IMPROVING WHEAT VARIETIES FOR NEBRASKA

1995 STATE BREEDING AND QUALITY EVALUATION REPORT

Report to the

NEBRASKA WHEAT DEVELOPMENT, UTILIZATION
AND MARKETING BOARD

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I. INTRODUCTION

Wheat variety development research in Nebraska is cooperative 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 and germplasm development, is a major component of the state wheat improvement research. This report will deal only with the state portion of the total wheat breeding effort. The basic project is located in the Department of Agronomy at the University of Nebraska-Lincoln. Very important contributions come from state and federal researchers in the department and at the Nebraska research and extension centers, from researchers in the Department of Plant Pathology (both state and federal), from plant pathologists located at the USDA Cereal Rust Laboratory, St. Paul, Minnesota, and USDA entomologists at Manhattan, Kansas. All of these 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 1995 NEBRASKA WHEAT CROP

1. Growing Conditions

The 1994-1995 growing season can best be described as being the best of times and the worst of times depending where the wheat was produced in the state. The best crop was produced in western Nebraska where above average spring rainfall greatly enhanced yields. Western Nebraska had very little fall moisture and semidwarf, short coleoptile wheats had difficulties emerging in some fields. The worst crop was in southeastern Nebraska where excessive rainfall during grainfilling virtually destroyed the crop due to diseases. As the wheat in the southern Great Plains suffered from the same excessive moisture, the price of wheat rose dramatically and western Nebraska producers had a four crop year (twice the yield/a at twice the price per bushel). The estimated production was 86.1 million bushels from 2.1 million harvested acres with a state average yield of 41 bu/a. This is 7 bu/a higher yield than last year (34 bu/a) and would be considered a good production year. Winterkilling was minimal throughout the state and winter tender lines such as TAM 200 and Arlin survived with no damage. As compared to the previous two years, this growing season would have to be considered as being average in the fall and early spring, followed by a wet spring, and a very hot dry summer. Insects (Russian wheat aphid and Hessian fly) were minor. However, diseases (leaf rust, scab, foot rots, septoria, etc.) were very severe in southeastern to south central Nebraska.

The difference between this season and the previous two is quite noticeable. Last year favored lines that came out of the winter early, flowered and matured early, and were semidwarf lines such as Karl 92, or lines with good stress tolerance, such as Alliance, Nekota and Niobrara. This year full season wheats that avoided excessive moisture at heading and early grainfill in southeastern Nebraska or took advantage of the above average rainfall in western Nebraska were favored.

2. Diseases

Foliar and head diseases are highly dependent on moisture, hence foliar diseases were important on the wheat crop. In 1995, the main diseases were scab, head blight (Septoria spp.), and root rots (excessive moisture prevented a good root system from being developed which provided insufficient rooting when the heat came). The races of leaf rust continue to evolve. Previously resistant lines, such as Karl, have lost most or all of their resistance. More leaf rust is being seen on lines with Lr3 and Lr16 which are present in Arapahoe, Redland, and Vista. These lines are so popular that the increasing frequency of leaf rust races

with virulence on these varieties may represent they are being sampled more often. 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.

3. Insects

In general, most insects pests were at low levels on wheat in 1995. Russian wheat aphid damage was insignificant 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 wheat production for Nebraska is 86,100,000 bushels from 2,100,000 harvested acres. The average yield was 41 bu/a. This would be considered a good crop, above the five year average of 35 bu/a. Only 50,000 planted acres were not harvested acres which again indicated a good growing environment.

Quality determinations by CII Laboratory Services were as follows:

Wheat Protein Content (12% moisture basis)

			Test Weight	
Nebraska	1995	1994	1995	1994
	%	%	(lbs/bu)	(lbs/bu)
Northeast	11.4	12.9	60.8	59.4
Southeast	11.7	12.1	59.8	60.0
Northcentral	11.2	13.1	61.0	60.0
Southwest	11.0	12.4	60.8	58.9
Panhandle	10.7	12.4	60.8	60.2

Generally, lower wheat protein contents were available to the milling and baking industry in 1994 when compared with last year.

Quality standards are being impacted by long fermentation processes, such as sponge and dough baking methods. Currently quality considerations of bread crumb grain and texture are paramount in the baking industry. These procedures require stronger gluten proteins (longer dough mixing times and tolerances). Of the quality characteristics that growers are paid for, test weight and protein content were affected by the generally cool, wet growing conditions.

5. Cultivar Distribution

Last year's report included the 1995 variety survey, so no new information is included in this report. Arapahoe has been quickly accepted by the growers and continues to be the most widely grown variety (33.6% of the state) in 1994. To put Arapahoe's acceptance in perspective, it was grown on more acres than varieties developed by other states and by commercial seed companies combined in Nebraska. Centura was the second most widely grown variety followed by Thunderbird and Karl. The acreage of Siouxland and TAM wheats continued to drop which will improve the reputation of Nebraska as a provider of wheat grain with superior end-use quality.

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 71.5% of the state acreage. Private varieties occupied 19.1% of the state acreage.

NEBRASKA--WHEAT VARIETIES
ESTIMATED PERCENTAGES PLANTED TO EACH VARIETY, 1989-1995

	Percent					
Variety	1989	1990	1991	1993	1994	1995
Brule	12.0	9.4	5.4	3.1	1.4	1.4
Siouxland	20.5	18.7	14.5	8.2	6.4	4.0
Centura	12.4	9.6	10.4	8.5	11.1	8.0
Centurk & Centurk 78	4.6	4.4	3.3	1.6	---	1.3
Agripro Thunderbird	7.2	10.7	12.8	12.4	10.0	7.8
Redland	10.0	15.2	14.9	7.9	6.3	4.3
Cody	2.9	2.4	1.8	---	---	---
Buckskin	2.2	1.9	2.2	4.7	5.5	4.0
Scout & Scout 66	2.6	2.2	2.4	2.8	1.6	3.4
Agripro Abilene	1.0	5.5	6.3	6.2	3.0	4.1
All TAM wheats	3.8	6.0	8.0	3.4	2.8	2.5
Arapahoe	---	1.8	8.5	28.6	32.9	33.6
Rawhide	---	---	---	2.1	2.0	1.0
Vista	---	---	---	---	---	4.6
Karl	---	---	---	2.1	3.8	6.9
Agripro Victory	---	---	1.7	1.3	---	1.0
Agripro Tomahawk	---	---	---	1.0	3.9	3.1
Agripro Laredo	---	---	---	---	---	1.2
Other Public Varieties	4.3	4.0	4.3	4.2	6.0	5.9
Other Private Varieties	6.0	3.1	2.0	1.9	3.3	1.9

6. New Cultivars

One new cultivar is in the process of being released. Pronghorn (formerly NE88584) is being released by the Nebraska Agricultural Experiment Station in cooperation with the Wyoming Agricultural Experiment Station, the South Dakota Agricultural Experiment Station, and the Northern Plains Area, Agricultural Research Service, U. S. Department of Agriculture. The name was chosen to represent the region where the namesake and the cultivar are adapted.

Pronghorn is an increase of a hard red winter wheat F_3-derived line from the cross Centura/Dawn//Colt sib which was made in 1982 by Dr. J. W. Schmidt. Pronghorn was identified as a line in 1988 and tested as NE88584 in Nebraska yield nurseries starting in 1989, and in the Southern Regional Performance Nursery starting in 1991 and the Western Regional Performance Nursery in 1993. The current breeder seed originated from a purification program in 1991-1992 and 1992-1993 designed to remove off-types by roguing.

Pronghorn is a white chaff, awned, tall wheat with medium maturity. It is 1.5 days earlier than Arapahoe and Lamar, and is 1 day earlier than Buckskin. Pronghorn is one inch shorter than Buckskin, one inch taller than Lamar, and two inches taller than Arapahoe. Pronghorn has moderate straw strength, greater than Scout 66, but less than Buckskin, Centura, Siouxland, and Thunderbird. Pronghorn has exhibited moderate resistance to stem rust (contains Sr6 and Sr17) and is moderately susceptible to leaf rust. Pronghorn is susceptible to the Great Plains Biotype of Hessian fly, soilborne mosaic virus, and wheat streak mosaic virus. The winterhardiness of Pronghorn is comparable to with other winter wheat cultivars adapted and commonly grown in Nebraska and South Dakota. It winterhardiness is similar to Arapahoe and Buckskin, and superior to Vona, TAM 200, and Rawhide. Pronghorn is a genetically high test weight wheat, similar to Buckskin, Siouxland, and Scout 66 and superior to Arapahoe.

The recommended growing area for Pronghorn, based on current information, is the

dryland wheat production areas of the Panhandle of Nebraska, eastern Wyoming, and western South Dakota. Using western Nebraska data from the Nebraska Fall Sown Cereal Variety Trials from 1993, 1994, and 1995 (16 environments); data from the Western Regional Performance Nursery in 1993 and 1994 (17 environments); and Wyoming in 1994 and 1995 (11 environments), Pronghorn (43.8 bu/a) was one bu/a higher yielding than Lamar and two bu/a higher yielding than Arapahoe. Using data from only western Nebraska and from Wyoming (27 environments), the yield of Pronghorn, Buckskin, Lamar, and Arapahoe were similar. In five years of testing in the advanced trials in Nebraska (24 environments), Pronghorn (46.1 bu/a) was 2 bu/a lower yielding than Alliance; 1 bu/a lower yielding than Redland, Vista, and Niobrara; similar to Rawhide and Siouxland; 2 bu/a higher yielding than Arapahoe; 3 bu/a higher yielding than TAM107, and 6 bu/a higher yielding than Buckskin.

Pronghorn has a long coleoptile similar to Scout 66 and can be planted deep in dry seedbeds. Pronghorn is tolerant to aluminum toxic soils. For dryland wheat production, Pronghorn is a complementary wheat to Buckskin, both being tall wheats with long coleoptiles adapted to dryland production needs. The main advantage that Pronghorn has when compared to Buckskin is its superior stem rust resistance. Lamar and Pronghorn are comparable for stem rust resistance. Buckskin is susceptible to the current field races of stem rust.

The milling and baking properties of Pronghorn were determined using seven years of testing by the Nebraska Wheat Quality Laboratory with Arapahoe and Scout 66 as check cultivars. Four years of comparisons are available between Pronghorn and Buckskin. The average wheat and flour protein content of Pronghorn is higher than Arapahoe, Scout 66, and Buckskin. The dough mixing properties were stronger than Arapahoe and Scout 66, but similar to Buckskin, though Pronghorn has the best mixing tolerance. While the baking absorption of Pronghorn was less than Arapahoe, Scout 66, and Buckskin, average loaf volumes were greater than Arapahoe, Scout 66, and Buckskin. The external appearance and internal attributes of the baked bread loaf indicated generally acceptable quality characteristics.

The Nebraska Foundation Seed Division, Department of Agronomy, University of Nebraska-Lincoln, Lincoln, NE 68583 will have foundation seed available to qualified certified seed producers in 1995. The U.S. Department of Agriculture will not have seed for distribution. The seed classes will be breeder, foundation, registered, and certified. Pronghorn will not be submitted for registration and plant variety protection under P. L. 910577 with the certification option.

III. FIELD RESEARCH

1. Increase of New Experimental Lines

Three experimental wheats are in large scale increase for possible release in 1996. In addition, one line that was under possible increase for 1995 has had the decision on its release deferred until 1996. The three lines currently under large scale increase are NE90625 (TX79A2729//Caldwell/ Brule field sel # 6/3/Siouxland), NE91631 (NE82761 (=CO725082 2*/RRI)/Brule 84 sel.), and NE91648 (NE82671 (=CO725082 2*/RRI)/2/Ctk78*2/Lov 13). The line with a deferred decision is NE90479 (KS83H2510 (H11)/Brule 83 composite).

NE90479 is a moderately tall, intermediate coleoptile length wheat (similar to TAM107) with average straw strength. It has large kernels and very good test weight characteristics. It would be considered a medium maturity wheat. It is moderately resistant to stem rust and wheat soilborne mosaic virus. It is moderately susceptible to leaf rust, Hessian fly, and wheat streak mosaic virus. It is susceptible to Russian wheat aphid. In its first year of testing in the state variety trial, it seems to do particularly well in eastern and southeastern Nebraska. This is the first wheat in many years with good wheat soilborne mosaic virus resistance, which will help its adaptation in southeastern and southcentral Nebraska which would be its targeted area. However, in its second year of testing, it performed below average in Nebraska. The overall milling and baking quality would be considered as well above average. This is a good quality wheat with a high test weigth and superior protein content. NE90479 probably has a low likelihood of release in 1996 based on its previous erratic performance.

NE90625 is a taller semidwarf wheat that retains its height in shorter height environ-

ments, and has a shorter coleoptile (similar to Redland) with above average straw strength. It has intermediately sized kernels and appears to be genetically lower in protein and test weight. It would be considered a late maturity wheat. It is moderately resistant to stem rust (contains Sr6 and Sr24) and to leaf rust. It is moderately susceptible to wheat streak mosaic virus. It is susceptible to Hessian fly and the Russian wheat aphid. In its second year of testing in the state variety trial, it seems to do particularly well in western Nebraska where its lateness is not detrimental. Anecdotal observations indicate this wheat may be resistant to wind erosion. The overall milling and baking quality would be considered as acceptable.

NE91631 is a tall wheat that may lose some of its height potential in shorter height environments, and has a short coleoptile (similar to Vona) with above average straw strength. It has smaller sized kernels and appears to be genetically lower in protein and test weight. It would be considered a late maturity wheat. It is moderately resistant to stem rust (contains Sr6, Sr16, and Sr24), to leaf rust, and to Hessian fly. It is susceptible to wheat streak mosaic virus and the Russian wheat aphid. In its first year of testing in the state variety trial, it did well across the state where it appears to have coupled stress tolerance (good finish under heat) with a lateness was gave full season growth. The overall milling and baking quality would be considered as acceptable although the average wheat and flour protein content is 2.0% less than Arapahoe. NE91631 would be considered as having the best potential for release in 1996.

NE91648 is a moderately tall wheat with an intermediate length coleoptile (similar to Arapahoe) and moderate straw strength (similar to Arapahoe). It has medium sized kernels, above average test weight patterns, and a medium to low protein content. It would be considered as a medium-late maturity wheat. It is moderately resistant to stem rust (contains Sr6, Sr17, and other minor genes). It appears to be moderately susceptible to wheat streak mosaic virus. It is susceptible to leaf rust, Hessian fly, and the Russian wheat aphid. NE91648 tends to be more susceptible to the leaf blight complex (Septoria spp., tan spot, etc.) than other Nebraska wheats. In its first year of testing in the state variety trial, it performed well where its lateness avoided head blights and in dryland western Nebraska where foliar diseases were minor. The overall milling and baking quality would be considered as acceptable.

The following lines are under small scale increase with earliest possible release in 1997: NE90476 (Bennett/Brule 83 composite), NE92458 (OK83201/Redland), NE92628 (MV11-85/Redland), and NE92662 (Redland/5/Trapper//CMN/OT/3/CIMMYT /Scout/4/ Buckskin sib/Homestead). It is becomign obvious that Brule and its reselection Redland have been two of the most successful parents in the breeding program. Brule or Redland is also a parent of Arapahoe, Niobrara, and Vista.

With the release of new varieties Pronghorn, Niobrara, Nekota, Alliance, Vista, Rawhide, Arapahoe, and co-release of Ike and TAM 200, many of the most advanced current breeding lines are not expected to be released.

2. Nebraska Variety Testing

Forty-six entries were included in some or all of the locations in the Fall Sown Small Grain Variety Tests in 1994. Fourteen dryland, one irrigated, and one ecofallow nurseries were harvested for yield data. The top ten lines in 1995 were:

Entry	Av. Yield bu/a	Entry	Av. Yield bu/a
Vista	58.0	NE90625	55.2
NE91631	58.0	Redland	54.5
TAM200	56.5	Niobrara	53.6
Karl 92	55.5	NE91648	52.8
Alliance	55.4	Arapahoe	52.7

In 1994, the top ten entries were:

Entry	Av. Yield	Entry	Av. Yield

	bu/a		bu/a
Niobrara	52.4	Vista	51.1
Ike	52.3	Rawhide	51.1
Alliance	52.1	NE90625	50.0
Nekota	51.7	Redland	49.9
NE90479	51.2	NE89526	49.8

In 1993, the top ten entries were:

Entry	Av. Yield bu/a	Entry	Av. Yield bu/a
Niobrara	58.8	Arapahoe	55.1
Alliance	57.3	TAM107	55.1
Nekota	55.9	Karl 92	54.6
Redland	55.8	NE89526	54.3
Vista	55.6	TAM200	54.2

In 1992 the top ten lines for dryland production were:

Entry	Av. Yield bu/a	Entry	Av. Yield bu/a
Alliance	49.25	Arapahoe	43.15
Nekota	48.18	NE87612	42.75
Vista	47.55	TAM107	42.63
Redland	45.97	NE83404	42.44
N87V106	44.24	Yuma	42.31

Of the lines tested in all locations except the irrigated test, Turkey had the lowest grain yield (32.8 bu/a). In 1994, TAM200 had the lowest yield (44.8 bu/a). Turkey was not tested in all locations (yielded 42.5 bu/a) and had the lowest yield in 1993 (36.4 bu/a) and in 1992. Hybrids continue to do well in these tests, but are generally no tested state-wide. Other varieties were not tested in all locations, hence other high yielding hybrids and varieties may be overlooked when using state-wide averages.

3. Irrigated Wheat Trials

The irrigated wheat nursery was planted on in Cheyenne County at the High Plain Agricultural Laboratory. This trial is planted in cooperation with Dr. D. Baltensperger. Only two replications were planted and in some cases only one plot of the two replications was harvested making comparisons difficult. The trial had good yields for late planted wheat and emphasized straw strength. The irrigated trial attempts to simulate the majority of irrigated wheat planting conditions: planted late as would be the case after a summer crop harvest. The results from 1995, 1994, and 1992 are:

1995 Results at Sidney

N93L071	91.3 bu/a
N94L179	88.1
NE93496	83.8
N87V106E	81.2
NE90476	80.3

1992 Results at Sidney		1994 Results at Scottsbluff	
NE88427	42 bu/a	Yuma	87 bu/a
Vista	39	Karl	86
TAM200	38	Laredo	85
Arapahoe	37	Rawhide	85
Agripro Sierra	37	Abilene	84
Hybrid F2#2	36	N87V106	84
Redland	36	Colt	83

In the state variety trial, Rawhide has performed very well. It appears that an irrigated Nebraska wheat needs high yield potential coupled with the ability to finish under severe stress (the reason for Rawhide's name). Efforts have been expanded (with a new preliminary irrigated trial) to identify lines that may have potential under irrigation, but not necessarily under dryland conditions. NE90476 is an excellent dryland wheat, but NE93496 is just an average dryland wheat.

4. Nebraska Intrastate Nursery

The Nebraska Intrastate Nursery (NIN) was seeded at eight locations (Mead is a single replicate for winterhardiness notes and Beatrice is a single replication for observation) and all locations were harvested. The nurseries at Mead (single replication) and Beatrice (due to too much disease) are not reported. The data from Lincoln is and is not included in the averages and ranks.

The NIN data follow:

	Yield (bu/a)									
VARIETY	Linc.	DeWee	N.Plat	Sidney	Hemming	McCook	Average	Aver.-Linc	RANKAVG	RANKAVG_L
ARAPAHOE	16.91	33.01	19.29	64.53	68.88	53.09	42.618	47.760	47	46
N93L005	16.39	36.80	22.05	69.18	70.62	57.50	45.423	51.230	39	41
NE88584	17.86	32.61	23.93	70.27	75.06	58.78	46.418	52.130	37	36
ALLIANCE	12.98	39.73	34.03	71.49	66.64	65.71	48.430	55.520	30	27
RAWHIDE	14.23	37.45	38.98	75.29	83.25	59.95	51.525	58.984	13	8
NIOBRARA	16.06	37.97	29.87	72.68	70.38	58.46	47.570	53.872	32	32
NE90476*	20.26	41.35	42.31	72.52	79.51	65.78	53.622	60.294	4	4
NE90479	16.79	32.21	31.69	42.64	73.44	50.61	41.230	46.118	49	51
NE90524	19.42	29.74	29.63	67.54	77.39	60.60	47.387	52.980	33	33
NE90625	17.95	37.86	28.04	74.76	78.02	72.37	51.500	58.210	14	13
KARL92	22.28	30.52	39.20	66.12	82.72	51.69	48.755	54.050	28	31
NE91515	19.93	34.89	31.00	68.88	67.77	58.28	46.792	52.164	35	34
NE91518	29.95	32.54	37.26	78.47	75.25	54.73	51.367	55.650	17	25
NE91631*	17.81	50.24	39.28	80.24	70.62	69.76	54.658	62.028	2	2
NE91648*	17.59	46.47	42.71	70.63	67.78	68.98	52.360	59.314	7	7
NE91651	19.64	39.28	42.18	75.90	79.09	57.00	52.182	58.690	9	10
SCOUT66	7.02	23.92	10.09	41.66	52.25	41.27	29.368	33.838	60	60
NE92456	19.60	33.34	41.54	75.90	75.94	63.89	51.702	58.122	11	14
NE92458*	12.37	27.13	58.05	80.63	67.26	67.98	52.237	60.210	8	5
NE92466	16.73	24.34	52.59	64.98	77.72	55.30	48.610	54.986	29	30
NE92477	19.58	32.66	38.22	60.54	62.31	55.44	44.792	49.834	43	43
CHEYENNE	9.41	32.60	10.05	56.22	66.18	54.42	38.147	43.894	59	58
NE92522	16.36	30.46	38.73	69.69	75.03	73.30	50.595	57.442	21	18
NE92603	21.43	43.77	33.45	76.10	69.69	59.40	50.640	56.482	20	21

NE92608	13.78	29.11	39.06	79.04	77.38	61.49	49.977	57.216	25	19
NE92614	19.04	26.90	22.35	69.34	75.08	53.42	44.355	49.418	44	44
REDLAND	21.39	43.52	38.18	72.61	76.04	69.76	53.583	60.022	5	6
NE92628*	17.03	46.08	54.43	79.71	80.63	68.89	57.795	65.948	1	1
NE92646*	14.31	27.17	50.71	75.03	73.17	63.87	50.710	57.990	19	16
NE92652*	24.13	37.56	32.73	68.19	76.73	60.85	50.032	55.212	24	28
NE92662*	24.21	36.45	42.20	73.25	74.21	64.48	52.467	58.118	6	15
NE93403	13.17	30.86	18.12	71.88	60.67	64.64	43.223	49.234	45	45
BUCKSKIN	7.70	29.87	10.08	68.89	69.74	50.77	39.508	45.870	57	54
NE93405*	22.36	38.59	29.25	60.16	74.95	57.49	47.133	52.088	34	37
NE93406	15.44	26.36	19.55	58.84	72.98	48.76	40.322	45.298	54	55
NE93427*	16.43	33.13	46.54	76.14	71.46	66.46	51.693	58.746	12	9
NE93435	19.60	35.05	45.63	81.07	81.48	48.43	51.877	58.332	10	12
TAM107	20.12	33.98	44.66	69.76	67.29	42.07	46.313	51.552	38	39
NE93451	14.41	34.91	16.87	55.00	70.05	41.84	38.847	43.734	58	59
NE93452	13.04	29.07	14.95	63.78	81.81	43.58	41.038	46.638	51	50
NE93462	12.35	32.63	34.32	62.72	73.00	57.51	45.422	52.036	40	38
NE93473	13.88	32.18	28.17	49.05	68.08	52.96	40.720	46.088	53	52
NE93477	19.71	31.67	18.67	54.92	74.75	54.58	42.383	46.918	48	48
VISTA	15.74	42.99	42.76	71.51	71.43	64.10	51.422	58.558	15	11
NE93496	18.50	25.86	34.82	68.10	71.54	60.41	46.538	52.146	36	35
NE93522	22.34	38.10	44.05	58.36	73.75	66.60	50.533	56.172	22	22
NE93535	16.55	30.71	32.07	68.65	71.46	52.19	45.272	51.016	41	42
NE93536	11.72	19.25	34.21	61.00	69.79	45.12	40.182	45.874	55	53
NE93549	16.08	25.32	48.84	71.02	74.61	58.61	49.080	55.680	26	24
NE93554*	22.26	33.94	42.34	69.30	67.98	64.56	50.063	55.624	23	26
NE93597	19.25	29.02	23.86	66.48	65.31	51.98	42.650	47.330	46	47
NE93598	24.23	39.27	34.71	70.73	76.96	58.84	50.790	56.102	18	23
NE93613*	21.15	41.19	38.87	72.24	85.28	66.94	54.278	60.904	3	3
NE93618	18.88	31.86	13.21	54.74	73.23	53.06	40.830	45.220	52	56
NE93649	14.52	33.35	35.24	75.14	70.07	61.55	48.312	55.070	31	29
NE93669	11.55	36.95	22.75	76.34	81.98	64.56	49.022	56.516	27	20
VBF0168	20.15	37.48	44.23	70.50	78.13	57.87	51.393	57.642	16	17
SXLD/RAM-1	12.97	33.95	17.80	62.87	74.40	44.39	41.063	46.682	50	49
SXLD/RAM-2	15.65	28.14	17.18	60.38	66.88	51.61	39.973	44.838	56	57
SIOUXLAND	13.51	38.86	21.56	70.84	75.48	49.90	45.025	51.328	42	40
GRAND MEAN	17.26	34.04	32.82	68.07	73.01	57.97	47.195	53.18		
CV	15.09	12.88	20.74	6.03	8.32	7.14	11.700			
LSD	3.64	6.13	9.51	5.74	8.49	8.69	7.033			

* Advanced to USDA regional nurseries.

In general all of the trials that were replicated except Lincoln and perhaps Deweese which were severely and moderately damaged by disease were excellent. Lodging was severe at North Platte, and Hemmingford had a significant cheat grass infestation. However, the wheat outgrew the cheat grass and yielded very well.

The Nebraska Wheat Quality Lab analyzed for milling and baking characteristics 38 advanced experimental lines and check varieties from the 1994 NIN which were retained for further testing in the 1995 NIN. One line, NE90479, was again rated as having superior baking properties. Bread baked from ten other lines from the NIN scored good to very good: NE90476, NE90524, NE90625, NE91648, NE92458, NE92477, NE92522, NE92628, NE92652, and VBF0168. One line, NE91518 (a purple wheat) was rated as having less desirable baking properties.

The Nebraska Wheat Quality Lab analyzed for milling and baking characteristics 28 advanced experimental lines and check varieties from the 1994 Triplicate Nursery which were advanced for further testing in the 1995 NIN. The Nebraska Wheat Quality Lab evaluated

nine samples as having notable promise for end-use processing. Breads baked from NE93403, NE93405, NE93451, NE93496, NE93522, NE93535, NE93549, NE93554, NE93597, and N931005 have loaf volumes in excess of 900cc. Additionally, the external appearance and internal characteristics of these experimental lines were scored good to very good. Two lines, NE93406 and NE93427, were rated as having sticky dough handling properties after mixing. These and three other lines, NE93435, NE93477, and NE93618, made less than satisfactory bread.

In 1994 the top nine lines were:

	Yield (bu/a)						Rank
VARIETY	Linc.	Holstein	N.Plat.	Sidney	Hemm.	Average	
Alliance	59.298	64.051	56.699	80.950	64.138	65.027	5
NE90476*	64.202	70.670	52.825	73.350	66.113	65.432	4
KARL92	68.323	68.665	51.202	76.900	72.038	67.426	1
NE91518	63.809	67.698	54.786	79.417	63.900	65.922	2
NE91648*	64.565	64.621	52.090	82.350	58.700	64.465	7
NE92522*	65.408	62.558	61.119	74.283	64.500	65.574	3
NE92608	68.684	64.275	56.692	71.233	60.925	64.362	9
NE92652	62.466	63.103	53.215	76.567	69.163	64.903	6
NE92605	64.647	70.610	54.429	70.067	62.113	64.373	8

* Advanced to USDA Regional Nurseries for further testing.

In 1993, the top ten lines in the NIN were:

	Yield (bu/a)						Rank
VARIETY	Linc.	ClayC.	N.Plat.	McCook	Hemm.	Average	
NE88584	37.46	30.00	53.54	49.92	73.25	48.834	6
Alliance	34.73	27.42	59.56	45.02	79.90	49.326	3
NE90476	31.68	34.64	50.86	54.78	71.41	48.674	7
NE90479	33.64	33.46	57.79	55.67	66.52	49.416	2
NE90524	34.70	28.10	54.33	57.69	67.11	48.386	9
NE90574	31.93	24.14	60.43	55.55	72.57	48.924	5
NE89671	34.84	23.80	66.17	46.88	77.65	49.868	1
NE91648	25.62	28.64	61.25	54.89	72.91	48.662	8
NE91651	24.55	29.26	60.03	63.35	67.43	48.924	4
HBF0263	24.54	36.62	55.86	52.64	70.44	48.020	10

5. Nebraska Triplicate Nursery

The same comments about the NIN data apply to the Nebraska Triplicate Nursery (NTN). The average does not include data from Mead (unreplicated trial). A number of high yielding lines were identified that exceeded the checks. Arapahoe had the highest yield of the checks and ranked 25th.

The yield data are:

			Yield (bu/a)						
ENTRY	RANK	Entry	Average	Hemming	DeWeese	McCook	Mead	N.Platte	Sidney
1	25	ARAPAHOE	60.913	71.37	39.10	59.615	34.40	64.71	69.77
2	58	NE94402	47.665	73.10	25.57	47.525	26.90	53.95	38.18
3	51	NE94403	51.504	70.23	31.37	49.980	25.40	53.07	52.87
4	41	NE94406	54.871	71.60	26.39	49.165	28.30	62.11	65.09
5	23	NE94407	61.138	78.07	41.59	54.060	35.60	59.61	72.36
6	29	NE94411	59.940	69.07	35.51	55.640	29.70	60.62	78.86
7	12	NE94413	63.772	67.83	35.48	67.460	34.80	75.86	72.23
8	31	NE94414	58.818	69.30	30.80	60.460	27.80	64.42	69.11
9	33	NE94415	57.323	84.37	28.28	54.845	28.90	54.64	64.48
10	56	NE94422	50.254	75.17	21.87	45.930	28.30	52.93	55.37
11	10	NE94431	64.858	75.07	37.05	71.470	30.80	66.95	73.75
12	46	NE94433	53.318	85.70	20.35	41.850	27.70	63.00	55.69
13	55	NE94434	51.019	72.47	24.48	50.415	31.50	60.00	47.73
14	60	NE94441	42.580	65.90	30.07	46.500	33.50	38.31	32.12
15	27	NE94444	60.322	85.07	33.95	60.550	35.30	56.25	65.79
16	8	NE94445	66.240	69.57	47.05	65.470	36.90	76.19	72.92
17	47	NE94458	53.280	72.60	35.23	42.560	47.20	69.31	46.70
18	35	NE94471	56.857	75.87	35.10	58.515	39.10	56.80	58.00
19	4	NE94479	68.127	81.43	47.13	72.015	43.50	65.93	74.13
20	36	KARL92	56.773	75.70	32.64	57.355	36.80	54.01	64.16
21	2	NE94481	71.336	79.93	52.15	73.170	53.00	72.29	79.14
22	1	NE94482	74.930	81.60	61.87	79.170	45.50	72.78	79.23
23	5	NE94489	67.586	85.93	35.31	63.350	33.70	68.77	84.57
24	52	NE94492	51.477	74.30	32.29	40.285	26.90	54.43	56.08
25	32	NE94507	57.705	69.33	28.41	54.185	24.60	66.14	70.46
26	20	NE94512	61.961	62.93	35.58	63.235	32.50	72.31	75.75
27	19	NE94518	62.057	90.37	38.06	51.865	31.80	65.00	64.99
28	40	NE94535	54.901	75.67	31.92	52.725	32.60	51.42	62.77
29	50	NE94538	52.068	70.57	31.97	46.460	27.30	56.84	54.50
30	48	NE94539	53.032	62.17	25.71	46.250	23.90	62.96	68.07
31	57	NE94541	48.399	65.90	28.03	40.855	20.00	46.14	61.07
32	6	NE94567	67.147	82.93	32.30	64.345	30.00	71.44	84.72
33	11	NE94577	64.340	72.30	41.14	59.920	28.00	75.96	72.38
34	43	NE94579	54.415	82.07	35.32	49.875	23.40	52.94	51.87
35	24	NE94585	61.077	71.83	34.56	61.125	38.90	67.16	70.71
36	34	NE94588	56.862	81.67	25.78	48.000	31.50	65.79	63.07
37	28	NE94589	60.076	76.90	34.60	53.420	24.90	58.42	77.04
38	38	NE94591	55.883	82.90	32.48	53.135	26.30	55.75	55.15
39	42	NE94592	54.747	65.87	33.50	46.565	30.10	69.86	57.94
40	59	SCOUT66	46.228	66.87	32.46	45.200	13.30	41.01	45.60
41	39	NE94596	55.246	72.10	25.11	44.820	21.40	62.19	72.01
42	45	NE94612	53.541	79.90	22.80	45.845	25.70	65.41	53.75
43	3	NE94631	70.199	75.80	50.26	65.585	38.60	77.88	81.47
44	9	NE94632	65.362	75.70	42.67	60.630	36.50	71.59	76.22
45	14	NE94653	63.537	67.13	36.93	62.225	44.00	69.64	81.76
46	21	NE94654	61.771	68.60	40.19	66.495	39.90	60.83	72.74
47	7	NE94655	66.888	76.77	38.34	69.500	34.30	76.57	73.26
48	15	NE94661	62.582	82.43	26.43	55.170	30.10	81.34	67.54
49	22	NE94665	61.380	72.77	35.85	63.220	27.80	68.19	66.87
50	26	NE94666	60.527	77.17	31.32	66.775	37.40	64.85	62.52

51	49	NE94669	52.889	61.00	32.47	50.015	33.60	62.65	58.31
52	37	NE94671	56.332	79.83	24.79	54.920	23.90	59.29	62.83
53	16	NE94673	62.330	72.40	30.40	63.140	32.50	75.09	70.62
54	30	NE94677	59.639	67.47	34.75	63.835	28.70	65.01	67.13
55	17	NE94678	62.302	86.47	31.79	64.590	23.90	63.32	65.34
56	18	NE94685	62.225	77.37	43.87	56.705	28.90	67.80	65.38
57	53	NE94686	51.311	70.20	32.25	42.705	26.60	53.19	58.21
58	54	NE94689	51.140	77.17	17.06	44.400	17.40	53.39	63.68
59	13	N87V106-L	63.573	84.70	36.39	58.965	40.40	72.99	64.82
60	44	TAM107	53.667	68.57	33.21	42.245	30.00	57.53	66.78
		GRAND MEAN	54.483	74.75	33.82	55.772		63.08	65.26
		CV	10.274	10.60	13.20	7.694		11.34	8.86
		LSD	8.346	13.44	6.25	9.012		10.02	8.10

Twenty-four lines were advanced to the Nebraska Intrastate Nursery which is normal for advancement from this nursery. All lines were thoroughly analyzed for milling and baking quality including an optimized bake test prior to advancement. The Nebraska Wheat Quality Laboratory milled and baked 69 composite wheat samples form the Duplicate Nursery. Wheat protein contents of these samples from the Duplicate Nursery ranged from 11.7% to 14.8% (14% moisture basis). Breads baked from eleven experimental lines were rated as very good in one or more evaluation criteria: NE94402, NE94403, NE94489, NE94507, NE94518, NE94669, NE94671, NE94673, NE94677, NE94678, and NE94680. NE94431, NE94458, NE94539, NE94539, and NE94431 were rated as poor for one or more quality factors.

In 1994, the top ten lines were:

	Yield (bu/a)							
VARIETY	Linc.	Holstein	N. Plat.	Sidney	Hemming.	StateAvg.	RANK	McCook* (bu/a)
NE93403	69.917	67.313	57.273	71.767	61.216	57.824	3	19.460
NE93405	63.122	65.947	52.606	65.050	68.664	56.780	6	25.290
NE93406	69.536	56.157	51.506	71.783	63.404	56.221	10	24.940
NE93427	65.134	60.800	54.719	75.067	59.117	56.401	8	23.570
NE93435	67.854	60.292	52.415	74.117	69.735	57.669	4	21.600
NE93536	71.445	64.055	53.131	66.800	62.607	56.736	7	22.375
NE93554	74.663	69.891	54.148	76.433	61.980	60.249	1	24.380
NE93613	67.562	63.200	58.332	76.533	60.762	57.552	5	18.920
NE93669	72.568	67.531	53.511	72.167	58.603	57.830	2	22.600
Tam107	71.490	57.730	52.568	73.400	65.484	56.349	9	17.420

In 1993, the top ten lines were:

	Yield (bu/a)						Rank
VARIETY	Linc.	ClayC.	N.Plat.	McCook	Hemm.	Average	
NE92455	30.93	24.24	64.10	67.35	64.10	50.144	5
NE92462	32.72	24.68	61.38	63.16	66.99	49.786	7
NE92522	26.56	27.55	60.57	61.54	72.19	49.682	8
NE92538	33.85	23.95	59.19	69.58	67.54	50.822	3
REDLAND	28.12	22.83	60.69	62.06	72.66	49.272	10
NE92578	28.24	29.18	66.31	52.02	72.06	49.562	9
NE92605	29.37	24.24	66.31	60.45	72.86	50.646	4

NE92614	29.07	23.58	63.13	65.24	69.00	50.004	6
NE92628	31.31	25.77	70.94	69.30	71.99	53.862	1
NE92662	30.27	30.79	61.78	59.65	72.00	50.898	2

6. Regional Nurseries

The Southern Regional Performance Nursery (SRPN) was harvested at DeWeese, North Platte, Sidney, and Hemmingford. Yields were as follows:

Variety			Yield (bu/a)				
ENTRY	RANK	VARIETY	Hemming.	DeWees	N.Platte	Sidney	Average
1	48	Kharkof	55.18	23.80	15.20	34.43	32.153
2	47	Scout 66	68.20	21.31	18.06	51.44	39.753
3	37	TAM-107	81.75	24.24	50.09	71.25	56.833
4	25	HBZ374C	88.95	31.95	51.10	86.21	64.553
5	4	OK91P648	80.20	48.67	64.71	82.20	68.945
6	24	OK93P735	78.14	38.33	47.05	94.95	64.618
7	30	OK93P656	82.42	41.37	42.70	75.55	60.510
8	12	OK93P727	85.45	49.22	51.73	79.94	66.585
9	5	TX91D6913	93.74	41.77	49.44	90.08	68.758
10	2	TX91D6991	86.14	46.85	68.95	98.38	75.080
11	44	TX90V6313	77.16	33.82	32.34	54.67	49.498
12	38	TX92V4135	78.62	30.69	44.59	71.63	56.383
13	10	HBE0726-1	80.25	45.98	47.82	94.06	67.028
14	31	TX92V3108	83.64	32.06	42.47	83.23	60.350
15	26	HBI0531-A2	78.87	31.10	65.32	81.47	64.190
16	14	TX93V5919	91.19	19.93	59.49	93.68	66.073
17	7	TX93V5922	79.22	28.07	63.11	99.93	67.583
18	45	TX93V4927	61.78	32.53	37.03	60.55	47.973
19	34	TX92V2519	76.08	34.24	41.71	80.12	58.038
20	35	CO890323	72.46	43.51	41.26	73.39	57.655
21	33	CO900166	78.10	41.06	32.25	82.30	58.428
22	6	KS92PO263-137	78.50	33.85	67.63	91.28	67.815
23	36	KS93U206	81.21	31.12	42.25	73.23	56.953
24	42	KS91H153-2	72.21	30.72	33.86	66.93	50.930
25	29	N93L058	81.97	28.60	61.57	72.17	61.078
26	11	NE91651	88.39	44.68	53.32	81.22	66.903
27	40	NE90476	78.21	37.68	29.49	69.11	53.623
28	15	NE92458	78.79	31.34	58.94	94.78	65.963
29	43	NE92614	71.90	37.37	22.72	68.55	50.135
30	9	NE92646	90.70	36.70	49.96	90.82	67.045
31	21	XH1706	94.17	25.44	46.86	93.43	64.975
32	22	XH1752	83.10	40.59	57.00	78.83	64.880
33	17	XH1778	85.04	44.44	46.36	85.57	65.353
34	16	XH1798	84.40	44.53	48.74	85.79	65.865
35	28	W91-091	78.36	36.01	57.53	78.28	62.545
36	41	W91-287	79.05	24.57	36.73	73.42	53.443
37	8	AP 7501	80.91	39.50	59.80	89.57	67.445
38	1	WX92-0408	79.96	46.17	79.60	97.77	75.875
39	19	WI89-163W	70.26	34.31	62.81	93.74	65.280
40	46	WI90-540W	67.23	15.78	32.88	60.26	44.038
41	27	W88-2619W	72.63	39.19	48.09	90.61	62.630
42	13	T702	78.50	44.19	52.92	90.07	66.420
43	32	T834	81.17	38.97	35.36	81.82	59.330

44	18	T812	76.56	46.22	55.54	82.99	65.328
45	20	T861	74.38	45.50	56.54	84.32	65.185
46	3	JAGGER	89.43	42.78	58.87	86.96	69.510
47	23	RAW1B	74.66	44.77	53.26	86.59	64.820
48	39	NE88427	82.46	28.30	35.32	76.84	55.730
		GRAND MEAN	79.41	36.12	48.13	80.51	61.043
		CV	10.41	12.60	17.06	8.41	
		LSD	11.61	6.39	11.53	9.50	

Hybrids performed well under these conditions as did many varieties.

The Northern Regional Performance Nursery (NRPN) also was harvested at North Platte and Sidney. No averages were taken as the nursery at North Platte suffered from severe lodging note Abilene, a very stiff strawed wheat topped this trial). The nursery at Sidney was excellent. Nurseries at Lincoln were abandoned due to disease and lodging and at Hemmingford due to computer errors in field collection of data. Yields were as follows:

		Yield (bu/a)	
Entry	Variety	N.Platte	Sidney
1	Kharkof	8.39	26.76
2	Roughrider	7.00	42.45
3	Abilene	56.54	73.75
4	SD89119	12.04	50.28
5	SD89153	12.30	62.45
6	SD89180	21.19	59.82
7	SD89186	27.07	72.27
8	SD89205	17.29	67.51
9	ND8974	47.50	70.14
10	ND9043	6.06	48.38
11	ND9064	25.06	61.66
12	ND9257	32.22	77.30
13	ND9272	21.91	80.83
14	ND9274	21.19	77.01
15	NE91631	38.08	94.43
16	NE91648	34.35	82.43
17	NE90479	37.32	52.68
18	NE92522	35.18	94.53
19	NE92628	36.21	81.68
20	NE92662	38.54	92.05
21	XH1752	36.38	76.49
22	XNH1773	36.02	80.02
23	XNH1798	37.93	90.76
24	XNH1799	31.78	90.93
25	XNH1802	33.19	97.42
26	XH1689A	45.24	86.18
27	MT88046	35.95	72.09
28	MTSF2238	13.17	79.20
29	W259	15.13	65.43
30	AMN4LV	17.52	67.13
0	GRAND MEAN	27.92	72.47
0	CV	25.78	12.00
0	LSD	10.17	12.28

In this nursery, the hybrids (XNH lines) continue to perform well as do many of the Nebraska

experimental lines.

7. Multiple-Location Observation Nursery

Five replications (locations) of this nursery were harvested. Lincoln was abandoned due to disease and lodging. With the size of the nursery and with disease affecting some of the nurseries and lodging affecting others, spatial variation was a problem at most locations. This necessitated ranking the lines on the basis of their yield data as well as their relative performance of nearest Arapahoe check plots. This variation made selection very difficult as some lines yielded well, but not relative to Arapahoe and vice versa. Efforts were made to keep the best yielding lines and those with good relative performance. The 1996 harvest will determine if the selection procedure was successful. Fifty-six lines (including five lines from Dr. C. J. Peterson's breeding efforts) were advance to the Nebraska Triplicate Nursery. The improved design (started in 1995) of having one replicated check throughout the nursery was very important in determining the relative performance.

8. Early Generation Nurseries

a. Single-plot Observation Nursery

Fourteen hundred and sixty lines including checks were evaluated in 1994. Of this group, 425 were selected for further testing. From this group about 300 lines were selected for further testing. The cooperative test became larger with the addition of about 30 lines from Dr. Peterson. The majority of lines were initially selected on the basis of yield (remembering that yields at Lincoln were very suspect due to disease and lodging) and then sent to the Nebraska Wheat Quality Laboratory. The quality analyses were completed before planting, hence high quality lines were advanced.

b. Headrow Nursery

Over 43,000 headrows were planted at Mead. The headrows survived the winter and were the best headrows in ten years of my tenure at the university. Over 2400 were selected and 2232 were advanced to the observation nursery. In addition, 250 strong strawed semi-dwarf lines were directly advanced to an irrigated observation nursery in cooperation with Dr. David Baltensperger. This is a higher than normal level of selection, but the headrows were far superior to normal.

a. F_3 bulk hybrids

The F_3 bulk hybrid nursery contained 692 bulks and check plots and were planted at Mead and Sidney. Most bulks survived the winter. At Sidney, the bulks were outstanding. At Mead, the bulks looked good, but were affected by head and stem blights. Heads were selected from the Mead bulks and the seed quality would be considered as generally below average, however this might provide a useful selection for disease resistance. All F_3 bulks were be planted at Mead and Sidney to provide better information on how segregating bulks do in the diverse environments and to provide a back-up site in case of inclement weather. The number of F_3 bulks is probably above the optimal size. Over 43,000 head rows were selected for fall planting. The project goal remains to have sufficiently good segregating F_3 material to select about 40 - 45,000 headrows.

b. F_2 bulk hybrids

The F_2 bulk hybrid nursery contained 696 bulks and check plots. These bulks also survived the winter. In order to quickly complete harvest, they were harvested by combine (hence will include some mixed seed). Harvesting four rows gave ample seed for planting the F_3 bulk nursery in 1996 at Mead and at Sidney. Bulks that segregated for red and white seed

types were advanced to the F_3 nursery and planted with the 1996 F_2s bulks for combine harvest. Normally F_3 bulks are not harvested, but the white seed color is a recessive trait and will increase proportionally in the population with further inbreeding. In future the red and white segregating populations may be harvested last with the hope that they will undergo extensive weathering and allow selection for sprout resistant white wheats.

9. Winter Triticale Nursery

The triticale nurseries this year were average. Sidney trials were very good, but the Lincoln trials were partially damaged by heavy rainfall during grainfill. 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 yield potential are available and may be useful as a feed grain or forage crop. Triticale research replaced our research on feed wheat.

					Yield (bu/a)*		
ENTRY	HD	Height	rank	Variety	Linc.	Sidney	Avg.
1	33	56.00	27	NE91T401	29.01	69.50	49.255
2	32	53.00	29	NE91T410	36.57	58.26	47.415
3	32	54.00	30	NE91T409	38.35	55.83	47.090
4	30	54.00	16	PRESTO	40.50	72.12	56.310
5	30	55.00	3	NE90T413	46.45	77.41	61.930
6	30	56.00	31	NE90T405	32.30	60.88	46.590
7	31	61.00	2	NE91T425	46.60	80.29	63.445
8	30	57.00	8	NE90T404	47.24	72.62	59.930
9	34	49.00	4	TSW250783	49.55	73.99	61.770
10	28	55.00	6	NE90T406	46.53	74.86	60.695
11	28	52.00	33	NEWCALE	42.45	46.26	44.355
12	39	52.00	34	TRICAL	29.66	57.15	43.405
13	35	48.00	35	ARAPAHOE	17.46	56.53	36.995
14	28	55.00	21	NE92T402	43.40	59.67	51.535
15	33	54.00	26	NE92T414	21.74	77.05	49.395
16	33	52.00	17	NE92T422	37.29	74.78	56.035
17	30	49.00	20	CHD 786	38.40	69.66	54.030
18	27	48.00	25	NE94T401	45.56	53.66	49.610
19	30	51.00	11	NE94T403	49.86	66.31	58.085
20	33	54.00	23	NE94T404	30.42	69.01	49.715
21	28	57.00	28	NE94T405	31.18	67.20	49.190
22	28	57.00	5	NE94T406	48.64	74.30	61.470
23	28	55.00	9	NE94T407	47.38	71.72	59.550
24	28	55.00	15	NE94T408	40.09	72.54	56.315
25	28	57.00	19	NE94T409	33.43	74.88	54.155
26	32	57.00	18	NE94T410	31.80	77.17	54.485
27	32	54.00	10	NE94T411	45.06	73.23	59.145
28	27	55.00	24	NE94T412	33.16	66.21	49.685
29	32	54.00	13	NE94T413	35.59	77.35	56.470
30	28	49.00	32	NE94T414	36.06	55.80	45.930
31	28	50.00	14	NE94T415	38.55	74.19	56.370
32	35	58.00	1	NE94T416	34.83	94.90	64.865
33	31	53.00	12	NE94T417	31.55	81.86	56.705
34	31	54.00	22	NE94T418	25.76	75.39	50.575
35	34	48.00	7	UGO	33.53	87.44	60.485
		53.00	0	GRAND MEAN	37.60	70.00	53.800
		6.00	0	CV	14.69	16.78	
		7.00	0	LSD	7.78	16.56	

The results from 1994 are as follows and are noteworthy for how different the grain yield ranks are between 1994 and 1995.

	Yield (bu/a)			Rank
	Linc.	Sidney	Avg.	
NE91T401	38.94	51.95	45.445	10
NE91T410	43.76	63.20	53.480	1
NE91T409	40.18	48.73	44.455	14
PRESTO	29.36	60.78	45.070	11
NE90T413	38.83	56.78	47.805	7
NE90T405	35.80	50.00	42.900	20
NE91T425	29.19	65.13	47.160	8
TSW250783	41.14	64.58	52.860	2
NE90T406	33.43	53.95	43.690	15
NEWCALE	32.59	50.18	41.385	25
TRICAL	52.75	44.88	48.815	4
ARAPAHOE	35.61	61.35	48.480	5
NE92T402	35.11	58.38	46.745	9
NE92T414	37.69	48.20	42.945	19
NE92T422	29.15	66.93	48.040	6
CHD 786	35.38	62.98	49.180	3
SIOUXLAND	24.87	61.95	43.410	18
GWT88-16	28.20	51.88	40.040	29
NE88T419	27.05	54.55	40.800	27
NE90T404	33.56	53.40	43.480	17
NE88T213	30.55	48.58	39.565	30
NE88T229	29.44	45.88	37.660	31
NE88T233	30.75	52.08	41.415	24
LAD285	29.25	57.85	43.550	16
GWT88-12	30.39	58.90	44.645	13
NE77T7	27.29	46.08	36.685	32
RYMIN RYE	36.09	48.85	42.470	21
NE92T413	20.10	42.38	31.240	33
NE92T415	19.05	26.78	22.915	35
NE92T418	25.23	54.90	40.065	28
NE92T419	29.43	53.05	41.240	26
NE92T420	28.10	55.25	41.675	23
NE92T421	18.32	41.45	29.885	34
OAC89-6	30.77	59.03	44.900	12
TAM200	31.26	52.38	41.820	22

* based on a 60 lbs/bu test weight.

10. Doubled Haploid and Wheat Tissue Culture Studies

Improving our ability to make doubled haploids was part of the research of Mr. Kamil Haliloglu. In his research, he identified that anther derived embryoids which were relatively large at 4 to 8 weeks after anther cultures were initiated regenerated the best and should be used for electroporation experiments. He was successful in transforming one plant and will repeat these experiments.

11. Chromosome Substitution Lines

A series of lines in which single pairs of chromosomes were transferred from Cheyenne, the most important ancestor in the Nebraska Wheat Improvement efforts, to Wichita, an im-

portant wheat from Kansas, and vice versa have been developed by Dr. M. R. Morris. Previous research showed that chromosomes 3A and 6A have major effects on agronomic performance (can reduce or enhance yield by 20%). Current efforts by Dr. Yang Yen and Mr. Maroof Shah are concentrating on developing recombinant chromosome lines which will be used to determine how many genes on the identified chromosomes affect yield. The first replicated field experiment was harvested in 1994 and was repeated in 1995. Additional field tests are underway. Some far one major gene has been identified for maturity on chromosome 3A. In cooperation with Agripro Biosciences, hybrids of the chromosome substitution lines have been made to identify chromosomal heterosis. Little or no high parent heterosis was found.

12. Effect of 1B/1R on Agronomic Performance

Previously, Dr. Benjamin Moreno-Sevilla had shown that lines containing 1B/1R from the cross Siouxland x Ram were 9% higher yielding than lines with 1B or lines heterogeneous for 1B/1R. Rawhide, a recent release, is heterogeneous for 1B and 1B/1R. 1B/1R and 1B lines were extracted from Rawhide and grown in three environments in Nebraska in 1992 and in 1993. No difference was found for yield between the 1B and 1B/1R lines in 1992 and in 1993 trials. Though the quality of the Rawhide 1B line is better than the Rawhide 1B/1R, the 1B/1R lines tended to have "acceptable" quality (at least, better than Siouxland). A similar replicated study conducted by Mr. Eduardo Espitia-Rangel, a graduate student, using Nekota and a seed increase of Niobrara for a future replicated study has been initiated to determine if 1A/1R has beneficial effects for yield. So far, 1A/1R in the Nekota background has no yield benefit. Dr. R. A. Graybosch (USDA-ARS) is helping identify which lines contain the rye translocation.

13. Non-red Grain Wheat

In the past, efforts have concentrated exclusively on hard red winter wheat. With the potential Far East market and domestic whole white wheat bread market, efforts will increase for hard white wheat development, mainly in Dr. C. J. Peterson's program. A small effort will continue in developing purple and blue wheats for unique markets. For example blue wheat may have potential for blue wheat flour tortillas similar to blue corn tortillas. 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).

14. Wheat Streak Mosaic Virus Research

Ms. Jill Petrisko has completed her research with Dr. Roy French (USDA-ARS) and Dr. Hein to determine if races exist within the wheat streak mosaic virus. Field data indicated considerable variability within and among fields for isolated, but that different parts of Nebraska were equally variable. That is there was no geographic distribution of the various isolates within Nebraska in a year. Between two years, there were differences in the distributions of the main isolates. Interestingly, the most isolate in the survey appears to the Sidney isolate which was first identified in the early 1980s. This isolate may have a competitive advantage that explains its longevity. Other historical isolates were not found in the survey.

Work continues on the resistance in M08 and with Dr. Martin and his co-workers who have developed some germplasm with the first real resistance/tolerance to wheat streak mosaic virus. The gene continues to be rapidly transferred to Nebraska germplasm.

15. Considerations on Nursery Sites

Efforts continue to develop better analytical methods for data analysis. The addition of field trend analyses has already proven itself to be beneficial for analyzing wheat data. The next project is to develop planting designs that better measure spatial variation in unreplicated or partially replicated designs. The augmented design used for the multilocation observation

nursery is an example of improved experimental designs which will continue with further modifications. This research is done in collaboration with Dr. W. Stroup of the Biometry Department. The southcentral site is continues to be on a sustainable farm to increase our linkages with these emerging farming groups.

IV. GREENHOUSE RESEARCH

The F_1 wheat populations were grown only in the Lincoln Greenhouses to avoid possible losses to winterkilling. Over 600 F_1 populations were grown. This is higher than normal and translates to over 650 F_2 plots including checks planted in 1995-1996. An additional 600+ wheat crosses were made for breeding purposes including improving the genetic male sterile population (first planted in 1990). Some crosses were made for genetic studies. In the triticale program, over 90 crosses were made.

V. 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

An above average crop was harvested in 1995 with production estimated at 86.1 million bushels from 2.1 million harvested acres with a state average yield of 41 bu/a. Winterkilling was minimal. As compared to the previous two years, this growing season would have to be considered as being drier in the fall and early spring, followed by ample to excessive moisture, and finishing under hot dry conditions. The general effect was a disastrous crop in southeast Nebraska and a tremendous crop in western Nebraska. Diseases were a major limitation in areas of excessive rainfall. Insects (Russian wheat aphid and Hessian fly) were minor.

Arapahoe was the most widely grown wheat in Nebraska in 1994. Rawhide, released in 1990, is slowly decreasing in acreage, while Vista, released in 1992, is increasing in popularity. Alliance continued to have good yields and Niobrara and Nekota, released in 1995, had a good first year.

One new cultivar is in the process of being released. Pronghorn (formerly NE88584) is an increase of a hard red winter wheat F_3-derived line from the cross Centura/Dawn//Colt sib which was made in 1982 by Dr. J. W. Schmidt. Pronghorn is a white chaff, awned, tall wheat with medium maturity. It is 1.5 days earlier than Arapahoe and Lamar, and is 1 day earlier than Buckskin. Pronghorn is one inch shorter than Buckskin, one inch taller than Lamar, and two inches taller than Arapahoe. Pronghorn has moderate straw strength, greater than Scout 66, but less than Buckskin, Centura, Siouxland, and Thunderbird. Pronghorn has exhibited moderate resistance to stem rust (contains Sr6 and Sr17) and is moderately susceptible to leaf rust. Pronghorn is susceptible to the Great Plains Biotype of Hessian fly, soilborne mosaic virus, and wheat streak mosaic virus. The winterhardiness of Pronghorn is comparable to with other winter wheat cultivars adapted and commonly grown in Nebraska and South Dakota. It winterhardiness is similar to Arapahoe and Buckskin, and superior to Vona, TAM 200, and Rawhide. Pronghorn is a genetically high test weight wheat, similar to Buckskin, Siouxland, and Scout 66 and superior to Arapahoe. The recommended growing area for Pronghorn is the dryland wheat production areas of the Panhandle of Nebraska, eastern Wyoming, and western South Dakota. Pronghorn has a long coleoptile similar to Scout 66 and can be planted deep in dry seedbeds. Pronghorn is tolerant to aluminum toxic soils. For dryland wheat production, Pronghorn is a complementary wheat to Buckskin, both being tall wheats with long coleoptiles adapted to dryland production needs. The main advantage that Pronghorn has when compared to Buckskin is its superior stem rust resistance. Lamar and Pronghorn are comparable for stem rust resistance. Buckskin is susceptible to the current field races of stem rust. The milling and baking properties of Pronghorn were determined using seven years of testing by the Nebraska Wheat Quality Laboratory with Arapahoe and Scout 66 as check cultivars. Four years of comparisons are available between Pronghorn and Buckskin. The average wheat and flour protein content of Pronghorn is higher than Arapahoe, Scout 66, and Buckskin. The dough mixing properties were stronger than Arapahoe and Scout 66, but similar to Buckskin, though Pronghorn has the best mixing tolerance. While the baking absorption of Pronghorn was less than Arapahoe, Scout 66, and Buckskin, average loaf volumes were greater than Arapahoe, Scout 66, and Buckskin. The external appearance and internal attributes of the baked bread loaf indicated generally acceptable quality characteristics.

Basic research to improve breeding efficiency continued in: 1. wheat tissue culture and transformation, 2. recombinant and reciprocal chromosome substitution line, 3. improving testing sites (including sustainable and irrigated) and data analysis, 4. The winter triticale program will continue and be positioned as a feed grain or forage alternative to winter wheat and barley for growers needing small grain feeds or forage.

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