2006 Historical Corn Demonstration Plots

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As a part of the Dickinson Research Extension Center Centennial Field Day in July, plots of corn representing the range of varieties used in North Dakota over the last two hundred years, along with some breeding and exotic populations, were planted on the station grounds. These plots were each six rows wide (32" spacing) and 75 feet long. They were planted by Roger Ashley with the station's Cross-Slot drill with 100 lbs/A of N applied as urea that was donated by SouthWest Grain on 11 May, 2006. Weed control was via a preplant burn down with glyphosate and two applications of postemergence herbicides. These were applied by Glenn Martin. Except for the hybrid check, the plots were planted with seed provided by the Mark Millard of the USDA Plant Introduction Station in Ames, IA or from seed grown at the DREC in 2005. They included the following varieties:

Native American populations:
Burleigh County Mixed Flint
Mandan Yellow Flour
Assiniboine Mixed Flint and Flour

Populations introduced by immigrants:
Northwestern Dent
Yellow Dent (Bulk of old dent varieties made by NDSU)

New populations developed in the late 1800s to early 1900s:
Dakota White Flint
Gehu Yellow Flint
Great Plains Rainbow Flint
Falconer Semident

Modern hybrid:
Pioneer HiBred Brand 3845

Breeding Populations:
NDSAB
NDSCD
CG Stiff Stalk
CG Syn A-NL

Exotics:
Zuni Blue Flour
Conico

Newer Variety from Dave Christensen in Montana:
Painted Mountain Flour

The older populations were all once sold by Oscar Will and Company out of Bismarck, ND (Will 1930, Hinebauch 1902). Will's grandson, G.F. Will Jr., attended the field day and spoke with visitors. His presentation about the history of his family's seed house (Appendix 1) was followed by one from Marcelo Carena, the NDSU corn breeder, about the future of corn growing in North Dakota.

Results

Besides a fine presentation on a hot, July day, the historical demonstration plots have provided several results that form the basis for some future research. First, observations were taken from these unreplicated plots on days from planting to anthesis and to silk. The varieties demonstrated quite a range in average time to flowering and ASI, which is related to drought tolerance (Table 1).

Table 1. Average time to flowering in corn varieties observed at the Dickinson Research Extension Center in 2006.

VARIETY	50% TASSEL	50% SILK	ASI*
Painted Mountain	58	60	2
Burleigh County	59	66	7
Mandan Yellow Flour	59	67	8
Assiniboine	59	64	5
Dakota White Flint	63	67	4
Gehu	63	69	6
Great Plains Rainbow	64	69	5
Falconer	65	70	5
Northwestern Dent	67	70	3
CG Syn A-NL	67	70	3
Yellow Dent Bulk	68	75	7
NDSBF	69	70	1
Zuni Blue	69	74	5
NDSAB	70	70	0
NDSCD	72	74	2
CGSS	72	75	3

* ASI is anthesis-silk interval.

The commercial hybrid check flowered just after these varieties that came from the USDA collection.

In the fall John Hazen, a student at DSU, with assistance from Jerry Larson and Tim Winch of the DREC, harvested three replicate 20' sections of row from several of the variety plots in order to take the first look at yield potential of some of these varieties in several decades. After drying, the corn was shelled, weighed, and test weight determined. Yields of two of the varieties was very near to the hybrid check whereas most varieties that John evaluated had much lower yields

(Table 2). Since these were unreplicated plots the results are reported to provide information useful in planning future replicated trials.

Table 2. Yield and test weights for selected historical varieties of corn and a modern hybrid check evaluated in non-replicated plots at the Dickinson Research Extension Center in 2006.

VARIETY	DRY WT LBS*	LBS/A	LBS/A AT 15.5%	TEST WT	BU/A AT 15.5%
Burliegh County	2.75	2243.26	2478.80	58.65	42.26
Pioneer	3.46	2822.43	3118.78	54.17	57.57
Rainbow	3.79	3091.62	3416.24	59.5	57.42
Falconer	3.45	2814.27	3109.77	56.83	54.72
Dakota White	2.29	1868.02	2064.16	59.67	34.59
CG SynA-NL	2.13	1737.50	1919.94	59.83	32.09
Mandan Yellow	2.49	2031.17	2244.44	54	41.56

*Dry weight is reported as the average for three 20' sections of rows in each plot.

These represented much higher corn yields than were recorded at the station in the 1940s and 1950s with some of the same varieties (Appendix 2, based on data gleaned from our annual reports - http://www.ag.ndsu.nodak.edu/dickinso/research/tocreports.htm).

Another DSU student, Matt Smith, collected samples of corn representing different colors to see how these varied in anthocyanin and total phenolic content. An additional sample of very purple corn was sent by Dave Christensen of Big Timber, MT to add to the range of white, yellow, blue and red that was harvested here in the historical corn demonstration plots. These phytochemicals are considered important antioxidants in human health. Evaluations were performed with standard methods by RuiHai Liu at Cornell University (Tables 3 and 4).

Table 3. Anthocyanin content* of different varieties of corn.

VARIETY	COLOR	Mean Anthocyanin (µg/g)
Dakota White	white	18.5
Pioneer HiBred brand 3845	yellow	0
Zuni Blue	blue	65
Painted Mountain	red	75.1
Painted Mountain	purple/black	2197.7

*Mean anthocyanin as µg cyanidine-3-glucoside equivalents / g corn

Table 4. Phenolic content* of different varieties of corn.

VARIETY	Free	Bound	Total
Dakota White	397.7	1881.9	2280
Pioneer HiBred brand 3845	536.1	2323.6	2860
Zuni Blue	538.8	2031.9	2570.8
Painted Mountain Red	699.9	1454.2	2154.1
Painted Mountain Purple	2734.8	1476.4	4211.2

*Phenolic content of corn expressed as µg gallic acid equivalents / g corn

The darker colored corns had more anthocyanins than the check hybrid but were otherwise similar when all phenolics were considered. The most impressive thing that Matt found was that the purple/black colored Painted Mountain had phytochemical content that is comparable to blueberries (Zheng and Wang 2003, Ehlenfeldt and Prior 2001, Prior et al. 1998).

References

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Appendix 1. Remarks by George F. Will, Jr. at the DREC Centennial Field Day

Oscar H. Will, pioneer in the development of seed varieties for the northern Plains.

During his service as a Captain in the Union forces during the Civil War, William Will, a nurseryman from upstate New York, became acquainted with a Major E. M. Fuller. In 1880, Fuller established a greenhouse business in the raw new town of Bismarck, Dakota Territory. His interests were broad and he needed a capable right hand to run the greenhouse. Remembering his friend Captain Will had been in a similar business, he asked Will to suggest someone to help. Will recommended his kid brother Oscar, who accepted the offer and arrived in Bismarck in the spring of 1881.

Then 26 years old, Oscar had nursery experience working for his brother William and others in the Syracuse, New York area. He was a capable, hard working and frugal young man and advanced rapidly in both his social and business life. In 1882 he married Elvira Isabel "Belle" Bird whose father, George M. Bird arrived in Bismarck in 1878 and established a machine shop near the site of the present Bismarck water works to service Missouri River steamboats. By 1885 Oscar had taken over the greenhouse and nursery business from Major Fuller.

Not long after his arrival in Bismarck, Oscar Will saw that many of the common varieties of garden plants and of seed corn grown in the east did not do well in the dryer climate of the Northern Plains and the shorter growing season of the North Country. He began selecting seeds from plants that showed promise of greater survival and production in the more extreme Dakota climate. He also became acquainted with varieties long grown by the agricultural Indians of the upper Missouri Valley, the Mandans, Hidatsa and Arikara.

His interest in selecting the best, hardiest, most adaptable varieties from both eastern and native grown seeds and plants led to a number of introductions in a wide range of species. Perhaps the most successful example is the Great Northern Bean. A pouch of white beans was presented to Oscar sometime in the 1880s by a Hidatsa, Son of a Star. Will planted, selected and increased the beans and introduced them in 1896 as the Great Northern Bean. This variety is still widely grown today and is found in many commercial bean soups, dry bean sections in grocery stores, and is perhaps one of the widest grown white beans in the country. It has undergone further development and change by many agricultural institutions over the years.

While the seed breeding and development methods of Oscar's era were a long way from what would be considered state of the art today, they served a valuable purpose, providing for hardy food crops in a section of the country where most varieties did not fare well. Basically Oscar selected from plants in a plot the showed the traits he sought, namely ability to mature in the short growing season, and to withstand the extreme summer weather conditions.
The next desired feature was resistance to lodging, meaning heavier stems and sturdier plants in the corn fields. The standard early varieties, such as Dakota White Flint, Burleigh County Mixed, Mandan Yellow Flour Corn, Assiniboine Mixed, and Gehu which are planted here, had lodging problems. It was sometimes said that to harvest them by machine you needed a potato digger rather than a corn picker. Of course they were descended from varieties that had been picked by hand for generations.

Another variety represented here, Falconer semi-dent, was one of the most widely grown corn varieties in the region for many years until the arrival of more advanced hybrids. In later years, Oscar's son George, Sr., began a limited corn hybrid program. While there were some successes, it did not become a large scale operation and was discontinued when George died in the fall of 1955.

Some of the old germ plasm does live on today, though, according to Dr. A. Forrest Troyer, long time geneticist with Dekalb Plant Genetics of Dekalb, Illinois. In 1891, J. W. Burch from Bloomington, Indiana, brought a corn variety called Bloody Butcher from his home state. Oscar Will selected about 20 ears of the variety that managed to mature prior to the early frost that killed most of the remaining stand. Will continued to develop and select the variety and introduced it as Northwestern Dent in 1886. It has white cobs and kernels that are red semi-dent with white or yellow indentations

It became the most popular dent corn variety in the Northwest, recommended in nine states: Idaho, Michigan, Minnesota, Montana, North Dakota, South Dakota, Utah, Wisconsin, and Wyoming. Inbred lines from it were introduced in hybrids in several states. Dr. Troyer's research indicates that about 5% of present U.S. corn hybrids can trace germ plasm back to Will's Northwestern Dent.

We are indebted to Mark Millard and the National Plant Germplasm System for seed of many of the more-or-less vanished varieties grown in these demonstration plots. A limited view, perhaps, but they do give you a picture of the advance of corn growing in western North Dakota.

And now for the meat of the corn field day's discussion, I turn this over to Marcelo Carena of NDSU.

Appendix 2. Corn production estimates from the Dickinson Research Extension Center, 1943-1953. Farmer varieties are in italics.

Corn Fodder Production at Dickinson, 1943-1953, tons/Acre

Variety	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	Avg
Falconer	**2**	**3.6**	**2.4**	**1.5**	**2.2**	**2.7**	**1.3**	**2.2**	**1.4**	**0.9**	**1.5**	**2.0**
Great Plains Rainbow	**2.6**	**4.2**	**2.4**	**1.7**	**2.8**	**2.8**	**1.4**	**2.2**	**1.8**	**0.5**	**1.6**	**2.2**
Minnesota 13	**1.7**	**3.9**	**2.2**	**1.4**	**1.9**	**1.9**	**1.1**	**2**	**1.7**	**0.8**	**1.4**	**1.8**
Nodak 201	**1.6**	**3.5**	**1.9**	**1.3**	**2**	**2.2**	**1.2**	**1.7**	**1.6**	**0.8**	**1**	**1.7**
Nodak 208						**2.3**	**1.2**	**2.1**	**2**	**0.7**	**1.6**	**1.7**
Nodak 301		**4**	**2.8**	**1.8**	**2**	**2.5**	**1.3**	**2**	**2.2**	**1.1**	**1.4**	**2.1**
Nodak 304						**1.9**	**1.2**	**1.7**	**1.9**	**0.9**	**1.5**	**1.5**
Wisconsin 240	**1.8**	**3.9**	**2.1**	**1.5**	**2.2**	**2**	**0.9**	**1.6**	**1.8**	**0.7**	**1.5**	**1.8**
Wisconsin 279	**1.9**	**3.9**	**2.2**	**1.5**	**2.4**	**2.1**	**1.2**	**2.1**	**1.9**	**0.9**	**1.5**	**2.0**
Kingscrost KF-1			**2.9**	**1.8**	**2.5**	**2.2**	**1.4**	**1.8**	**2.4**	**1.2**	**1.6**	**2.0**

Corn Grain Production at Dickinson, 1943-1953, Bushels/Acre

Variety	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	Avg
Falconer	**20.1**	**43.9**	**29.9**	**18.6**	**31.8**	**31.9**	**13.8**	**23**	**22**	**12.9**	**29.4**	**25.2**
Great Plains Rainbow	**19**	**38.9**	**22.6**	**18.4**	**38.9**	**34.2**	**14.3**	**23.1**	**18.5**	**8.1**	**31.8**	**24.3**
Minnesota 13	**9.9**	**34.2**	**20.9**	**12.1**	**25.3**	**24.6**	**8.5**	**16.3**	**15.6**	**8.1**	**22.9**	**18.0**
Nodak 201	**14.8**	**40.2**	**26.3**	**15**	**27.9**	**30.2**	**11.5**	**20.4**	**15.4**	**10.3**	**22.9**	**21.4**
Nodak 208						**31.9**	**14.7**	**25.3**	**26.6**	**14.2**	**35.9**	**24.8**
Nodak 301		**42.3**	**29.9**	**16.9**	**27.9**	**34.9**	**12.7**	**19.6**	**22.6**	**16.7**	**28.5**	**25.2**
Nodak 304						**28.6**	**14.5**	**15.8**	**24.7**	**12.9**	**31.4**	**21.3**
Wisconsin 240	**18.6**	**40.7**	**26.2**	**15**	**29.8**	**26.8**	**10.7**	**16.9**	**18.3**	**9.3**	**32.2**	**22.2**
Wisconsin 279	**15.1**	**37.3**	**22.4**	**10.6**	**32.6**	**28.4**	**8.2**	**18.7**	**18.8**	**10**	**31.1**	**21.2**
Kingscrost KF-1			**26.1**	**15.5**	**30.8**	**27**	**10**	**16.7**	**17.1**	**9.7**	**25.5**	**19.8**