A Century of Cereal Crops Production in North Dakota

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WHEAT IN NORTH DAKOTA

Wheat production in North Dakota was 170,662 bushels in 1870 and 323,000,000 bushels in 1985. The early varieties were primarily File and Blue Stem types of the hard red spring wheat class. Present leading varieties are Stoa, Len and Butte 86 of the hard red spring class; Vic, Monroe, Rugby, Ward and Cando of the durum class; and Rough-rider, Agassiz and Seward of the hard red winter class.

Production problems over the years have been increasing grain yield while maintaining end use quality, incorporation of resistance to plant diseases, primarily black stem rust, control of weeds in crops, lodging of the weak-strawed types, shattering of the seed, determination of rate and time of seeding, optimum fertilization and control of all pests, seedbed preparation, whether to fallow or not, whether to produce high yielding and lower protein or moderately high yielding and high protein varieties and many others too numerous to list.

Wheat Improvement By Plant Breeding and Genetics

Saunders (2) made the first wheat cross or hybrid in North America at the Ontario Agricultural Experiment Station in 1885. Some of the progeny of crosses made by Saunders and many types of File and Blue Stem wheats were evaluated for yield and other characteristics at Glyndon, Minn., and Fargo by 1889, and the first wheat crosses were made at NDAC in 1892.

L.R. Waldron (11) began intensive wheat breeding in 1910 and he, along with G.S. Smith and R.C. Frohberg, have been the most productive breeders of hard red spring wheat. R.C. Frohberg is the current breeder.

Approximately 40 new, improved varieties of HRSW have been developed by NDSU, and three NDSU varieties, Stoa, Len and Butte 86, composed 60 percent of the 1988 and 63 percent of the 1989 acreage in North Dakota. These three along with five other older NDSU-developed varieties accounted for 70 percent of the 1989 and 73 percent of the 1989 acreage (12).

NDSU varieties are well known for their superior agronomic characteristics, including resistance to stem rust and high grain yield combined with high milling and baking quality. Approximately 50 percent of the hard red spring wheat and durum crop of North Dakota is exported to foreign countries as superior wheats for blending and specialty breads, or to manufacture high quality pasta products.

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A durum wheat breeding program began in 1929 at Langdon and was transferred to NDAC in 1933 (10). North Dakota produces about 85 percent of the U.S. durum crop, and NDSU-developed varieties usually have composed 95 to 100 percent of the crop grown in North Dakota. G.S. Smith, Rueben Heermann, and Kenneth Lebscock of USDA, and James Quick, Roy Cantrell, and now Elias Elias of NDSU have been the productive durum wheat breeders.

Durum wheat grown in North Dakota is the standard of quality worldwide. Major superior quality characteristics of large seed, yellow color and strong gluten have been incorporated in varieties from NDSU.

A breeding program in hard red winter wheat began in 1969. Three new varieties, Roughrider, Agassiz and Seward, having winter hardiness, high yield and suitable bread making quality have been developed. John Erickson and Darrell Cox have been the productive breeders.

Average state yields of wheat and other cereal grains have increased about threefold since 1900 (9) due to improvement from breeding and such production practices as supplemental fertilizer, chemical weed control, more timely tillage and seeding, more efficient harvest techniques, etc. The increased economic value of increased yields, greater protein percentage, etc. of new wheat varieties over older varieties has been millions of dollars. The value of Stoan over Len in its first year of production was estimated at $43,000,000 (3). The incorporation of stem rust resistance in current wheat germplasm is potentially worth hundreds of millions in dollars in terms of potential loss of the wheat crop as occurred to 15B rust in the 1952-54 period.

Marketing, Transportation and Storage of Grain With Wheat Emphasis

The Minneapolis Grain Exchange was started in 1881 and the Winnipeg Grain Exchange in 1891. Cereal grains were marketed on basis of subjective terms prior to 1916, e.g., dry or wet, clean or dirty, sound or damaged, good or bad quality, in good or bad condition, etc., considered much to the disadvantage of the wheat producer and the miller and to the advantage of the wheat broker or speculator. The dissatisfaction of the wheat producer with the so-called "grain thieves" in Minneapolis markets led to creation of the North Dakota State Mill in 1919 to mill North Dakota wheat and market the flour.

The subjective terms used in wheat and other cereal grain marketing which did not communicate clearly between buyer and seller led to passage of the United States Grain Standards Act in 1916, which provided for precise terms to describe the physical nature of a lot or parcel of grains covered by the act. The act provided (a) the basis for the descriptive terms to be used, i.e., numerical grade, class or subclass, special grades if applicable, and dockage percentage, (b) a system for licensing and supervision of grain inspectors, (c) an appeals system as redress if people having a financial interest in the grain thought it had been graded incorrectly by the licensed inspector, and (d) until recently, that all grain passing through an inspection point must be graded.

The objective of the act was to assure that wheat and other grains would be graded identically within human and experimental error at any point in the United States where grains are graded. The act has worked remarkably well and been revised as appropriate to meet new conditions of technology, transportation, storage, marketing, etc. Now, in 1990, some interest is developing to change the act to attempt to assure cleaner grain for domestic and international customers and to compete with grain exporters in other countries.

Futures markets for wheat and other grains have allowed the country elevator, the miller, now the grain producer if he
wishes, to hedge several grains over variable time periods. Government farm programs with loan and target prices and deficiency payments have influenced certain grain prices along with supply/demand situations, now worldwide rather than regional or national as in earlier years.

The terms or labels, really subclasses, Dark Northern Spring and Hard Amber Durum have become trademarks of excellence for wheat and six-rowed malting barley for barley produced in North Dakota.

Storage of grain when produced in the 1812 to 1820 period at the Selkirk colony in the Pembina area and southwards in the Red River Valley was in woven baskets or crude bags (2). Later, bagged grain, especially wheat, was hauled to market in oxcarts or wagons. Eureka (now in South Dakota) of Dakota Territory was a central market for a few years in the 1880s with as many as 1,000 wagons delivering wheat and other grains daily to small country elevators at Eureka, "stated with authenticity as the world's largest primary wheat receiving point" (1). Railway main and branch lines increased rapidly in the 1872-86 period leading to rapid land settlement, grain production, grain marketing, and small community development.

Grain later was stored in larger bags, some in "baked mud" or wooden containers, then to "slos" or elevators of "stone" (concrete) or wood soon after 1900. Reliable farm storage and terminal elevators developed later. The rapid "at harvest time" marketing of wheat when farm storage was not available caused the grain producer to be at the mercy of the prices offered when the grain reached the primary market. Sophisticated farm storage with elevators and movement by air came much later, 1950-60.

Grain was transported first in bags or woven baskets, two-wheeled oxcarts, then in four-wheeled wagons, then in steam or petroleum powered trucks to the closest railway branch or main line. Wheat especially and some barley then was moved via main line railway to Minneapolis for barge transport on the Mississippi or lake transport out of Duluth, then via rail to points on the Erie Canal. The Great Lakes-St. Lawrence Seaway all-water route was developed much later and still is limited to medium draft vessels or those that are "topped off" at deep water ports down the St. Lawrence Seaway and ready for ocean transport.

Grain, especially wheat, marketing in Dakota Territory or early in the statehood of North Dakota sometimes was on barter basis at the nearest general store for basic essentials. The proprietor of the general store then marketed the bulked grain to the nearest cash market available. Bagged grain was marketed at harvest time, later to the nearest cash market. The wheat producer was at mercy of the grain buyer when grain was delivered via oxcart or wagon.

The term "Hard Northern" was used in the late 1880s for present hard red spring wheat in both Canada and the United States. Durum wheat was known as "flint" wheat and used only for feed until the steel rolling mills were developed, because the stone grinding mills would not grind durum wheats.

Later, bulk grain was marketed in wagons, then trucks, at country elevators on branch or main rail lines. Elevators had lifts to dump either wagons or trucks into pits to elevate to storage bins. Many elevators had associated flour mills. Wheat was shipped from country elevators to terminals in Minneapolis and Duluth most commonly with little westward movement prior to relative recent shipment to western markets, such as Portland, Oregon.

Grain Commodity Organizations and Government Programs

Farmers made their own decisions on how much and which crops to grow in the United States prior to 1933. The Agricultural Adjustment Act of 1933 attempted to regular supply and demand of crops, especially wheat, with various compensations for compliance. The Commodity Credit Corporation via which the federal government purchased wheat also was created in 1933, and the Farm Credit Administration in 1959. The AAA evolved into the Agricultural Stabilization and Conservation Service, ASCS, which administers the so-called "Farm Program" of the federal government having acreage controls, loan payments for grain in storage, target prices, deficiency payments, etc. Public law 480 to "sell" grain to lesser developed countries for payment in their currency and the recent Economic Enhancement Program providing a "discount" on U.S. grain sold to certain countries has influenced grain production and prices, along with environmental factors which influence grain supplies variably over years.

Farmers producing major crops in the United States have cooperated to organize commodity organizations to promote their crop by development of markets and publicity about end uses, provide "grant" support for production or utilization research, etc. The North Dakota State Wheat Commission was organized in 1959, the U.S. Durum Growers in 1957, and the North Dakota Wheat Producers in 1967. The National Barley Growers Association and North Dakota Barley Council were organized April 14, 1962, and July 1, 1983, resp., and the North Dakota Corn Growers Association in 1986. A self-imposed "checkoff" or levy on grain sold supports the commodity commissions or councils and their activities. Other states have commodity associations also which are organized into national organizations.

Power For Machinery and Processing

The first wheat grown in North Dakota probably (2) was about 1812 or shortly after near Pembina, along the Red River, as an outgrowth of the Selkirk colony in Selkirk south of St. Boniface and present Winnipeg (7). Barley, oats and corn were grown somewhat later, 1875-80.

Cultivation in 1812 was with a hoe, seeding via broadcast and harvest with a scythe or sickle. Later oxcen and horses or mules were used for power to pull wooden plows, later yet steel-tipped plows. Still later, steam, gasoline and diesel powered tractors supplemented or replaced animal power. Animals provided all the power for the early Bonanza (5,7) farms in the 1878-85 period.

The McCormick and other reapers replaced cutting wheat by hand, first without bundle tiers, with bundle tiers by 1878. Thresher-separators powered by animals were developed first, then replaced with pull type combines, still later self-propelled combines. The development of mechanical, then hydraulic, lifts and electrical tools also have been great technological advances for farmers in grain production. Wheat and other grains were moved by scoop shovels and bags in the early days, replaced by first bucket or auger conveyors and more recently air movement of grain into all kinds of farm and terminal storage.

Grain Evaluation For End Use Products

Hard red spring wheat varieties have been evaluated for milling and baking quality by the USDA since 1893 and by NDSU since 1905. Hard red winter wheat also is evaluated for bread baking quality as used alone for general use flours. Semolina from durum varieties has been evaluated for pasta quality since 1929. Barley has been evaluated for production of malt and beer since 1956. Harris, Len Sibbitt, Bert D'
Wheat varieties have been evaluated for milling and baking quality at NDSU since 1893. This protein test was conducted in 1928.

Appolonia, Brendan Donnelly and more recently Joel Dick and David Shelton have been leaders in wheat quality evaluation and Banasik, Pyler, Madsen and now Schwartz in barley evaluation relevant to end uses.

Flour making from North Dakota wheats once was performed at nearly 100 flour mills in North Dakota. Technology progressed from stone ground wheat to steel roller mills, later involving multi-sifters and purifiers, and from bucket and belt movement to air movement of materials. Technology has progressed from marketing in various size bags to high volumes in bulk in rail cars. The North Dakota Mill and Elevator has been a leader in this field since established in 1919 by the state legislature with the first flour produced in 1922.

BARLEY IN NORTH DAKOTA

Immigrants to North Dakota about 1880 brought barley to grow for feed and food to a limited extent. The "varieties" were the Manchuria or Oederbrucker six-rowed, white aleurone, rough-awned types either from central Europe or Manchuria via Europe and Asia (8). The blue aleurone types were introduced via Canada slightly later, e.g., O.A.C. 21 (Ontario Agricultural College). The two-rowed Hanchen variety was evaluated by farmers and agronomists but only excelled over six-rowed types in western North Dakota where the climate is drier and less damage from foliar diseases, especially stem rust, occurs. The blue-aleurone variety Trebi from Aberdeen, Idaho, in 1918, and Tregal, selected and released from the North Central Experiment Station, Minot, were grown but were not suitable for malting. Wisconsin 38 was introduced for malting prior to 1942, but the selection and release of Kindred barley in 1942 in North Dakota was the first malting type resistant to stem rust and having adequate agronomic and quality characteristics grown widely in North Dakota.

The barley acreage in North Dakota was about 65,000 in 1881, increased to over one million in 1906-10, reached over 2 million in the late 1920s, and over 3 million in 1956-60. North Dakota has led all states in barley production for 30 or more years, growing approximately 3 million acres per year in most recent years depending on economic alternatives among crops and government programs. North Dakota now produces 40 percent of the six-rowed barley in the United States. The average annual barley production of North Dakota, 1985-87, was 166,000,000 bushels having an annual value of $248,000,000 (6).

Barley production problems requiring solution by plant breeding have been yield improvement, resistance to stem rust and other foliar diseases, including those caused by viruses, resistance to lodging and seed shattering, production of larger seed, etc. and the many characteristics for malt and beer quality required by the maltsters and brewers including seed protein percentage at or below 13.5 percent.

Research for barley improvement began intensively at the North Dakota Agricultural Experiment Station in 1947, although Gus Geiszler had selected Tregal at Minot earlier (10). Andy Lejeune and Orville Banasik were hired as barley breeder and barley chemist in 1947; Bill Sisler replaced Lejeune in 1948 and Glenn Peterson replaced Sisler in 1958. A.B. Schooier in 1956 and A.E. Foster and Don Morton in 1958 were hired at cytogeneticist, geneticist and plant pathologist, respectively, to improve the basic barley germplasm available to barley breeders. Foster later shifted to develop “hybrid barley,” then to six-rowed barley breeding. Mel Anderson was hired as two-rowed barley breeder in 1974. J.D. Frankckowiak replaced Anderson as two-rowed barley breeder in 1978. Roland Timian, a USDA plant pathologist, began research on barley viruses in 1953 and was later replaced by Michael Edwards. Vernyl Pederson replaced Don Morton and after retirement recently was replaced by Brian Stephenson. Rich Horsley recently has replaced Foster as six-rowed barley breeder.

The barley improvement program was and is supported by funds from North Dakota and the USDA. However, in 1956, the Midwest Malting Barley Association (later the Malting Barley Improvement Association then the American
Malting Barley Association) of maltsters and brewers and gave a grant of $50,000 per year to the NDAES for malting barley improvement. This grant was the largest received by NDSU for many years and now totals over $2,500,000 since inception. The grant has supported research primarily in Agronomy (now Crop and Weed Sciences Department), Cereal Technology (now Cereal Science and Food Technology Department), Plant Pathology, and Soil Science.

The barley improvement program at NDSU has been very successful. Increased grain yields of new varieties suitable for malting and receiving malting price premiums have brought millions of dollars of new wealth to North Dakota. The six-rowed varieties Traill, Trophy, Larker, Beacon, Glenn, Dickson, Nordic, Azure (blue aleurone) and Hazen composed 75 percent or more of the barley acreage in North Dakota, Minnesota and South Dakota for many years. The variety Hazen probably was the best six-rowed barley ever developed, with a combination of desirable agronomic and quality characteristics, but unfortunately was not approved as suitable for malting by the now American Malting Barley Association. (Morex and Robust from Minnesota now compose most of the six-rowed barley acreage.) Hybrid barley did not succeed and the research was terminated. Bowman two-rowed barley from NDSU is an excellent variety grown widely in western North Dakota and adjacent areas. Two-rowed varieties having malting approval probably will be developed and released in the future.

OATs IN NORTH DAKOTA

Oats, like wheat and barley, was introduced to North Dakota by immigrants about and just before 1880. Oats were grown for animal and human food in Europe and Asia and brought to North Dakota for the same uses. Oat grain and straw were basic feeds for horses used to power farm machinery and for young animals especially. When petroleum fueled engines replaced horses, oats continued to be grown in North Dakota for livestock feed, for food, and to export to other areas as "race horse oats." The annual acreage of oats in North Dakota has fluctuated around one million acres in recent years, 1,170,000 acres per year in the last 10 years. Production is about 38 to 40 million bushels per year with a value of $56,000,000. North Dakota usually ranks third or fourth in oat production in the United States, but most of the oats of the United States probably are grown within a 300 mile radius of Fargo.

Recent interest in and promotion of "oat bran" based human food in the United States coincident with oat prices not being competitive with other grains has led to our importing 60 to 80 million bushels of oats annually from Canada and Europe in recent years, especially the drought years of 1988 and 1989 in the Northern Plains.

North Dakota did not have an oat breeding program of any significance until 1976. The immigrants brought the varieties "White Russian" and "Green Russian" to North Dakota. T.E. Stoa, early agronomist at NDSU, selected Rusota in 1922 and Rainbow in 1929 from Green Russian for their stem and crown rust resistance. Ransom was selected and matured in our short summer season. Objectives of the oat test program of the upper Midwest and Canada each year and are potential new varieties. Varieties have improved for grain yield, resistance to foliar diseases especially stem and crown rust, early maturity, decreased straw height, lodging resistance, percentage groat (grain inside the glumes) and grain protein.

The grain characteristics are very important for oats used in the human food industry, an increasingly important market for oats from North Dakota. Oats for the food industry probably will continue to expand in future years. If oat prices can become more competitive, oats can or should become a more important crop in North Dakota with grain sold for food and "race horse oats" and the straw by product used in the livestock industry.

CORN OR MAIZE IN NORTH DAKOTA

Corn is a cereal or "grass grown for its edible grain" as are wheat, barley, and oats. Indian corn or maize has been grown in North Dakota for centuries. The early immigrants to North Dakota also brought corn seed from other states and grew the flint and flour corns of the American Indians. Corn in North Dakota was open-pollinated until the first hybrids were released: Lodak 14, a white flint, in 1942; and yellow dent hybrids, Lodak 201 and 203 in 1942, Lodak 301 in 1944, and Lodak 307 in 1956.

P.J. Olson was the first corn breeder at the North Dakota Agricultural Experiment Station, 1924-34; followed by William Wildakas, 1934-71. H.R. Lund associated with Wildakas for a short period in 1970-71; and Harold Cross has been the corn breeder from 1971 to date.

Corn or maize is essentially a warm season crop. However, the flint and flour corns of the American Indian grew and matured in our short summer season. Objectives of the corn breeding project were improved grain yield, earliness, rapid grain filling and drydown, drought resistance, resistance to lodging, etc. Resistance to disease and insect damage has not been a major problem.

Olson and Wildakas developed adapted, superior inbreds to produce adapted early hybrids for North Dakota. Lodak 307 was a very popular hybrid. Hybrids were developed in the 75-93 day maturity range. The production of Lodak hybrids was an important seed business in North Dakota for many years but now private seed companies produce all hybrid corn seed. Harold Cross has produced and released many superior inbreds and synthetics of corn used in the hybrids corn seed industry for upper latitudes and short growing seasons. A recent survey by Wisconsin showed that about one-third of the corn germplasm used in early hybrids was from corn inbreds developed at NDSU.

Although farmers grew corn for grain if mature enough, or silage if not, in earlier years, most corn in North Dakota now is grown for grain. About 900,000 acres of corn are grown annually in North Dakota (1985-87 average) with a value of $108,000,000 for grain plus value of 2 million tons of silage.

REFERENCES


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