NW97S154	56.7	42.1	61.2	51.9	52.96	17
42	NW97S343	49.5	43.3	49.2	48.4	47.58	41
43	W95-385	54.2	41.9	66.8	45.5	52.12	25
44	W96-410	55.4	40.8	57.0	46.0	49.79	35
45	W97-234	47.4	43.5	53.7	54.6	49.79	34
	GRAND MEAN	53.0	42.6	58.4	53.4	51.85	
	CV	12.6	11.0	5.7	18.3	11.91	
	LSD	9.0	6.4	4.5	13.3	8.31	

Data for the NRPN:

		--------Yield (bu/a) ----------				
ENTRY	VARIETY	Lincoln	Sidney	Alliance	Average	Rank
1	CI 1442	39.1	45.3	48.3	44.22	33
2	CI 17439	48.2	51.4	43.6	47.72	32
3	PI 511307	59.4	71.5	53.1	61.30	15
4	PI 584997	55.4	77.7	44.7	59.26	18
5	Nuplains	62.5	72.6	55.4	63.51	9
6	T194	61.1	67.2	43.4	57.21	25
7	NE96649	54.0	72.8	47.5	58.10	22
8	NE97489	56.8	64.0	54.7	58.46	21
9	NE97558	62.1	68.3	54.1	61.47	14
10	NE97612	67.7	63.3	46.4	59.14	20

11	NE97638	72.1	80.2	60.6	70.96	3
12	NE97669	59.7	84.7	58.7	67.67	7
13	NE97675	57.1	73.9	51.7	60.92	17
14	NE97689	70.5	84.0	67.2	73.89	1
15	NI97405	55.5	92.3	57.7	68.49	6
16	MT9432	54.1	56.3	51.6	53.99	29
17	MTW9441	48.0	62.0	42.9	50.95	31
18	NW97S182	57.4	73.2	54.6	61.70	11
19	NW97S218	50.2	74.9	47.8	57.64	23
20	NW97S278	68.9	85.1	59.5	71.16	2
21	NW97S312	62.1	75.9	46.4	61.47	13
22	W94-480W	66.2	82.2	61.8	70.05	5
23	W95-610W	75.0	80.6	55.7	70.41	4
24	IDO537	67.1	67.3	49.1	61.17	16
25	IDO539	48.8	74.7	39.3	54.25	28
26	SD93267	62.2	59.3	56.0	59.16	19
27	SD94149	64.0	74.5	51.4	63.28	10
28	SD95203	62.4	68.4	53.8	61.52	12
29	SD95218	54.2	62.6	55.4	57.36	24
30	ND9257	52.8	65.0	51.5	56.41	26
31	ND9304	50.8	55.3	51.7	52.59	30
32	ND9419	61.6	80.2	57.9	66.57	8
33	ND9460	61.6	59.4	46.3	55.77	27
	GRAND MEAN	59.0	70.5	52.1	64.76	
	CV	8.6	8.7	13.9	8.64	
	LSD	5.4	6.5	7.7	5.92	

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 will continue. As part of these efforts, one early generation nursery is grown in Kansas to identify lines that are early with good performance characteristics.

7. Multiple-Location Observation Nursery

Six replications (locations) in Nebraska (Lincoln, Mead, Clay Center, McCook, Sidney, and Alliance) and one location from Kansas (grown by Hybritech at Wichita) 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-two lines from this nursery and five lines from the irrigated nursery 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 nineteen including checks were evaluated at Lincoln in 2000. Of the 1519 lines and checks, 1314 where red seeded and 205 where "white" seeded. Many of the putative white seeded lines were either segregating or misclassified. Of this group, 548 were harvested and over 400 were submitted for Quadrumat Junior milling, flour protein content, and dough mixing properties. 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, 293 red wheat and 30 white wheat lines were selected for further testing.

b. Headrow Nursery

Over 40,000 headrows were planted at Mead. In general, the headrow nursery had an excellent start despite being in very dry soil (the previous crop was oats, so there may have bee more subsoil moisture saved from the previous year) and finished well, but was severely rained upon after harvest. The late rains lodged many lines, making selection difficult. 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 at or before optimal planting time. In the past we often were forced to plant late which led to selecting tall segregants. We harvested over 1800 lines and planted 1477 red wheat lines and 188 white wheat lines. Of the red and white wheat lines, 322 where sent to Dr. Baltensperger for planting at Scottsbluff in our irrigated observati0n nursery, and 90 lines to Joe Martin at hays, Kansas for testing for wheat steak mosaic virus tolerance.

a. F3 bulk hybrids

The F3 bulk hybrid nursery contained 1043 bulks and check plots. All plots were planted at Mead and most were planted at Sidney. The bulks survived the winter and were average for selection due the dry fall and the difficulties of getting a uniform irrigation pattern. Heads were selected from the Mead bulks and the seed quality would be considered as average. The number of F3 bulks is far 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 906 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, about 700 were advanced as individual bulks for further consideration in 2001 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. Nearly an additional 100 bulks were received from Colorado and Oklahoma to augment our breeding program.

9. Winter Triticale Nursery

The triticale nurseries this year were above average at Lincoln and average 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 2000 Triticale Variety Trial are:

			----------Yield (bu/a)*----------						
ENTRY	VARIETY	TYPE	Lincoln	Sidney	Mead	Average	Rank	HDL	HTL
1	PRESTO	G**	68.74	76.01	53.19	65.98	4	11.1	41.2
2	NE95T426	G	83.93	73.00	65.13	74.02	2	12.3	41.6
3	NE95T427	G	77.12	69.85	76.90	74.62	1	13.3	42.4
4	NE96T420	G	56.73	92.87	53.71	67.77	3	14.2	41.5
5	NE96T422	F	54.10	65.60	41.79	53.83	22	21.8	48.1
6	NE96T431	G	58.90	71.99	55.57	62.15	7	12.5	40.7
7	NE96T441	F	69.08	61.55	43.06	57.90	16	20.8	45.2
8	NE98T413	G	61.62	64.93	61.35	62.63	6	11.0	43.5
9	NE98T424	G	68.28	57.74	65.17	63.73	5	11.4	42.8
10	NEWCALE	G	60.65	58.06	49.08	55.93	21	12.2	41.8
11	NE98T425	FO/G	54.28	61.20	63.82	59.77	10	11.8	42.5
12	NE98T428	G	57.28	68.43	53.63	59.78	9	12.0	41.8
13	NE98T448	G	64.03	59.86	55.02	59.64	11	12.8	41.9
14	NE99T404	G	59.55	67.02	54.98	60.52	8	12.7	41.1
15	NE99T440	G/F	59.82	67.10	48.97	58.63	14	12.7	42.1
16	NE99T441	F	69.43	57.70	51.53	59.55	12	16.0	43.2
17	NE99T448	F	57.93	73.78	39.72	57.14	17	15.4	40.8
18	NT00409	G	71.10	73.30	64.96	69.79	9	13.0	43.0
19	NT00410	G	68.85	69.90	63.01	67.25	12	11.0	44.0
20	ARAPAHOE	CG	47.84	45.72	51.20	48.25	27	13.2	32.4
21	NT00418	G	78.20	82.85	63.00	74.68	3	11.0	43.0
22	NT00419	G	69.50	89.20	62.83	73.84	4	12.0	41.0
23	NT00421	A-/FO	70.25	34.50	70.40	58.38	33	15.0	43.0
24	NT00427	G	82.30	70.65	68.03	73.66	5	12.0	47.0
25	NT00428	G	99.80	68.80	55.56	74.72	2	12.0	44.0
26	NT00432	G	101.45	47.95	66.98	72.13	6	12.0	35.0

27	NT00436	G	73.65	60.00	81.52	71.72	8	13.0	44.0
28	NT00449	FO	78.05	34.00	56.63	56.23	39	14.0	49.0
29	NT00459	FO	68.70	48.60	57.78	58.36	34	17.0	48.0
30	TRICAL	CF	60.29	23.88	42.93	42.37	29	23.5	44.0

* The bushel used in these calculations is 60 lbs/bu so the measurements are directly comparable to wheat. The official triticale bu is 48 lbs/bu.

** Grain or forage type.

On the basis of the continued interest in forage triticale, NE96T422 was recommended for release in 2001 as T422. A related forage line NE96T441, as approved for sale by the Nebraska Foundation Seed Division to interested third parties. As few funds are available to support the triticale breeding program, it was decided that a research and development fee would be charged on both NE96T422 and NE96T441. T422 seems to be well received by the seed industry and is currently being produced under a number of irrigation pivots. With the increased interest in forage triticale, the grain triticales NE95T426 and NE95T427 which have had outstanding years are currently being increased in hopes there will be a grain triticale market develop also.

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

10. Wheat Transformation and Tissue Culture Studies

Wheat transformation continues to be a key strategic effort in the wheat improvement overall effort. In our current research, we are emphasizing trying to develop wheat lines with improved Fusarium head blight (FHB) resistance as part of the US Wheat and Barely Scab Initiative. This is a collaborative effort between Dr. T. Clemente and Ms. S. Sato of the Transformation Core facility (does our wheat transformation), Dr. J. Watkins and Ms. J. Schimelfenig of the Department of Plant Pathology (does the screening of conventionally bred and transgenic wheat lines with FHB) and Drs. A. Mitra and M. Dickman, also of the Department of Plant Pathology who are studying new concepts in disease resistance. Ms. S. Mitra has been very helpful in maintaining the plants and doing much of the transgene analysis. So far, we have concentrated on putting in the following genes: a) inhibitors of apoptosis (programmed cell death): ced9, IAP, and BCL X(L), b) lactoferrin and a related derived protein, lactoferricin, and c) oxalyl-CoA- decarboxylase. With the exception of BCL X(L) where the work is in progress, we have created over 10 events for the other genes. In many cases, the T_1 plants have been screened for FHB tolerance and T_2 seed has been harvested. Seed from plants in the T_1 and T_2 generations which appear to have useful levels of FHB tolerance are being planted in the greenhouse for crossing to known FHB susceptible and resistant lines. Those crosses will be made this year on our most advanced material. The cross to the FHB susceptible line will help understand the inheritance of the putative FHB tolerance and the cross to the FHB resistant lines will indicate if the transgenic line can increase the level of FHB resistance above what is currently the best level of FHB tolerance in conventionally bred lines. One of the difficulties with working with FHB and transgenic lines is that FHB is a notoriously difficulty disease to work with and requires many plants and multiple heads per plant to be screened. Hence working with early generation transgenic material is very difficult.

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. It is done in collaboration with Drs. Kent Eskridge, Kulvinder Gill, and Dan Nettleton. Dr. Mohammed Maroof Shah, a former graduate student, has rejoined our project after being a postdoc at Iowa State University and with Kulvinder on another project. Dr. Shah will have a key leadership role in our future research. Mr. Mustafa Erayman, Todd Campbell, and Hikmet Budak are graduate students who actively working various aspects of this project. Mustafa is "binning" the known probes for chromosome 3A using deletion stocks developed at Kansas State University. His research is helping us understand the recombinational map and the physical map for chromosome 3A. This effort is needed to fill in the gaps in our map and to determine the physical size of the critical chromosome regions. Todd is evaluating 98 recombinant inbred chromosome lines (RICLs) for Cheyenne (CNN)-Wichita (WI) chromosome 3A lines [e.g. CNN(RICLs3A)] in the field and increasing the number of markers on our map for chromosome 3A. Todd has more replications in each testing location than we have had in the past, so he should be able to more tightly link markers to traits of interest and to thoroughly study genotype x environmental interactions. Hikmet is increasing the seed of WI(RICLs3A), the mirror image set of lines to Todd's CNN(RICLs3A) to determine in the genes/QTLs in WI(CNN3A) which reduce the yield of WI(CNN3A) compared to WI are at the same location as the genes/QTLs in CNN(WI3A) which increase the yield of CNN(WI3A) compared to CNN. Hikmet will also be involved with adding markers to chromosome 3A.

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 we began making all of the dedicated white wheat crosses and advancing the early generation materials. 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 over time 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 and Fusarium head blight (FHB, research funded by the U.S. What and Barley Scab Initiative), and as time permits with wheat leaf rust. The greenhouse tests were excellent for stem rust. Unfortunately, in the field, the hot, dry 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. Dr. Watkins and his staff will also take leadership for screening lines in our transgenic lines for FHB in the greenhouse and our breeding lines for FHB in the field. A mist screening nursery is being developed for FHB screening which has the added advantage of allowing us to screen white wheats for sprouting tolerance.

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. We (Dr. Kent Eskridge and I) believe that alpha-lattices will greatly help our data evaluation. Using nearest neighbor analyses has not been very successful for trials with two replications due to

not having enough replications to correct for field variation.

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 (Drs. Baenziger, Graybosch) 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 have modified our strategy so that we will cover these greenhouses only in the spring, just before flowering. Using this approach, the greenhouse cover will be less exposed to inclement weather. Also, the critical time for our studies is grain filling, so we will be concentrating our efforts on the critical period. We are also 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 700 F_1 populations were grown. This is higher than normal and translates to over 193 white and 876red F_2 plots including checks planted in 2000-01. An additional 900+ 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 retrospect, too many crosses have been made. The goal will be to have 750 crosses (250 red crosses, 250 white crosses, and 250 segregating red and white crosses). In the triticale program, over 60 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 have successfully negotiated with an agricultural chemical company for the research use of their herbicide tolerant wheat germplasm. We have received the germplasm and have rapidly introgressed the trait into our germplasm. 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 will develop a commercial agreement for the use of this trait as we develop commercially viable products. The herbicide tolerance is very effective in the field and Mr. Soleman Al-Otayk is developing improved selection methods for this important trait. This research is supported by a gift from the company to cover the costs of doing the research.

With a second major herbicide company, we have negotiated their having access to our germplasm for developing herbicide tolerant wheat. In this case, we do not receive funding form the company, but they do all of the work (backcrossing, testing, etc.)

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 having additional trials at Alliance, where the cool nights might 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 2000 Nebraska Wheat Crop was estimated at 59,400,000 bu, which represented a 36.0 bu/a state average yield on 1,650,000 harvested acres. 1,800,000 acres were planted to winter wheat. The crop was much lower than the 1999 crop (86,400,000 bu from 1,800,000 harvested acres with a 48 bu/a state average yield), the 1998 crop (82,800,000 bu harvested from 1,800,000 acres with a 46 bu/a yield average) and the 1997 crop (70,300,000 bu harvested from 1,900,000 acres with a 37.0 bu/a yield average). Despite continued genetic improvement, the main determinant in wheat production seems to be acres harvested and weather (which also affects disease pressure). Stem rust on the leaf was common, but below damaging levels. Stem rust requires higher temperatures than other rusts, so in a way, the drought saved eastern Nebraska from a severe stem rust epidemic. In western Nebraska, the warm fall favored wheat streak mosaic virus spread, especially among early planted dryland wheat.

Arapahoe continued to be the most widely grown wheat in Nebraska in 1999. Producers are rapidly accepting Alliance and our more recently released varieties. Wesley, Alliance, Culver, Millennium, and 2137 performed well across the state, as did the soon to be released Wahoo.

In 2000, one new cultivar was recommended for release. Wahoo is a hard red winter wheat (*Triticum aestivum* L.) cultivar developed cooperatively by the Nebraska Agricultural Experiment Station and the USDA-ARS and will most likely be jointly released in 2001 by the developing institutions and Wyoming Agricultural Experiment Station. Wahoo was selected from the cross Arapahoe/Abilene //Arapahoe. Wahoo was released primarily for its superior adaptation to rainfed wheat production systems in eastern Nebraska and broad adaptation to rainfed wheat production systems in Wyoming and Nebraska. Wahoo was performance tested as NE94654 in Nebraska yield nurseries starting in 1995 and in the Northern Regional Performance Nursery in 1998 and 1999, and in Nebraska cultivar performance trials in 1999 and 2000. 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 eastern Nebraska. The average rainfed yield of Wahoo (27 environments) was 3620 kg/ha (53.8 bu/a) that compares favorably to Alliance (3550 kg/ha, 52.7 bu/a), Culver (3510 kg/ha, 52.2 bu/a) and Millennium (3580 kg/ha, 53.3 bu/a). Wahoo has not performed well under irrigation and is not recommended for use in irrigated productions systems. Other measurements of performance from comparison trials show that Wahoo is medium in maturity, and has a longer length coleoptile (53 mm) for a semi-dwarf wheat. The mature plant height of Wahoo (36 in) is 2 in shorter than Arapahoe and 2 in taller than Wesley. Wahoo has moderate straw strength, similar to Arapahoe, but lower than Wesley, Alliance, and Millennium. The winter hardiness of Wahoo is good to very good, similar to Abilene and comparable to other winter wheat cultivars adapted and commonly grown in Nebraska. Wahoo is moderately resistant to stem rust, leaf rust**,** and Hessian fly, and susceptible to wheat soilborne mosaic virus, wheat streak mosaic virus, and barley yellow dwarf virus. Wahoo is a genetically lower in grain volume weight. The overall end-use quality characteristics for Wahoo should be acceptable to the milling and baking industries. In preliminary noodle quality tests, noodles made from Wahoo discolor less over time than noodles made from flour from most other hard red winter wheat varieties. Noodle discoloration is an undesirable trait in the marketplace. In positioning Wahoo, based on performance data to date, it should be well adapted to most rainfed wheat production systems, with average or above average yield potential in most of Nebraska. It has performed exceptionally well in eastern Nebraska and should be grown there as a medium maturity wheat variety. It should perform well in similar growing areas in adjacent states. Where it is adapted, Wahoo should be a good replacement for Arapahoe as it has a higher yield potential, similar straw strength, and similar disease and insect resistances. The seed classes will be Breeder, Foundation, Registered, and Certified. The Registered seed class will be a nonsalable seed class. Wahoo will be submitted for registration and plant variety protection under P. L. 10577 with the certification option.

Basic research studies continue in developing transgenic wheat, herbicide tolerant wheat, disease and insect resistant wheat, superior data analytical techniques, and how to better understand wheat grain yield and agronomic traits.

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