University of Nebraska Lincoln | Panhandle Research and Extension Center

1910-2010

A Century of Change and Progress In Service to Western Nebraska

About this Booklet

As the Panhandle Research and Extension Center begins its second century of service to the citizens of Nebraska, we are also preparing to celebrate the accomplishments of the first 100 years by those who came before us. The purpose of this publication is to historically archive the progress made since the 50th Anniversary in 1960, and to serve as a time capsule pertaining to the current programs located in Scottsbluff for future generations. We intend to present a brief snapshot of the faculty and staff and document some of the major areas of research and extension activities being conducted in 2010.

Editors: Dave Ostdiek, Bob Harveson, Dean Yonts, Bob Wilson, Tom Holman

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Profile of Progress: Serving Agriculture 50 Years. Scotts Bluff Experiment Station anniversary booklet published in 1960 by the editors of the University of Nebraska Department of Information at the College of Agriculture.

New Horizons for Agriculture in Western Nebraska. Published in 1956 on the occasion of the dedication of the Administration and Laboratory Building at the Scotts Bluff Agricultuural Experiment Station (later named the Lionel Harris Building)

On the cover:

The view of the original office of the Scotts Bluff Experimental Substation on July 14, 1910.

Program
Centennial Celebration Schedule
July 24, 2010

7:30 - 9:00 a.m.: ..... Pancake breakfast

8:30 - 10:50 a.m.: ..... Exhibits and field tours

11:00 - 11:30 a.m.: ..... Welcome, introductions and centennial celebration

11:30 a.m. - 1:00 p.m.: ..... Lunch

12:30 - 2:50 p.m.: ..... Exhibits and field tours

2:00 - 3:15 p.m.: ..... Watermelon feed

Field Tours

Field Machinery — From Horses to Satellites

Changes in Sugarbeet Production Over the Last Century

Irrigation developments: What's Changed and What Hasn't

Exhibits on the Lawn

Potato Types and Nebraska History

The Food Preservation Journey

A Century of Advancements in Plant Pathology

From County Agent to Educator -- My, How We've Changed

Beef: Improving Cattlemen's Retail Value

4-H Celebrate the Past…Meet the Future

Changes in the Feedlot Industry and Range Management

Insect Management and Pesticide Safety Then and Now

A Century of Small Grains Development

Dry Bean Breeding Program

A Century of Soil, Fertilizer and Corn Research

A brief history of the Panhandle Center:

100 Years of Research (And Extension)

By David Ostdiek, Communications/Technology Associate
Panhandle Research and Extension Center

The Scotts Bluff Experimental Substation was established in 1910 so agricultural research could be conducted on irrigated crops under local conditions. Starting with 160 acres and several buildings, the station has changed, expanded and moved, eventually becoming the Panhandle Research and Extension Center.

Land was provided by the Bureau of Reclamation, which turned it over to the U.S. Department of Agriculture. In 1910 construction began at the original location 6 miles east of Mitchell (about 4 miles north of Scottsbluff on Highway 71, then 1 mile west on Experiment Farm Road). The plots were managed by the USDA until 1948, when the land and management were turned over to the state, and subsequently the university. In 1956 the experiment station moved into a newly constructed building, later named the Lionel Harris Building. In 1975 the station moved to its current location, the former site of Hiram Scott College. But the original site – now known as the Mitchell ag lab – is still an integral part of the research program.

The mission of the Panhandle Research and Extension Center has broadened to include not only research, but also extension – sharing with the public what is learned through research.

From the earliest days to the present, much of the work done at the Scotts Bluff Station/Panhandle Research and Extension Center has been related to irrigated agriculture. Dryland agricultural research is performed at another unit administered by UNL in the Panhandle, the High Plains Ag Lab near Sidney.

Today the Panhandle Research and Extension Center has 14 faculty members, most with joint research and extension appointments, representing the following disciplines: beef nutrition and feedlot management, business development and entrepreneurship, cow-calf production and range management, entomology, weed science, irrigation management, machinery systems, plant pathology, soil and nutrient management, alternative crops breeding, dry bean breeding, potato production, crop physiology, hydrogeology, nutrition and wellness, and dryland cropping systems. In addition, there are technicians and administrative and support staff.

Panhandle Center's Three Locations

The Panhandle Research and Extension Center has been housed in three different buildings. At the original site, an office and laboratory had been built, in addition to a barn, grain bin, machine shed and other structures, by July 1910. By 1912, four houses had been constructed for station personnel. Along the way, other improvements were made.

The three buildings that have housed the Panhandle Research and Extension Center during its 100 years: From top, the original buildings in 1915; the Lionel Harris Building, constructed in 1956; and the J.G. Elliott building in 1975.

Acreage grew to 320 acres, in addition to 800 acres of experimental rangeland several miles north in Sioux County.

In 1956, when Lionel Harris was superintendent, a new administration and laboratory building was dedicated on the same site. The 8,600-square-foot Lionel Harris Building housed an auditorium, office space, five research laboratories, and offices for administration, and research and extension faculty.

The Harris building, several other buildings (constructed later), and 210 acres of experimental plots (includ-

Panhandle Center history, Continued

ing the Knorr-Holden plots, planted to corn continuously since 1912) are still located at the Mitchell site. The Panhandle Research Feedlot, built in the 1970s and expanded to a state-of-the-art facility in 2007, also is located there.

The Harris building served as the headquarters for the research station until 1975. It also housed the Veterinary Diagnostic Lab until its closure several years ago. Today it is used by a variety of programs for laboratory space, storage and other purposes. In the future, it could be used to house visiting scientists and graduate students. The potential is being studied.

In the early 1970s, a unique opportunity to move to a larger, newer building – at no cost – presented itself. Hiram Scott College, a liberal arts college created in 1965 by Scottsbluff-area businessmen, closed in 1972 for lack of students. The Scottsbluff-Gering Payroll Development Foundation offered to give more than 200 acres of land and improvements to the university. The headquarters building was named the J.G. Elliott Building, after a Scottsbluff business leader who served on the NU Board of Regents from 1952-74.

The Elliott building has gone through several renovations and remodeling, and as of 2010 it housed offices for faculty members, as well as administrative and support staff. The building also has laboratories, an auditorium and several meeting rooms with satellite and internet connections. Greenhouses, a maintenance building and equipment and storage sheds have been constructed on the grounds.

The Scotts Bluff County Extension Office also is located in the Elliott Building, as are the University of Nebraska Medical Center College of Nursing West Nebraska Division and University of Nebraska at Omaha's Business Development Center.

The D.A. Murphy Arboretum and Library

A $90,000 endownment to the University of Nebraska Foundation in 1987 from the estate of D.A. Murphy, a University of Nebraska alumnus and successful regional businessman, was used to make significant improvements to a teaching arboretum and a library on the grounds.

The Arboretum: The D.A. Murphy Panhandle Arboretum, 40 acres of landscaped grounds and research plots, was established in January 1984 as the University of Nebraska Panhandle Arboretum. It was dedicated and became an affiliate site of the Nebraska Statewide Arboretum in August 1985. It was designated a Master Arboretum by the Nebraska Statewide Arboretum on April 4, 1997.

The arboretum plays an important role in the research, teaching and extension mission of the University of Nebraska. It includes examples of both high and low intensity landscaping and showcases the diversity of plants that can be successfully established and grown in the High Plains region. Many of the collections are devoted to plants or landscaping techniques that have low moisture requirements and/or need limited maintenance.

Points of interest include the ornamental grass, shrub rose, Great Plants of the Great Plains, Monument Valley Iris Society, and Diana Harms Cottonwood collections, as well as areas highlighting alternatives to turf and the use of berms and locally adapted trees, shrubs, and other plants in landscaping. Collections continue to evolve to incorporate new plant material and highlight emerging issues.

The Library: The D. A. Murphy Library contains more than 3,500 titles, including scholarly journals, most of which are geared toward the programs at the Center. Ag-related sections include titles dealing with carious crops and livestock produced in this area. Other sections deal with community, family, nutrition and personal growth and development. Video and audio titles are available. The library is open to the public, Monday - Friday from 8:00 a.m. to 5:00 p.m.

Superintendents and Directors:

Fritz Knorr
Superintendent 1910-16

James A. Holden
Superintendent, 1917-34

Lionel Harris
Acting Superintendent 1935-38, Superintendent 1938-71

John Weihing
Superintendent and District Extension Director 1971-81
District Director of Research and Extension, 1981-83

Robert D. Fritschen
District Director 1984-86 and 1987-91

Burton A. Weichenthal
Interim District Director, 1986-87 and 1991-94

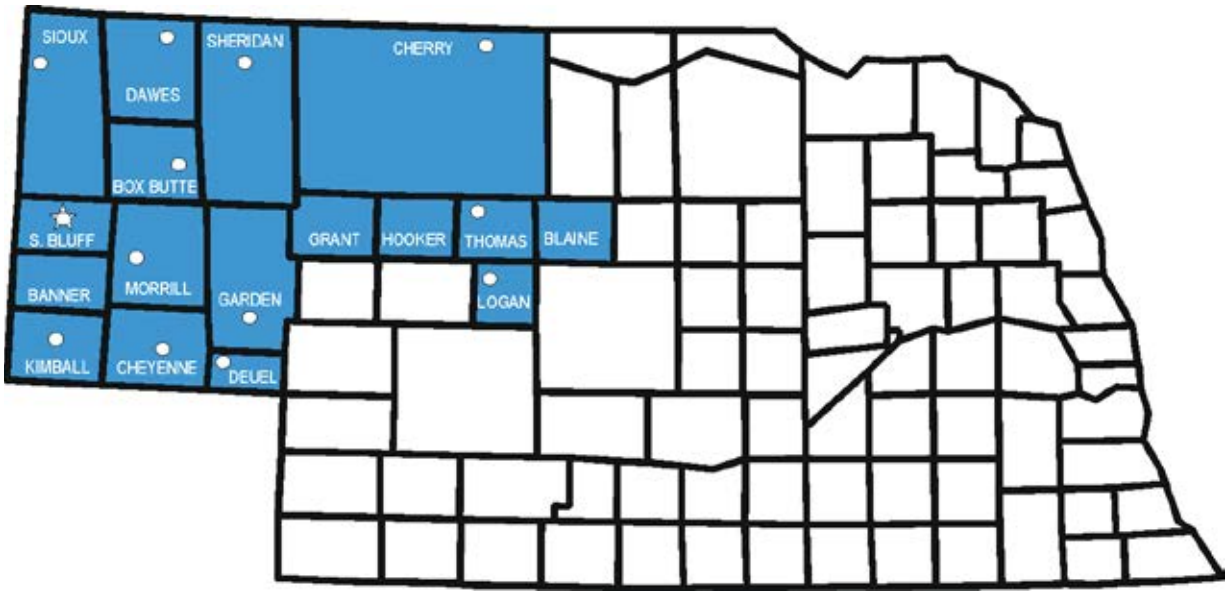
Charles A. (Chuck) Hibberd
District Director 1994-2007

Linda S. Boeckner
District Director, 2008 -

The Panhandle District

In the beginning, research was the only mission of the Scotts Bluff Experimental Substation. But it became apparent that extension work was necessary to share information with agricultural producers in western Nebraska. Today, in addition to research, The Panhandle Research and Extension Center has become the administrative headquarters of UNL Extension in the Panhandle District. The Scotts Bluff County Extension Office is located at the Panhandle Research and Extension Center, and there are 11 other county-based Extension offices.

A satellite research unit, the High Plains Ag Lab, located near Sidney, was established in 1970 to provide a facility for dryland agriculture reseach. The University of Nebraska-Lincoln also conducted ag research at the Northwest Agricultural Laboratory located in Box Butte County from 1929 until around 1990. For much of its existence the Northwest Ag Lab was managed by a committee based in Lincoln, but in 1967 it was made a satellite of the Panhandle Station.



County-based Extension Staff:

Box Butte County: Bill Booker (Unit Leader/Educator), Jennne Murray (Educator), Deb Kraenow (4-H Assistant), Carol Kleinsasser (Office Staff).

Central Sandhills: Bethany Sitz Johnston (Unit Leader/Educator), Sue Pearman (Educator), Sally Sawyer (Office Staff).

Cherry County: Jay Jenkins (Unit leader/Educator), Jody Soester (4-H Assistant), Betty Quick (Office), Evelyn Foster (Office Staff).

Cheyenne-Kimball-Banner: Aaron Berger (Educator), Karen DeBoer (Unit Leader/Educator), Connie Hancock (Educator), Kerry Elsen (4-H Assistant), Chanda DeMasters (4-H Assistant), Elsie Vogel (Office Staff).

Dawes County: Scott Cotton (Unit Leader/Educator), Jamie Goffena (Educator), Sandy Schiaffo (Office Staff).

Deuel-Garden County: Carla Mahar (Unit Leader/Educator), Heather Borck (Educator), Karla Poenisch (Office Staff), Konni Sauder (Office Staff).

Scotts Bluff-Morrill counties: Tom Holman (Unit Leader/Educator), Jackie Guzman (Educator), Cathy Johnston (Educator/4-H Coordinator), Jim Schild (Educator), Peggy Backer (4-H Assistant), Jana Schwartz (4-H Assistant), Stacy Brown (Office Staff), Bonnie Franklin (Office Staff), Pat Randolph (CYFAR Grant Coordinator), Jeannie Yeoman (Office Staff).

Sheridan County: Cindy Tusler (Unit Leader/Educator), Debra Austin (4-H Assistant), Ruth Schmaltz (Office Staff), Judy Young (Office Staff).

Sioux County: Jenny Nixon (Unit Leader/Educator), Aaron Cross (Office Staff).

High Plains Ag Lab Staff

Farm Manager: Tom Nightingale. Research Technicians: Glen Frickel, Rob Higgins, Vernon Florke, Paul McMillen.

Centennial Photos:

Pictures Tell Story of 100 Years

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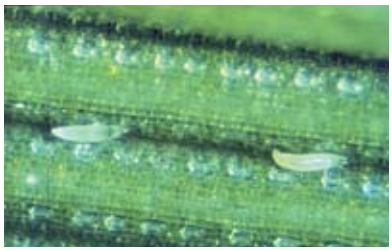
Pictures Tell Story of 100 Years



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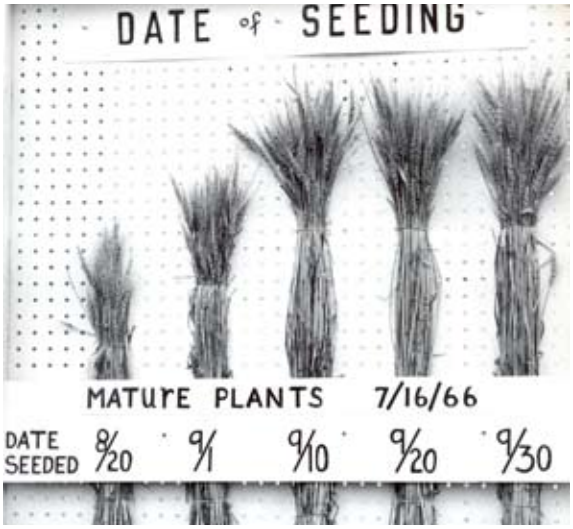


Centennial Profile:

Plant Pathology in Western Nebraska

By Robert M. Harveson, Extension Plant Pathologist
Panhandle Research and Extension Center

Early Studies

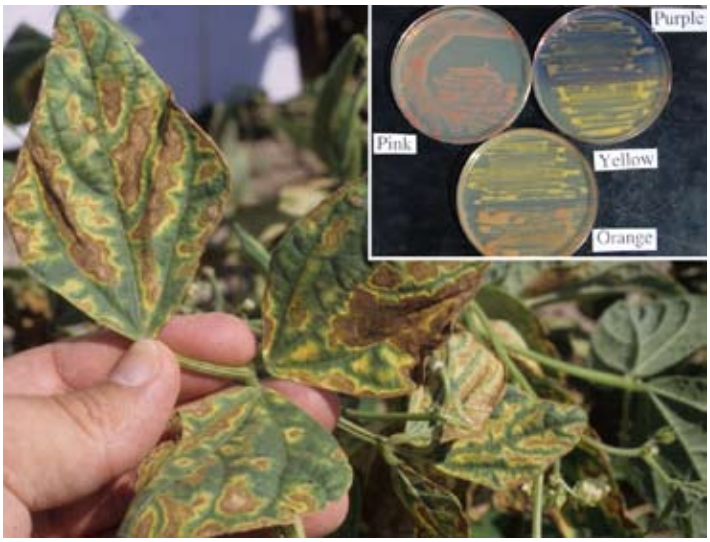
Although not officially recognized as a separate entity from botany until about 1920, plant pathology studies were being conducted as early as 1885, prior to the establishment of the Agricultural Experiment Station in 1887. These studies were promoted by Charles Bessey, the first Dean of the College of Agriculture. Bessey was initially hired as the first station botanist, and conducted the first work in a small greenhouse on City Campus. He additionally included plant diseases in his botany course in 1884, although the subject had probably been previously taught by the Horticulture Department as cryptogamic botany - later known as mycology (the study of fungi). Between 1885 and 1905 almost a dozen reports, papers, and bulletins were produced pertaining to plant diseases by Bessey and his students.

Plant Pathology in Moves to Western Nebraska

Potato production became the first subject of plant disease studies in western Nebraska. In the summer of 1909 (prior to the establishment of the Scotts Bluff Experimental Substation in 1910) a potato disease lab was set up in Alliance with the help of special legislative funds to study storage diseases of potatoes. Work on tuber dry rot (caused by *Fusarium trichothecioides*) by Link served as his M.S. thesis in 1912, and also resulted in the publication of the first Research Bulletin (No. 1) of the Experiment Station. Link later published a comparative physiological study of the wilt fungus (caused by *Fusarium oxysporum*) with the dry-rot fungus in 1916 as Research Bulletin No. 9 (also his Ph.D. thesis).

During the early 1920s, both E. Mead Wilcox (Station Plant Pathologist) and Robert W. Goss (later Dean of the Graduate College) attempted to set up plant disease experiments at the Scotts Bluff Substation, but gave up after several years. The director of the substation at that time (James Holden) had no interest in research collaborations with East Campus staff members. In the mid-1920s, additional work was begun with the purpose of reversing severe yield reductions in alfalfa crops due to the combination of the bacterial wilt disease and winter injury through the collaborations of UNL plant pathologist George Peltier, USDA, and the Agronomy Department. This resulted in the variety Ranger. which became the first winter hardy, wilt resistant variety ever developed. It subsequently became the leading variety grown in the U.S. through the 1960s.

In 1930, an experimental farm was established by the Experiment Station near Alliance (later known as the Northwest Agricultural Lab) in cooperation with Box Butte County with the primary purpose of studying potatoes under dry land conditions. After unsuccessfully working with Holden at the Scotts Bluff Substation, Goss continued at the Alliance field lab working with soilborne diseases such as scab and root rot (Rhizoctonia) and some of the first studies in the U.S. with virus diseases.



Typical wilt symptoms in dry edible bean, consisting of interveinal necrosis (death) surrounded by yellow borders. The inset photo shows the pink wilt pathogen variant growing in culture compared to the typical yellow, orange, and purple variants (inset).

Expansion of Plant Pathology in Western Nebraska

The arrival of Lionel Harris resulted in a change of philosophy for collaboration with the University of Nebraska as he promoted maximum cooperation with East Campus staff members and Extension. Plant pathology has played a major role in both research and extension activities ever since. For the next 30 years, plant pathology personnel from East Campus were stationed at Scottsbluff during the summers to conduct field experiments and address disease problems more efficiently. Beginning in 1946, Max Schuster was assigned this task, and studied soilborne and virus diseases of potatoes, bacterial diseases of dry beans, corn stalk rots, and sugar beet root diseases. Some major accomplishments included finding a new disease of sugar beets caused by a nematode pathogen indigenous to western Nebraska, *Nacobbus aberrans*, (false root-knot nematode). He additionally identified new color variants (orange and purple) of the bacterial wilt pathogen that are also unique to the Panhandle.

Two diseases of wheat also provide examples of col-

Plant Pathology, Continued

laboration between Lincoln-based faculty and those stationed in Scottsbluff, including western streak mosaic and root and crown rot, both of which we are still dealing with today. Bill Allington, Bob Staples, and Charlie Fenster worked for many years on the epidemiology of western streak mosaic (now known as wheat streak mosaic), and contributed significantly to formulating control measures for the disease. Root and crown rot was a devastating disease for many years in western Nebraska, but is now managed by planting wheat at appropriate dates for different regions of the state. These recommendations are still being used today, and are based largely on results of almost 20 years of research on this topic done by Charlie Fenster and Mike Boosalis.

First Permanent Extension Plant Pathologist

As a result of a committee established in 1965 to evaluate current and future research and extension needs in western Nebraska, the No. 1 recommended priority for new specialist positions in the Panhandle Area was judged to be a plant pathologist. Thus Eric Kerr was hired in 1967 as the first full-time extension plant pathologist at the Panhandle REC. His appointment was changed to 50 percent extension and 50 percent research in 1980, as the position still exists to this day.

Kerr established effective nematocidal treatments against sugar beet nematodes, and provided the industry with guidelines for determining the threshold levels of nematode populations needed for economical nematocide treatments. He also studied nematode diseases of corn and the carry-over effects of nematocidal soil treatments in a corn-dry bean-sugar beet rotation. He developed a forecasting system with

These sugarbeets show multiple diseases from a single field found infecting roots simultaneously. Roots from left to right infected with Aphanomyces and Rhzoctonia root rots; Fusarium root rot/ yellows, and rhizomania.

Sunflower leaves infected with the early spore stages of rust -- pycnial (left) and aecial (right).

Al Weiss (extension climatologist) for Cercospora leaf spot control in sugar beets (which is still in use today). Lastly, he collaborated with Lincoln-based faculty in the biological control of Rhizoctonia root rot in sugar beets, and control of white mold, rust, and bacterial diseases of dry beans.

Changing of the Guard in Scottsbluff

Kerr retired in March 1998 and his position was filled in 1999 by Robert Harveson, who currently has responsibility for specialty crop diseases with an emphasis on sugar beets, dry beans, and sunflowers. He has determined that Aphanomyces root rot is a major component of the root disease complex in sugar beets (with rhizomania, Rhizoctonia root rot, and others) and is focusing on integrated methods of management including biological, cultural, chemical, and predictive. He also is studying the re-appearance of the bacterial wilt disease of dry beans (first investigated by M. Schuster in the 1950s), and its ability to survive on other crops grown in rotation with dry beans. This work has uncovered the presence of another pathogen color variant (pink) near Scottsbluff which has never been reported from any other location. He also identified the early stages of sunflower rust for the first time from naturally-occurring field infections in volunteers and wild species, and demonstrated the implications of this for subsequent disease development in commercial sunflower crops. His extension program has focused on providing a diagnostic service for producers (more than 22,000 samples since 2000) that tests both soils and plant specimens for disease identification and incidence. Much of the successes realized by plant pathology have been due to the longstanding technical support of Clay Carlson, and Kathy Nielsen, who have provided more than 50 combined years of experience and service to the Panhandle REC.

Centennial Profile:

Community Development Programming

By Cheryl Burkhart-Kriesel, Extension Community Development/Entrepreneurship Specialist
And Connie Hancock, Extension Educator/Technology

Community development as a focus is a fairly recent phenomenon for the Research and Extension Center. From 1981-1987 Arnold Bateman was the Extension Resource Development Specialist/Resource Conservation & Development Program Coordinator. As the coordinator of the Resource Conservation and Development project, he worked with U.S. Department of Agriculture agencies in providing leadership for both funded and non-funded natural resource development programs and projects in the 12 western counties of Nebraska.

Several of the funded projects worked on in western Nebraska were recreation development, irrigation and flood control projects. He prepared project development plans on over 20 projects and assisted in obtaining Soil Conservation Service Resource Conservation and Development funds to help in construction of several of the projects. In addition, his cooperative extension responsibilities included providing leadership to rural revitalization training and development programs in the Panhandle. Major project accomplishments include the organization of the Nebraska Dry Bean Growers Association, the development of the Nebraska Dry Bean Commission (check off program), and the development of the American Dry Bean Board. Leadership programming included helping to develop the Family Community Leadership Development statewide program.

From 1987 to 1997, Bateman moved to another role at the Center, as the Coordinator for the University of Nebraska Panhandle Education Center. The Education Center, created in the late 1970s, was funded by the University of Nebraska-Lincoln Office of Extended Education and Outreach and Cooperative Extension and created a new blended community development role for the region.

As coordinator, he provided leadership for a credit and non-credit continuing education organization with four full-time and three part-time staff members that served over 9,400 people contacts per year. Credit programming, primarily delivered by telephone and later by satellite, included five graduate programs from the University of Nebraska-Lincoln and one certificate program from University of Nebraska at Omaha. Community and business workshops often were focused on strategic planning, leadership, customer service, team building, and management principles.

In 1998, Cheryl Burkhart-Kriesel took over the coordinator role for the newly reorganized University of Nebraska Panhandle Learning Center, one of four regional Learning Centers in the state. Burkhart-Kriesel supervised the annual development and implementation of over 40 public and inservice noncredit business development workshops with

two full-time and two part-time staff members. She provided leadership to offer distance delivered credit courses from UNL, UNO, and UNK and worked collaboratively as a partner with Chadron State College and Western Nebraska Community College in course delivery. The Learning Center also coordinated satellite (Neb-SAT) technical assistance to the public for approximately 100 workshops each year. In addition to the program offerings at the Center in Scottsbluff, programs and courses were offered through distance education in Sidney (Connie Hancock, Extension Educator – coordinator), Alliance (Tony Merrigan, Extension Educator – coordinator), and in Rushville (Sheryl Carson, Extension Educator – coordinator).

Burkhart-Kriesel focused her extension teaching responsibilities in the area of strategic planning, customer service, and business management principles. Hancock, Extension Educator in Cheyenne and Kimball/Banner, also worked in the area of community development within the district during this time period. Her emphasis was in the area of technology education.

In 2001 the community development emphasis was separated from the Learning Center and a new Community Development Specialist position was created, with Burkhart-Kriesel being selected to fill the position. Since 2001 Burkhart-Kriesel has focused community development efforts in two areas, business development (primarily within the tourism industry) and new resident recruitment and retention.

Hancock has maintained her focus in information technology and has partnered with other educators, specifically Jenny Nixon (Sioux County) and Jay Jenkins (Cherry County) in the Panhandle District, to help small businesses enhance their e-commerce presence.

Burkhart-Kriesel and Hancock are currently involved in a multi-state USDA National Research Initiative grant that focuses on identifying effective ways to market rural communities to improve new resident recruitment and retention.

Centennial Profile:

Livestock Research in the Panhandle

By Tom Holman, Extension Educator

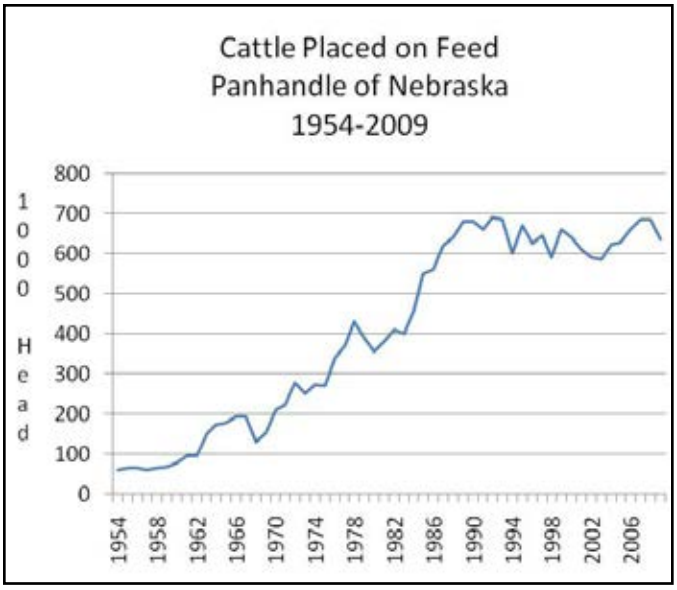
Prior to 1915, sufficient livestock facilities were developed at the Panhandle Research and Extension Center to begin dairy, swine, sheep and beef research. True to the land grant mission livestock and related research centered around solving production issues of local producers.

Dairy research published in 1915 involved sire selection for replacement females in local herds.

Early in the 1920s the center was instrumental in the development of a six-breed swine composite breed for improvement in carcass quality.

In 1949, sheep feeding trials were concluded to compare beet tops with traditional expensive pelleted feeds. This resulted in using a cheap byproduct of the sugar industry to reduce lamb feeding costs.

In 1951 winter hardiness of a landmark alfalfa variety, Ranger, was tested at the Research Center. Alfalfa variety tests continued from 1974 to the present along with weed control that addressed producer concerns. In addition, insect interactions (1976) and fertilizer trials (1977 and 1979) were conducted to improve yields. Later in 1978, innoculants tested for their viability in harvesting alfalfa and the effects of nematodes (1982) were tested to address producer problems.



In response to the dramatic expansion of cattle feeding in the Panhandle of Nebraska that occurred in 1963, 1968 and again in 1980, primary livestock research investigated implants, supplements and locally grown cheap feeds to improve cattle efficiency and reduce cost of gain in the feeding industry. In 2007 the Research Feedlot completed a significant expansion to continue to solve producer problems in a state-of-the-art facility. The cattle segment was and is still the largest agricultural contributor to the economy of the Panhandle.

Cattle at the Panhandle Research Feedlot.

Implant research to improve weight gain and control diseases began in 1951, and continues to the present with initial testing and profitable use of such industry standards as Bovatec, Rumensin, Ralgro, Synovex and Finaplex on growing and finished cattle.

Feed tests to reduce feed costs and improve weight gains were extensively and routinely conducted on locally grown feeds. These feeds included corn silage, beet pulp, alfalfa silage, corn stalks, wheat straw, high moisture corn, dry beans and ammoniation of many feeds to improve protein digestability. The first published feed trials occurred in 1973 and continue to today.

Beef herd health has been a priority for producers, and products commonly used today were initially tested at the Center. These include mineral, vitamin, and enzyme additives, antibiotic, viral and insecticide products injected and added to feeds to improve livestock health and producer income. The first of these improvement tests were conducted in 1973 and are still an important part of the program.

Profitability and sustainability of the range beef cattle industry benefitted from Center research. In 1969 the effects of different stocking rates on native pasture were evaluated, which identified bench marks for grazing management in Western Nebraska. Another grazing study completed in 1976 measured the effect of different breeds on Western Nebraska native ranges.

A detailed beef herd evaluation project provided beef producers with a method of quantifying profits in comparison with other herds. Spaying and implant trials on heifers were conducted in 1981 to improve feedlot gains. Recently, in response to the drought of the 1980s and 1990s, early weaning trials were conducted to improve cow health and measure the effects on calves.

Centennial Profile:

Horticulture in the Panhandle

By Jim Schild, Extension Educator
And Bob Hawley, Research Technician

Early Work

Many people associated the work of the Scottsbluff Station with the production of grains, but the early work of the Scottsbluff station was also to investigate the possibility of horticultural production in the Panhandle region.

The first station manager, Fritz Knorr, planted an orchard in 1911. The station's charge was to evaluate varieties for adaption to the region. Jules Sandoz was growing fruit trees in his orchard in Sheridan County at the turn of the century, but the unpredictable weather challenged him and others trying to grow fruit and vegetables.

Weather has and continues to be the biggest challenge for growers trying to produce quality fruits and vegetables, as evidenced by this report for the station from 1916: "The garden and orchard work were a total failure this year, due to sand storms, late snow and the hail at a later date. On June 20 the garden was practically as bare of vegetation as in January. All that we were able to get out of the garden was a few string beans and a few tomatoes, the first of which ripened about a week before the first frost. All of the fruit was destroyed by the weather this fall. The hail did perhaps most of the damage to the young fruit. The trees were considerably damaged by the hail, most of the scars, however, healed very nicely during the summer and no winter damage should result from these wounds." Gardeners today can relate to those same weather challenges.

This 1913 photograph shot by Fritz Knorr, the first superintendent at the Scotts Bluff Agricultural Experiment Substation, shows a bird's eye view of the garden at the station in July of that year.

The second superintendent, James Holden, planted 100 fruit trees (apples, pears, cherries and plums) and 250 small fruits (currants, gooseberries, grapes, raspberries, and strawberries) in 1923. Some of the trees lived and produced fruit periodically during the next 30 years. In 1949 the apple crop contributed to the cash revenue of the station, the only year the orchard did so.

The third superintendent, Lionel Harris, continued looking at fruit production. He worked in cooperation with the U.S. Department of Agriculture Cheyenne Horticultural Station and planted an experimental orchard in 1939. Out of that collaboration many fruit trees and small fruits were identified as being hardy, and some are still planted in this region today.

Harris also conducted vegetable variety tests in the early to mid 1930s. Vegetables that were tried included asparagus, bush beans, table beets, cabbage, carrots, cauliflower, celery, chard, sweet corn, cucumbers, eggplant, peppers, endive, kohlrabi, lettuce, muskmelons, watermelons, okra, onions, parsnips, peas, radishes, salsify, spinach, squash, pumpkins, sweet potatoes, tomatoes, and turnips. The work was mostly concerned with varieties and other factors from the standpoint of the home garden.

However, Harris also goes on to say that commercial production of cabbage and onions is feasible in the area, and that certain varieties of tomatoes, peas, beans, sweet corn, and red beets have canning possibilities. In March 1937, a meeting was held for local growers to discuss growing vegetables for canning purposes. The following is the report in Harris's weekly log: "The Otoe Food Products Co. is building a canning factory near Scottsbluff at the present time. This company will can only tomatoes and sweet corn this year, but eventually expects also to process asparagus, spinach, red beets, carrots, beans and peas. Approximately 200 growers attended the meeting, which indicates the interest that is being shown in the new industry."

Otoe Foods, later called Morton House, canned vegetables from 1939 to 1946, when it was sold to Consumer's Cooperative of Kansas City.

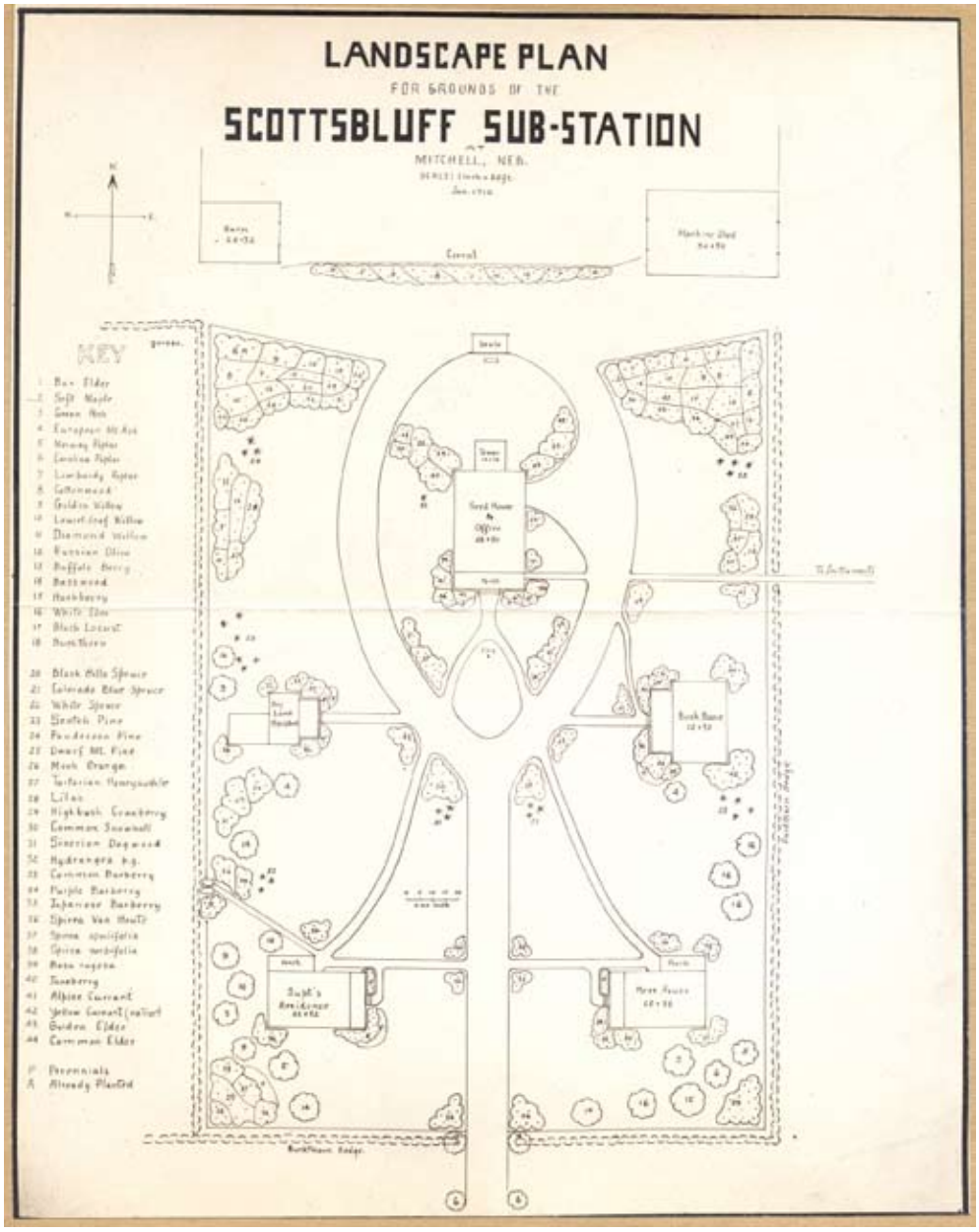
Commercial vegetable production interest was renewed in the 1960s, when David Nuland evaluated vegetable varieties in 19 counties in Nebraska. The specific purpose was to generate information for the vegetable processing industry regarding the potential for vegetable production

Horticulture, Continued

in Nebraska. Information was compiled on asparagus, lima beans, dry beans, snapbeans, red beets, carrots, broccoli, cabbage, cucumbers, onions, peas, potatoes, pumpkins, sweet corn, and tomatoes.

Campbell Soups in Omaha was looking for local sources of vegetables, but as the interstate road system developed it brought with it the ability to bring in fresh produce from the traditional vegetable growing regions.

Nuland began looking at turf and landscape issues in the early 1970s, conducting trials on bluegrass varieties and looking at warm season grasses suited to the high plains landscapes. Nuland teamed up with Stan Haas, who was the Communication Specialist at the center and started the D.A. Murphy Arboretum. The arboretum is part of the Nebraska Statewide Arboretum System and was still in existence as of 2010. Nuland, along with county agents in the Panhandle region, started and recruited Master Gardeners for a new state program in 1986. In return for classroom instruction the Master Gardener volunteers donate back to their communities 40 hours of their time working on various horticultural projects.



The 1912 landscape plan for the Scottsbluff Substation lists the plants (left) on the grounds, and shows where they were planted.

An attempt at vegetable production was again made in the mid 1980s, when the UNL Food Processing Center established a presence at the Lionel Harris building at the Mitchell Unit. Carrots, onions, and peppers were all grown at the center. Onions started in paper pots in greenhouses and later transplanted to the field were also evaluated. Some local businessmen were at this time trying to set up a freeze dry operation in Gering to package the vegetable products. Unfortunately, the local bank that was helping with the project failed and with the bank failure the project also failed.

Nuland retired in 2000 and in the budget-cutting process for that year the horticultural position at the Panhandle Center was lost. Extension Educator Jim Schild and other educators picked up pieces of Nuland's work.

Schild's horticultural work has been looking at different varieties of grapes that can be grown in western Nebraska. As of 2010, three commercial wineries were in operation.

The D.A. Murphy Arboretum continues and the focus of the work has been to reduce the amount of water used in the landscape. Native shrubs and trees have been planted in landscape beds, bluegrass turf areas have been converted to buffalograss turf and mulched landscape plantings of trees and shrubs.

Centennial Profile:

Feedlot Management and Nutrition

By Karla H. Jenkins, Cow/Calf Range Management Specialist, and Ivan Rush, Professor Emeritus, Retired Livestock Specialist

The Beginning of Finishing Research

Finishing studies conducted in the late 1950s and early 1960s in the Nebraska Panhandle consisted of diets containing greater than 20 percent roughage, and resulted in gains ranging from less than 2 pounds per day to almost 3 pounds per day. Feed efficiency averaged around 7.5-8 pounds of feed per pound of gain. Today our roughage levels are between 7-10 percent, our gains over 4 pounds per day and efficiency between 5 and 6 pounds of feed per pound of gain. Our carcasses are heavier and better quality. Sixty years of research has led to the development of the commercial cattle feeding industry. That industry is now responsible for a major portion of the economy of the Great Plains.

Humble Beginnings

When the Scotts Bluff Experiment Station was located east of Mitchell, Walt Woods, Don Clanton, and Lionel Harris conducted small finishing studies in a set of 10 pens behind what is now known as the Lionel Harris Building. Early research attempted to reduce back fat on Hereford steers with a metabolic stimulant. Additional research focused on the effects of implants, physical form of the diet, roughage and protein sources.

The First Expansion

The early 1970s witnessed the birth of the commercial feeding industry and research needed to focus on developing the efficiency of this new industry. UNL Animal Science Professor Terry Klopfenstein designed 28 feedlot pens east of the Mitchell station where the current research feedlot exists today. In 1970 a strong research program began to focus on bunk management, waste management, improving feed efficiency and cost of gain.

In 1974 Dr. Ivan Rush joined the Panhandle Research and Extension Center as the Livestock Specialist for the district. For the next 35 years, Rush contributed to the development of the feedlot industry by researching the use of ensiled corn, roughage and protein sources, implants, feed additives, and by-product utilization in feedlot diets. His vision for feedlot research in the Nebraska Panhandle and his relationship with western Nebraska producers eventually led to a collaborative effort to expand the research feedlot to a 1,500-head-capacity lot with 102 research pens.

Collaborative Efforts, Vision, and Promise

The uniqueness of western Nebraska's climate allows this research feedlot to conduct research that is not only applicable in western Nebraska, but also in the southern Great Plains as well. Today research is conducted on the use of distiller's grains, beet pulp, alternative crops, feed additives, implant strategies, and processing methods in both dry rolled corn and steam flaked corn based diets. It is one of the largest research feedlots in the United States.

Centennial Profile:

Range Management in Western Nebraska

By James Stubbendieck, Professor and Director, Center for Great Plains Studies
and Karla H. Jenkins, Cow/Calf Range Management Specialist, Panhandle Research and Extension Center

Dr. Donald F. Burzlaff initiated range research on the 800-acre experimental range in Sioux County in about 1960. He cross-fenced the tract into several rest rotation systems and initiated research on livestock yearling steer gains under the different systems and the influences of the systems on the vegetation. During this early period O.E. (Gene) Hoehne did the work on his Animal Science Ph.D. dissertation studying the chemical composition and in-vitro digestibility of forbs consumed by cattle grazing on native range. Also, Charles Streeter did his animal science Ph.D. work evaluating techniques used to estimate the in vitro digestibility of grazed forage. Both students conducted their research under the tutelage of Dr. Don Clanton.

Mature needleandthread grass, an early producing cool season grass important to western Nebraska.

Larry Rittenhouse conducted his M.S. thesis project titled "Phenological and environmental influences of foliage cover as measured by the focal point technique" under Dr. Burzlaff. He graduated in 1966. James Stubbendiek moved to Scottsbluff in 1966 and also completed his M.S. under Dr. Burzlaff titled "Investigations relative to the growth and development of blue grama" and graduated in 1968. Today blue grama remains a prominent important species for western Nebraska. James Stubbendiek worked as a technician and managed the grazing trials under Dr. Burzlaff's direction. After receiving his Ph.D. at Texas A&M, he returned to Scottsbluff in 1974 as the first Range Specialist. Dr. Stubbendiek finished an 8-year project that Dr. Burzlaff initiated before he accepted the position of Chair of the Range and Wildlife Department at Texas Tech. The project was to determine the influences of low rates (30 pounds per acre) of nitrogen fertilizer (as nitrogen was inexpensive at the time) on steer gains and vegetation in some of the same rest rotation systems that Dr. Burzlaff set up about 15 years before.

Additional research conducted evaluated cheatgrass control, dryland legumes, warm season grass establishment, and wet meadow fertility. Dr. Stubbendiek then moved to Lincoln in 1978 and remains on faculty today. With Dr. Stubbendiek's position change to Lincoln, a new range ecologist, Pat Reece was hired for the Panhandle in 1978. Dr. Reece conducted research on the range in the Panhandle until his retirement in 2007. Dr. Reece focused his research efforts on grazing and seasonal effects on predominant species such as prairie sandreed, sand bluestem, and blue grama. He extensively studied the effects of stocking density as well as the effects of intense grazing rotations and multiple occupancies throughout the grazing season. Dr. Karla Jenkins became the Cow/calf, range management specialist in 2009. Research efforts will focus on enhancing the sustainability of the range through supplementation and grazing strategies, as well as the use of alternative forages.

In summary, some of the pioneering work on rest rotation systems was done at the Panhandle Center. Systems researched were very similar to those in use today throughout the Great Plains. The nitrogen fertilization work showed that the economic returns did not justify the inputs. In addition it caused a conversion of the mixture of warm- and cool-season grasses to nearly all cool-season species. The intensive research on specific species of vegetation revealed how grazing management affects available forage quantity and quality and has created an awareness of the importance of properly managed range.

Western wheatgrass, a cool season staple of the Nebraska Panhandle.

Centennial Profile:

Weed Research in Western Nebraska

By Dr. Robert G. Wilson, Professor of Agronomy and Horticulture, Panhandle Research and Extension Center

Weed science research was initiated at the Panhandle Research and Extension Center (PREC) in the spring of 1975, when Robert G. Wilson joined the faculty at the center. This new position was created to meet the demands of producers in western Nebraska for weed control information for irrigated crops and to explore methods for suppressing Canada thistle. The need for new and improved thistle management techniques caused producers across Nebraska to lobby the legislators in 1974 for the creation of two new weed science positions, one at Scottsbluff and one at Clay Center.

Over the past 35 years weed control research has been conducted for sugarbeets, dry beans, alfalfa, corn, chicory, sunflowers, potatoes, onions, garbanzo beans, wheat, pasture, and rangeland.

Research Highlights

Irrigation canals.

Weed Seeds: The system of dams, canals, and laterals that distribute water throughout the North Platte River valley also provide a conduit for the dissemination of weed seed. Seed of 77 different plant species were collected from surface irrigation water over a 2-year period in the Farmers and Enterprise canals. Pigweed species were the most common seed found in irrigation water, but barnyardgrass and lambsquarters followed. During a typical irrigation season surface irrigation water had the potential to introduce over 20,000 seeds per acre into irrigated fields.

Canada Thistle: Canada thistle is a perennial weed that develops an extensive underground root system that allows the weed to spread and overwinter. Root carbohydrate reserves consist of free sugars glucose, fructose and sucrose, and fructans with varying degrees of polymerization. The concentration of root carbohydrates undergo seasonal changes which allow the plant to tolerate environmental stresses. For Canada thistle to successfully survive freezing soils, the carbohydrate composition of roots changes as winter approaches. Long-chain length fructans break down to form kestose, nystose, and sucrose which allow the roots to survive in frozen soils. Fall application of herbicides at the occurrence of the first frost interrupts carbohydrate metabolism and results in increased herbicide efficacy.

Canada thistle roots.

Chicory roots.

Chicory: In the fall of 1994 researchers at the PREC were approached by Western Sugar Company to explore the possibilities of growing chicory in western Nebraska. This

Weed Research, Continued

project evolved over the next 16 years as a major research and extension effort. Chicory is a root crop like sugarbeets but is a member of a different plant family and hence is not affected by the same diseases that attack sugarbeets. Chicory seed is planted in mid April and can be harvested from mid September through November. Root development increases very rapidly in the fall. On Sept. 1, root yield averaged 15 tons/acre and by Nov. 15 had increased to 27 tons/acre. Chicory roots contain 20 percent storage carbohydrates as fructans, which can be used as functional food ingredients. Early-season weed suppression is one of the major obstacles in growing the crop. Weed control research identified two herbicides imazamox (Raptor) and rimsulfuron plus thifenosulfuron (Basis) that could be applied early in the growing season for selective weed control in the crop. Results from research indicated that chicory can be successfully grown in western Nebraska.

Roundup vs. conventional sugarbeets.

Weed Control in Sugarbeets: Weed control in sugarbeets has been the nemesis of the crop ever since the crop was introduced in Nebraska in the early 1900s. Migrant labor toiled in the fields to remove weeds for the first 80 years of production. Beginning in 1990 the concept of using multiple postemergence herbicide applications nicknamed the half-rate was developed at the PREC. This weed control program became very popular and reduced the need for hand labor. The major drawback to the program was early season sugarbeet injury. Beginning in 1998, research was initiated on glyphosate (Roundup) tolerant sugarbeets. Glyphosate applied two or three times at 2-week intervals, beginning when weeds were 4 inches tall, provided excellent weed control, yield, and net economic return. Compared to conventional sugarbeets treated with conventional herbicides, glyphosate-tolerant sugarbeets treated with glyphosate had less early season crop injury and a 19 percent increase in sucrose yield per acre. During the 2009 cropping season glyphosate-tolerant sugarbeets were planted on 99 percent of the sugarbeet acreage in Nebraska and sugarbeet root yields for the 2009 growing season reached an all-time high of 25 tons/acre.

Research plots in long-term glyphosate resistance study.

Glyphosate-Tolerant Weeds: With the advent of glyphosate-resistant crops in the mid 1990s and their rapid adoption by U.S. farmers, concerns have arisen about weed resistance to glyphosate. In the spring of 1998 a long-term experiment was initiated at the PREC to measure weed populations following multiple applications of glyphosate or alternating glyphosate with nonglyphosate in continuous corn or in a crop rotation of corn, sugarbeet, spring wheat, and soybean with all crops resistant to glyphosate. After 6 years, the composition of the weed population shifted from kochia and wild proso millet to predominately common lambsquarters. Using a reduced rate of glyphosate caused the population of common lambsquarters to increase to the extent that corn grain yield was reduced 43% compared to corn yield where the recommended rate of glyphosate was utilized. Common lambsquarters control was achieved by applying a herbicide other than glyphosate at planting. This strategy has suppressed the weed population and when combined with glyphosate provided excellent corn grain yields. In the nonglyphosate treatment after 8 years of use kochia density increased to the extent that additional herbicide was required for weed suppression. After repeated use most herbicide modes of action will select for tolerant weeds, the key to successful weed management is to scout for weed shifts and counter them by adding herbicide with a different mode of action.

Centennial Profile:

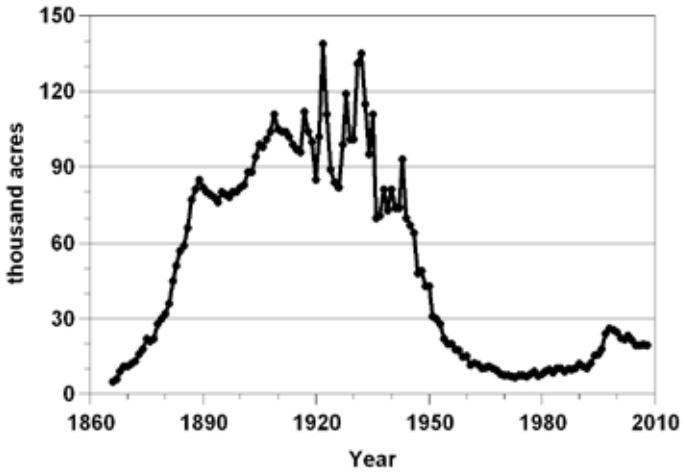
Growth of the Nebraska Potato Industry

By Dr. Alexander D. Pavlista, Potato Specialist & Crop Physiologist, Panhandle Research and Extension Center

The Beginning

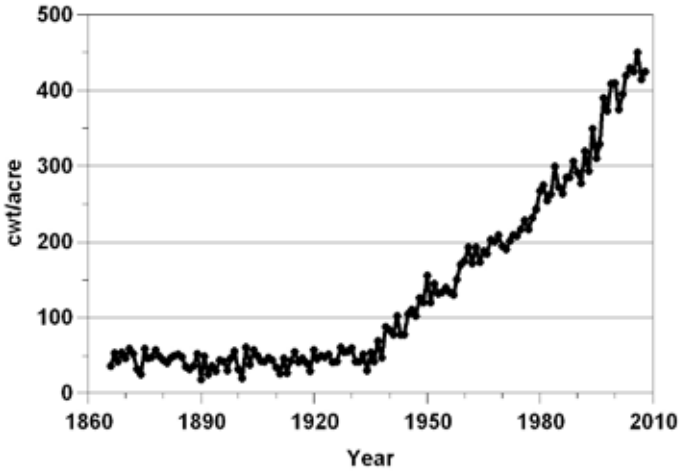
The Nebraska Agricultural Statistics Service (NASS) began tracking the potato industry in 1866, a year before statehood. Then, acreage was 5,000; yield was 36 cwt/a (cwt = hundredweight = 100 lb), and the crop value was $500,000. The late 19th Century saw the advent of the "Mechanical Revolution," the first modern agricultural milestone. Acreage steadily increased reaching a plateau of around 100,000 acres in 1907 (Figure 1) that lasted to 1935. Potato production during this period was directly related to increased acreage. There was no change in yield which remained at about 50 cwt/a (Figure 2).

Figure 1. Potato History, 1866-2008: Harvested Acres



The sudden 37% decline in potato acreage between 1935 and 1936 can be accounted for by the Dust Bowl and the Great Depression. From 1936, through WWII to 1946, a short plateau was maintained at 70,000 acres. Interestingly, during this period, production attained its highest level to that time (Figure 3). At about 7 million cwt, production was nearly double that attained during WWI. The value of production, at about $13 million from 1942-48, was the highest to that time as well (Figure 4). Several forces account for this plateau and record highs. During WWII, the US government identified potato as an essential commodity for the wartime effort. The second modern agricultural milestone, the "Chemical Revolution," began with the advent of pesticide usage in the late 1930s. Also from 1935 to the present, yield has undergone a steady improvement at 4-5 cwt/a per year. This yield increase resulted from improved cultivars,

Figure 2. Potato History, 1866-2008: Yield



progressive cultural practices such as fertilization, pest recognition, monitoring and control, emphasis on soil husbandry, and a shift from rain-fed to irrigated production. These innovations were due to University research and usage by progressive growers.

After 1948, potato acreage dropped from 49,000 to an all-time low of less than 7,000 in 1972-73. During this time, production declined due to acreage from over 6 million cwt to less than 1½ million. Gross income was reduced from over 6 million $US to less than 2½ million for the State. However, the declines would have been more cataclysmic if it were not for the continual research in improving potato yield which continued to improve at 4-5 cwt/a per year. This period of decline may be attributed to many factors including increased urbanization with a decline of the small family farm growing potato. The potato market was becoming more and more national, and less local.

Dr. Harvey Werner: In 1910 the Scotts Bluff Experiment Station, currently known as the Panhandle Research and Extension Center, was established. After Dr. Harvey Werner came to the University in 1918, he established a Potato Program in 1920 and was the first Potato Specialist / Horticulturist in Nebraska. He was President of the Potato Association of America (PAA) in 1925. Dr. Werner focused on developing new varieties for growers, releasing 11 potato cultivars. See the S.B. Exp. Sta. 50th Anniversary "Profiles of Progress" p. 8-9 (1960). He worked extensively on potato storage and initiated the Seed Certification Program.

From 1960 to 1990

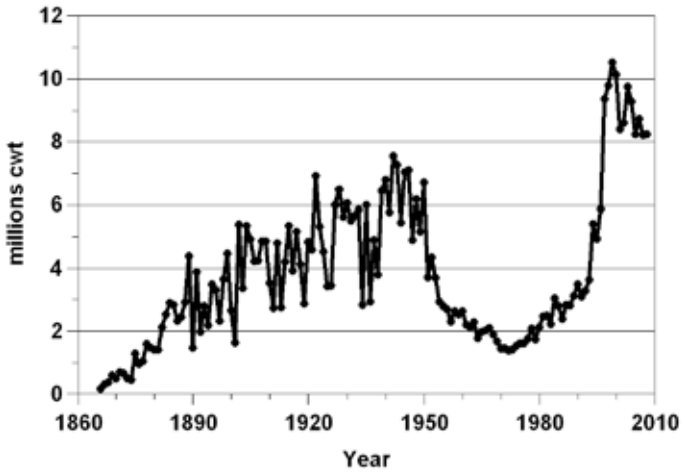
From 1960 to 1990, the Nebraska potato industry was at its low point. During this period, the fast food industry grew and began to dominate potato production. The

Potato Industry, Continued

premier cultivar for french fry production was, and still is, the Russet Burbank. But, this cultivar grows unacceptably in Nebraska so the State could not take advantage of this boom. Due to its leadership in potato certification, Nebraska, specifically the Panhandle, became known for seed tuber production. The State produced red-skinned cultivars for use in the southern states and the main fresh market potato was the Norgold Russet, released by Dr. Robert Johansen of North Dakota State University in 1964. Norgold Russet was great tasting but not visually appealing.

However, during this period, several major developments were beginning that would influence the future of the Nebraska industry in the 21st Century. Center-pivot irrigation began and was gaining wide-spread acceptance. Center-pivot irrigation allowed the growers to control when and how much water to apply to potatoes. Through research, irrigation management was found to partially control infection by common scab and black scurf, two major disease problems. Potato farms were aggregating into larger, corporate farming operations allowing for major investment in specialized equipment and cultural practices. The chipping cultivar Atlantic was released by the USDA-ARS at Beltsville, MD, in 1978. Atlantic became, and still is, the premier chipping cultivar, and it grows well in Nebraska although it tends to be prone to common scab. The ability to grow Atlantic attracted the potato chip industry to western Nebraska increasing not only chip but also seed production. Frito-Lay was becoming the dominant corporation in the chip market and its presence in Nebraska was growing with contracts to growers in the Panhandle. In 1987, the cultivar Russet Norkotah was released by NDSU and it quickly replaced Norgold Russet because of its nicer appearance albeit poorer taste. Again, this cultivar for the fresh market grows well in Nebraska and revitalized the industry here in the 21st Century. The third cultivar that was to influence the Nebraska industry was Yukon Gold, released in 1981 by the Univ. of Guelph but not reaching popularity until around 2000.

Figure 3. Potato History, 1866-2008: Production



Dr. Robert O'Keefe: Upon Werner's retirement in 1962, his graduate student, Dr. Robert O'Keefe become the second Potato Specialist. He was President of the Potato Association of America (PAA) in 1980. O'Keefe, as did Werner, focused on improving potato cultivars emphasizing common scab resistence. He released seven cultivars, helped expand seed production and successfully promoted Nebraska as a potato chip industry.

From 1990 to the Present

In the late 1980s, potato acres were level at about 10,000. During this decade, production and its value gradually increased. After 1992, acreage took a sharp upswing to a peak of 26,000 in 1998-99 and then leveled at about 20,000 acres partially due to a drought that may be ending in 2009. In 1999, a record production of 10½ million cwt was attained, 40% higher than the record set in 1942 when there were four times the acreage. That year, yield went over 400 cwt/a for the first time. In the past 20 years, the rate of yield change increased to 8-9 cwt/a per year, accounting for the difference between 1942 and 1999. Yield increase was associated with water and nitrogen management, new cultivars (Atlantic and Norkotah Russet) and their management, and pesticide development and management, e.g., integrated pest management, and pest identification and monitoring. Today, Russet Norkotah is sometimes referred to as the "Nebraska Russet" and dominates nearly all fresh market production in the State. Chip production, all of which is contracted to Frito-Lay with about 85 percent of the national market, also dominates. Seed production remains an important part of the overall industry. With the stabilizing of national potato acreage in the past several years, prices have shown major improvement. In 2008, the average price was about $10/cwt for Nebraska growers resulting in a record value of over $82 million. This compares with $110 million for dry bean, $42 million for sugar beet (2007), $61 million for grain sorghum, and $20 million for sunflower. New strains of the late blight pathogen, with resistance to current fungicides, and more aggressive and virulent than the one that caused the Irish potato famine in the 19th Century, appeared in Nebraska in the late 1990s. New fungicides were developed and their management incorporated.

Dr. Alexander Pavlista: In the late 1980s, potato growers decided to shift emphasis to production. When O'Keefe retired in 1988, Dr. Alexander Pavlista, a plant physiologist from the chemical corporate world, came to Nebraska as the third (and current) Potato Specialist and President of the PAA in 2007. Major projects were sulfur fertilization to control common scab, fungicides to control early and late blights, insecticides for potato psyllids, plant growth regulators for yield, and cultivar evaluations. New

Potato Industry, Continued

projects were initiated recently to deal with limited irrigation and crop rotation with regard to climate change and biofuels.

Next 10 years

Dr. Pavlista expects acreage to be stable near 20,000 while yield inclines. The income from potato to State growers could continue to rise to $100 million level as practices and cultivars keep improving. A key factor for the future is the third modern agricultural milestone, the "Genetic Revolution," heralded with the 'Flavr Savr' tomato in the 1980s. Genetic modification (GMO) has become prominent in corn and soybean production. In the 1990s, GMO potato cultivars were introduced but due to pressure by interest groups on fast-food industry, they were withdrawn. As GMOs acceptance by the public increases, GMO potato production will be key in the 21st Century food supply. With the growing identification of climate change as a major problem in the 21st Century, research on plant management under limited water availability for potato and for potential rotational crops such as canola and camelina for biofuels was initiated. Research on growth regulators expanded recently to rotational crops in potato production. New problems are always on the horizon, such as zebra chip disease transmitted by potato psyllids, and new virulent and aggressive strains of late and early blight pathogens.

Potato Certification Association of Nebraska

The Potato Certification Association of Nebraska (PCAN) was designated by the Institute of Agriculture and Natural Resources to conduct the potato certification program in Nebraska under State law. PCAN was established at the request of seed potato growers. The Vice-Chancellor of IANR and an advisory committee specify the standards and review all appointments, rules and procedures. Following the incorporation of PCAN in 1951, Warren Trank was the Secretary-Manager until retiring in 1980 when Gary Leever took this position. Upon Gary's recent retirement in 2009, Steve Marquardt become the Secretary-Manager. The Secretary-Manager of PCAN has a courtesy appointment to the Department of Agronomy-Horticulture at the University of Nebraska. Since its incorporation, the seed potato program of PCAN and UNL's potato program have been closely aligned. Cultivar development under the Potato Specialists, provided PCAN with pertinent data on new cultivars adaptable to Nebraska. Prior to the mid-1970s, material coming into industry use from breeding, testing, and development programs carried significant levels of disease. In order to solve this problem and provide a disease free basis of cultivars, PCAN used the Panhandle Research and Extension Center (PREC)

Figure 4. Potato History, 1866-2008: Value

facilities, greenhouse, cellar and laboratory/office space at the Mitchell Ag Lab. At that time, PREC headquarters was transferred to new facilities vacated by Hiram Scott College in Scottsbluff. The NPCA holds up standards for the seed potato industry and is centered in Box Butte County. To remain competitive, the seed potato industry must be progressive and have disease-free seed stocks. The open channels of communication between the Departments of Plant Pathology, Agronomy-Horticulture, and Entomology and the NPCA are viewed by the seed potato industry as extremely important to keep Nebraska potato industry current with the new techniques. The Potato Certification Association is the University's designated agent to conduct Potato Certification in Nebraska. As such by law as a non-profit Association, it can only charge a fee to cover the cost of service provided to the industry which it serves.

Centennial Profile:

Mechanized Crop Production

By John A. Smith, Professor/Machinery Systems Engineer
Panhandle Research and Extension Center

Power and mechanization for agricultural crop production have been at the center of a dramatic history of production agriculture in the Nebraska Panhandle through the 100 years from 1910 to 2010. The technology invented and developed by Agricultural Engineers within the history of this period has increased crop yields, has eliminated almost all heavy physical labor, has provided a safe and economical food supply, and has increased the acreage of a typical crop production operation in the Nebraska Panhandle by as much as 40-fold during this period.

Direct harvest of dry edible beans is an evolving crop production practice that is an example of the contribution of Agricultural Engineering to western Nebraska agriculture.

The development of a reliable internal combustion engine for the farm tractor perhaps made more impact on the "progress" of crop production than any other single advancement or change between 1910 and 2010. In 1910 there were very few "tractors" in the Nebraska Panhandle and these were steam engines used for pulling multi-gang sod plows for breaking the prairie, and for powering stationary threshing machines for harvesting dryland wheat. It was really in the 1930's and early 1940's before tractors with internal combustion engines became commonplace as the primary power source on individual Panhandle farms, replacing a stable of draft horses. In a period as short as 15 years, horses were replaced by tractors, and the field capacity of an individual producer went from level to a steep incline. Row crop tractors increased in engine power from a common 15-30 hp in 1935 to a typical 240 hp in 2010, creating a near 10-fold increase in unit productivity.

Invention, development, and adaptation of field implements also made dramatic change in field operations and reduction in manual labor for crop production during the previous 100 years. Grain harvest evolved from horse-drawn binders and manual shocking of the grain sheaves to the present self-propelled combine harvesters with features including 40-foot-wide headers; 300-bushel grain tanks; self-adjusting threshing and cleaning systems to minimize grain damage and field loss while maximizing field capacity; and yield monitors. Hay harvest has changed from literally making piles of hay to be later fed to livestock in the field to making dense, 1-ton square bale packages designed for efficient transport to other states. Pneumatic and mechanical thinners were developed to replace manual thinning of the sugarbeet crop. Sugarbeet harvesters reduced the dreaded hand labor of topping, loading, and transporting the roots to the factory. Tillage implements and row-crop planters increased in width, robustness, and field capacity to match the continuing increase in tractor power. Planters, for example, have progressed from four or six row implements with mechanical singulation mechanisms, to more precise pneumatic seed handling implements with common widths of 12 and 16 rows, and widths now available up to 48 rows.

Agricultural engineers have contributed much more than just 'bigger, heavier steel' to the mechanization of crop production. Engine technology has provided more reliable, fuel-efficient power with reduced emissions as documented by the world-famous University of Nebraska Tractor Test Laboratory. Complex electrical and hydraulic systems on tractors, combines, and other implements have all but eliminated human power with modern farm operations that was so intense with field work 100 years ago. Agricultural en-

Mechanized Crop Production, Continued

gineers and designers have most recently taken a page from NASA and military operations to utilize satellite signals and digital communication (GPS) to enable assisted steering and positioning of tractors, combines, and implements. This technology has now progressed to true sub-inch auto-steer, including automatic turning and positioning of implements at ends of fields; prescription rate application of chemicals and planting; and mapping of crop yields, soil properties, and applied chemicals. These technologies are endangering the meticulous art of tractor driving, but are enabling real-time management of the technologies of the field operation!

But this 100 years of power and mechanization development has brought much more than simple productivity to modern crop production. Perhaps as important to long-term agriculture, this technology has made possible improved quality of harvested crop and a practical stewardship of our natural resources, particularly soil and water, necessary for sustainable crop production into the next 100 years. Agricultural engineers have led research and the practical development of conservation tillage production systems which minimize soil tillage operations and maintain crop residues on the soil surface, both significantly reducing soil erosion, conserving soil water for the intended crop, and improving soil properties. Modern farm implement inventions and developments have enabled widespread utilization of these sustainable and environmentally responsible crop production systems.

These changes, improvements, and developments in farm power and machinery, and their contributions to crop production, have encompassed a national, even global, scope. The Machinery systems engineering position at the Panhandle Research and Extension Center, created in 1979, has been a contributor to this process and progress for local crops and production systems. Examples include:

• Development of a practical transplanting system for Nebraska sugarbeet production.

• Measurement of field loss from dry bean and sugarbeet harvest operations which has lead to awareness of harvest loss and subsequent reduction in this field loss.

• Research on seed quality from dry bean harvest which has resulted in changes to combine design and operating adjustments to accommodate higher harvested seed quality.

• Development of an electronic planter test stand to accurately measure sugarbeet planter seed spacing performance and which has replaced grease belts. This technology is used in the annual sugarbeet industry planter clinics. The concept has led to a commercially available system for monitoring planter seed spacing accuracy in the field.

• Zone tillage equipment and systems for sugarbeet and dry bean production. Zone tillage is now a primary production system used in the Nebraska Panhandle to reduce production costs, improve conservation of soil and water, and to alleviate soil compaction.

• Development of direct-harvest systems for dry edible beans specifically for Nebraska harvest conditions and producer objectives. Header manufacturers have modified equipment, the necessity of maintaining a very level field has been recognized, bean varieties have been evaluated, and harvest loss documented.

• Development of tillage, planting, and harvesting systems for chicory production in Nebraska.

Centennial Profile:

A Century of Soil Research

By Gary W. Hergert, Soil Fertility and Nutrient Specialist and Rex A. Nielsen, Research Technician Panhandle Research and Extension Center

Sustaining soil productivity was an important part of at the Panhandle Station which later became the University of Nebraska Panhandle Research and Extension Center. Although some aspects of enhancing or maintaining soil fertility have been known for centuries, materials useful for enhancing soil fertility were limited. When the native sod was broken, the residual fertility from this virgin prairie was enough to keep the land productive for several years. However, to sustain a reasonable level of productivity, new methods needed to be developed. Station scientists were soon called on to find solutions to these problems.

Research technician Rex Nielsen collects soil samples from a research plot.

Traditional methods of sustaining soil fertility included crop rotation, green manures and adding livestock manure. As early as 1912 Fritz Knorr, the first station director, established a large set of plots, containing 9 with continuous cropping and 25 with different crop rotations, several including alfalfa and manure. A few years later, then director James Holden reported dramatic yield benefits of rotating alfalfa. He also noted that with longer rotations certain crop diseases and pests were significantly decreased.

Commercial fertilizer products were limited and expensive in the early 20th century. In western Nebraska, legumes and livestock manure were the predominant means for enhancing soil fertility. However World War II dramatically changed the availability of manufactured fertilizers because it created a large need for munitions. The United States expanded production of anhydrous ammonia from the Haber-Bosch process and made ammonium nitrate for munitions. There was excess of these products (ammonium nitrate and ammonia) at the end of the war, and they became available for agricultural use at economical prices. The large-scale production of sulfuric and nitric acids also provided the means to begin commercial phosphate production by acidulating rock phosphate.

Publications written by Lionel Harris and Vance Pumphrey in the 1950s report the benefits of nitrogen fertilizer on corn. Publications at the time noted that as little as one pound of nitrogen fertilizer could produce an additional bushel of corn. Research also demonstrated the benefits of applying phosphorus to sugar beets and corn. Most of the fertilizers we have today came from research at the Tennessee Valley Authority (TVA) Fertilizer branch in Muscle Shoals, Ala., created by legislation authored by Senator Frank Norris of Nebraska. The first products were ammonium nitrate and ordinary superphosphate. Later products included triple super phosphate (0-46-0), urea-ammonium nitrate solution (32-0-0), and ammonium polyphosphate (10-34-0). TVA conducted national demonstration efforts in conjunction with land-grant universities to promote the use of fertilizer from the 1960's into the 1990s.

Too much fertilizer can be a problem just like deficiencies. In the 1950s Great Western Sugar Company stipulated in beet contracts that farmers apply 200 pounds of superphosphate per acre. Dr. Gary Peterson (former Nebraska scientist) found that the excess phosporus induced micronutrient deficiencies in corn. These problems were particularly evident on high pH soils found in the North Platte Valley. Lower P rates and soil testing helped address the problem.

In the 1960s, Frank Anderson conducted numerous experiments with various zinc fertilizer products on corn.

Soil Research, continued

Anderson also did research on fertilization of potatoes with various combinations of N, P and K. The primary thrust was the quality of the potato for chipping. In the late 1960s, Anderson and Gary Peterson initiated a series of experiments to calibrate the nitrogen soil test for sugar beets by measuring soil nitrate content to six feet. Their calibrations were adopted by Great Western Sugar Company and it improved yield and quality.

Louis Daigger was an extension soil scientist who did extensive work on small grains in the 1960s and '70s plus other crops. In the 1980's, Frank Anderson assumed responsibility for fertility work for dryland crops as well and conducted numerous experiments on N and P for winter wheat under different types of fallow tillage methods.

When Frank Anderson retired in 1990, Dr. Greg Binford worked on developing fertilizer recommendations for sunflowers. Corn research determined why corn yields were sometimes depressed following beets. Dr. Binford worked with spoked-wheel fertilizer applicators and did extensive work with chlorophyll meters.

Dr. Jurg Blumenthal followed Binford. He did extensive research on precision fertilizer applications on both sugar beets and corn using GPS technology. He modified a full-size sugar beet harvester to monitor sugar beet yields as it was pulled through the field. He also collected and isolated new strains of native nitrogen-fixing bacteria for dry edible bean inoculation.

Dr. Gary Hergert came to the Panhandle in 2004 after 26 years at the West Central Research and Extension Center at North Platte. His research efforts focus on soil and nutrient management to improve fertilizer use efficiency for corn, dry beans, winter wheat, canola, sugar beets and irrigated grasses. It includes iron chlorosis on high-pH soils, manure management, and a major project on no-till limited irrigation systems that is designed to help farmers adapt to restricted irrigation water use. Rex Nielsen has served as technologist for all the soil scientists beginning with Frank Anderson and has been instrumental in managing the Knorr-Holden Long Term Manure plots plus other soil fertility experiments.

Research technician Rex Nielsen and Gary Hergert, soil fertility and nutrient specialist, set up a fertilizer trial on sugarbeets.

Centennial Profile:

A History of the Knorr-Holden Corn Plot

By Gary W. Hergert, Soil Fertility and Nutrient Specialist and Rex A. Nielsen, Research Technician Panhandle Research and Extension Center

The Story of Agricultural Research in the North Platte River Valley and the Knorr-Holden Corn Plot began with the establishment of the Scottsbluff Experiment Substation in 1910. Shortly after the station was established a large series of rotation plots were layed out on the newly plowed ground. The plots, including what is now the the

Shortly after construction of the Scotts Bluff Experimental Substation, the native soil is broken on the ground where the Knorr-Holden Plot would come to be located.

Knorr-Holden Corn Plot played a significant role in the educational research conducted at the University of Nebraska Panhandle Research and Extension Center and its predecessor the Scottsbluff Experiment Substation. Since its establishment in 1912, the plot has yielded valuable information about the ecology, environmental impact and production principles of long-term continuous irrigated corn.

In the first half of the 19th century many historic trails followed the North Platte River Valley. Thousands of immigrants traveled through the area on the way to the west coast with few stopping to settle. With the arrival of the railroad in the late 1860s and the elimination of the threat of Indian attack, a few years later the area became a promising site for homesteaders.

The rush of homesteaders became quite large in the late 1880s and early 1890s. The settlers soon realized that rainfall in western Nebraska was generally insufficient and unreliable enough to grow most crops to maturity. With only a few small streams in the area, the waters of the North Platte River were soon called upon to make up for the rain not supplied by nature.

The first irrigation company in the area was formed in 1887 for the irrigation of the area now included in the Farmer's Irrigation District. The canal system for this irrigation district was extended from time to time and was finally completed in 1911. The second irrigation company was also formed in 1887. This company was called the Minatare Mutual Canal and Winters Creek Canal, this canal was finished in 1888. Several other small canals were completed in the next few years. Irrigation from these canals was an immediate success. This attracted a great deal of attention from drought stricken farmers in the area. The success of the irrigation projects proved that irrigation would be a necessity to realize the full productivity of the land, however it would take large scale irrigation projects to realize the full agricultural potential of the North Platte River Valley.

Many more canals, large and small, were proposed, but due to the area farmers' lack of financial resources, large scale irrigation projects would need government support. In 1895 Nebraska enacted an irrigation district law permitting the formation of districts with the power to assess land for irrigation improvements.

The Federal Reclamation Act was passed in 1902 and studies were begun by the Reclamation Service for the North Platte Project. The project was authorized in 1903 and during the same year surveys were started to determine the location of irrigable lands and a reservoir site. In 1905, construction began on the Pathfinder Dam and the Interstate Canal. By 1915, work on the Interstate Canal and Reservoir was completed and work had started on the Fort Laramie Canal. The Northport Canal system was started in 1918. All construction was completed by 1925 and the Guernsey Dam was completed in 1927. Several other dams and irrigation projects have been constructed since 1925.

The North Platte Project extends 111 miles along the river valley from near Guernsey, Wyoming to below Bridgeport, Nebraska. The city of Scottsbluff is near the center of the development. The project supplies water for irrigation of approximately 390,000 acres that are divided into four irrigation districts. A supplemental supply is furnished to eight water user associations serving a combined area of 190,000 acres. Also the aquifer created by the surface irrigation provides groundwater to irrigate another 100,000 acres.

With this large acreage now open to irrigation and the majority of farmers in the area lacking experience in

Knorr-Holden Plot, Continued

managing the irrigated crops grown on the sandy soils of the valley, the United States Department of Agriculture (USDA) soon recognized that new techniques were needed to be developed to successfully farm the newly irrigated lands. To facilitate research and disseminate information to area farmers, an agricultural experiment station was established in the area.

In 1910, the USDA, in cooperation with the Nebraska Experiment Station, created the Scottsbluff Experiment Substation on 160 acres of unclaimed land six miles east of Mitchell, Nebraska. The Office of Western Agriculture, USDA, managed the station until 1948 when the land and management was turned over to the University of Nebraska. The Scotts Bluff Ag Lab is currently part of the University of Nebraska Panhandle Research and Extension Center.

The native short grass prairie was broken out in 1910 and the next spring the land was seeded to oats. Then in 1912 under the supervision of Fritz Knorr, the first superintendent of the station, an extensive series of both irrigated and dryland rotation experiments were begun.

In 1917, James A. Holden became the second station superintendent to supervise the rotation plots. Under his supervision the foundation was set for the rotation plots to become a long-term project. The rotation plots were continued until 1941 when all but the continuous corn plots were discontinued. From 1942 to the present, the corn plots have been maintained as a study by itself.

Over the years, the data collected from this plot has been presented at national meetings and published in many bulletins and scientific journals. From the time of establishment to the present, at least three dozen scientists and graduate students have been involved in the plot.

The data collected from the plot has proven that continuous corn can be successfully grown in western Nebraska and that manuring is a valuable practice in maintaining soil productivity. It has shown that N fertilization alone was capable of restoring most of the production capacity of the soil. The practice of manuring greatly improved the physical condition of the soil. Initiation of N fertilization resulted in a much more rapid recovery of yield than did the initiation of manuring. In the first year of N fertilization on non-manured non-fertilized soil, yields reached a level that required ten years of manuring to attain. Protein levels in the corn grain have been consistently highest on manured treatments at all but the 160 lb/A nitrogen fertilizer rate. Cultivation without manuring or N fertilization decreased the soil N content to 40% of the native content after 30 years of continuous corn production. In the plots receiving manure treatments, the soil N content has increased to 147 percent of the level present in the soil in its native condition. Also organic matter in the top 12 inches of soil in the manured plots was 68 percent higher than the non-manured plots. The yearly manure applications from 1953 to the present have increased soil nitrogen and organic matter levels to the point that they now exceed what the native sod had when first plowed in 1912.

Valuable information has been collected from this plot over the years and much more can be collected in the future. This type of information can only be collected from plots that are long-term in design. Continuous research plots, however, are rare because they require a commitment for generations past and future. We appreciate the efforts of Mr. Frank Anderson and others who supervised the plots for many years when the value of long-term research was not as well understood as it is today.

A load of manure is spread on the Knorr-Holden plot.

At the present time, over 700,000 acres are irrigated in the Panhandle of Nebraska, and of that, 310,000 acres are in corn. The average corn yield in 1914 was about 60 bushels per acres; the average today is 160 bushels per acres. These statistics show the value of corn to the area and the improvement that research has made.

The Knorr-Holden plot is one of the five oldest continuous field crop experiments in the United States. It is also the oldest irrigated corn plot, and the third oldest corn research plot in North America and possibly the world. Two other continuous field experiments, the Morrow Plots at the University of Illinois and Sanborn Field at the University of Missouri, received National Historic Landmark designation in the 1960's. To date, only three long-term research plots were listed in the National Register of Historic Places: the Magruder Plots, in Oklahoma (listed 1979); the Old Rotation at Auburn University (listed 1988); and the Knorr-Holden plots at Scottsbluff, Nebraska 1992.

The Knorr-Holden Plot was conceived when the first large scale irrigation projects were under construction

Knorr-Holden Plot, Continued

Local producers gather at the Knorr-Holden plot for a recent field day.

in the North Platte Valley of western Nebraska. The state, and most of the intensively cropped areas of the west are highly dependent on irrigation. The Knorr-Holden Continuous Corn Plot was developed in response to a need to determine the best methods of farming the newly developed irrigated land of western Nebraska. Since it was established in 1912, the Knorr-Holden plot has been a significant part of the research conducted at the Panhandle Research and Extension Center and continues to yield valuable information on the long-term effects of soil management practices.

The Knorr-Holden Continuous Corn Plot was officially listed in the National Register of Historic Places on June 11, 1992. The register is the federal government's official list of historic properties worth of preservation. Properties with significant historical importance that meet certain criteria are eligible for nomination to the Federal Register. The process of including properties in the National Register of Historic Places is designed with several levels of review at both state and national levels. These reviews follow an orderly and systematic process that requires extensive research and documentation of the nominated property. This process was begun in the fall of 1991 and was successfully concluded in June of 1992.

Scientists Who Have Supervised the Plot

Fritz Knorr
James A. Holden
Lionel Harris
Vance Pumphrey
Ray Allmaraas
Orlando Howe
Delbert Larson
Frank Anderson
David Baltensperger
Greg Binford
Jurg Blumenthal
Gary Hergert

Centennial Profile:

Development of Irrigation

By C. Dean Yonts, Irrigation Management Specialist
Panhandle Research and Extension Center

The Bureau of Reclamation completed construction of the Pathfinder Irrigation Dam in 1909, which opened the North Platte Valley project to irrigation. It didn't take long for the Department of Agriculture to realize that farmers were going to need help establishing proper irrigation practices. In 1910 the Scotts Bluff Experiment Substation, now known as the Panhandle Research and Extension Center, was established. By the summer of 1912, a number of crop rotation experiments, including both dryland and irrigated crops, were established. Irrigated crop production continued to be a significant part of the research and over the next 20 years, experiments were conducted to determine where crops obtained water in the soil and how much water crops needed. In subsequent years, weighing lysimeters were used to determine daily crop water use values. These experiments provided the basis for modern day irrigation scheduling.

When the Scotts Bluff Experiment Station celebrated its 50th anniversary in 1960, three specific projects related to irrigation were described. One of these was conducted by Orlando.W. Howe, a USDA Irrigation Engineer, who wanted to "find out how the effects of a limited amount of water applied at the proper time and at proper intervals would compare with less discriminate use of irrigation water." It seems the concern to conserve water was as prevalent 100 years ago as it is today. Although hybrids have changed drastically over the years, current experiments are achieving similar results to Howe's, indicating that the concept of limiting the amount of irrigation water applied can result in economically profitable crop yields.

In another study, Norris P. Swanson, an agricultural engineer with the university, used a "specially designed sprinkler system to spray artificial rain" to study the impact of rainfall on runoff and soil erosion. Part of his results indicated that on nearly level benches no soil erosion occurred as the excess water drained slowly from the field. This experiment was conducted on different crops and field slopes and it was determined that runoff and soil erosion was much greater on fields having steeper slopes. Similar studies were conducted in the early 1980s and compared runoff and soil erosion from fields established using different tillage systems.

The creative thinking that brought about these types of studies additionally contributed to developing the "big experiment" as described by then Superintendent Lionel Harris. This project involved a number of researchers, cost $150 per acre to establish and furthermore showed a net profit. It was considered to potentially have far-reaching effects on all irrigated land in western Nebraska. Harris' design consisted of benches having level cross slope and a gentle field slope, each separated by a grass berm. The system allowed uniform application of irrigation water while keeping runoff and soil erosion to a minimum.

In this photo from the UNL Panhandle Center archives, an unidentified worker irrigates a field in June 1913 using a collapsible canvas dam.

Lionel Harris stated that "While it is not an entirely new development to the farmers in western Nebraska, the gently sloping level benches seem almost out of place from the air, where you are accustomed to seeing square and rectangular patches of land." The idea never caught on in this area, but the superintendent had no way of knowing at that time that an even bigger change was coming to the landscape as a result of changing irrigation practices. As people flew through the air, they wondered what these strange perfectly round circles amongst the square and rectangular fields could be. Those circles turned out to be fields irrigated with a system called a center pivot.

In 1952, Frank Zybach patented the center pivot, resulting in an enormous change in the practice of irrigation. It wasn't until the late 1960s and early 70s that center pivots in western Nebraska really started to appear. At first, pivots were installed on the tablelands north and south of the valley and used groundwater. In the North Platte Valley, irrigators ran surface water from Pathfinder Dam down furrows, and there was no need for a sprinkling machine.

During the late 1980s work on surface irrigation systems continued, as over 60 percent of the irrigated acres in Nebraska used furrow irrigation. Experiments during that period concentrated on methods to improve furrow irriga-

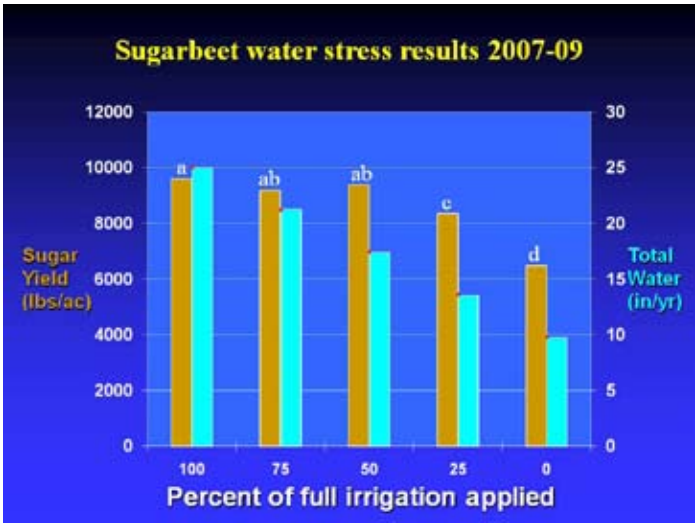
Irrigation, Continued

tion efficiency. The university extensively studied a new method of furrow irrigation called surge. This system used a solar powered butterfly valve to automatically turn water on and off between two irrigation sets. The short cycle times and the wetting and drying of the furrows reduced the soil infiltration rate, increased advance time, increased application uniformity and reduced runoff.

Although surge irrigation is a viable alternative for many furrow irrigators today, the biggest changes are still occurring with the pivot. Between 2000 and 2010, furrow-irrigated acres in the North Platte Valley were converted to center pivots at a rate of approximately 10,000 acres per year. The valley growers did not give up their surface water rights, but rather dug small pits from which they diverted the surface water supply and then pumped it through the irrigation system.

Since the 1960s, a number of additional researchers have contributed to advancing irrigation practices. In the late 1960s and early 1970s, David Fonken, extension irrigation specialist, worked on an experiment to determine the water- use rate of sugarbeets using a sprinkler system at the university's Northwest Ag Lab near Alliance. Walter L. Trimmer was the extension irrigation specialist in the early 1970s. Some of Trimmer's work dealt with setting up weather stations throughout the Panhandle to provide crop-water use information to irrigators using a phone-in irrigation hotline. During this same time, Robert Edling, the research irrigation engineer, monitored flow in the irrigation canals to determine conveyance losses to help irrigation districts improve their delivery efficiency.

In 1980, C. Dean Yonts was hired as the research/extension irrigation engineer. In addition to his earlier work on surge irrigation, he more recently has studied the impact of limited irrigation similar to Howe's work in the late 1950s. Yonts has concentrated on trying to define the impact on yield of sugarbeets and dry beans when irrigation is withheld during different stages of growth. He has also taken advantage of a newer type of irrigation system and has conducted deficit irrigation with corn using subsurface drip irrigation.



Research data: The effect of season-long deficit irrigation on yield of sugarbeets.

Top: A center pivot is used to study impact of crop water stress. Bottom: A surge valve is used to improve furrow irrigation efficiency.

This article is intended to illustrate the creative and extensive nature of irrigation research conducted in western Nebraska for the past 100 years. Although progression and improvements appear to have been rapid, many of the changes have occurred only when economic situations were right and when an individual was ready to make a change. As a result, center pivots can now be controlled by computers and cell phones, yet there are still fields that are irrigated using dams and siphon tubes. With the progression of any system, the challenges and rewards are great. However, it is only when we stop to look back that one truly sees the advancements that are the results of many peoples' lifetime work.

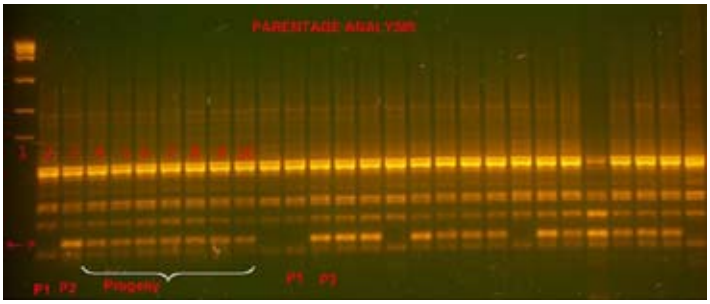
Centennial Profile:
Dry Bean Breeding Program

By Dr. Carlos A. Urrea, Dry Bean Breeding Specialist
Panhandle Research and Extension Center

Past

The University of Nebraska-Lincoln Dry Bean Breeding Program started in 1961, when Dermot Coyne (Plant Breeder) visited a field of great northern beans (cultivar Nebraska #1) at Scottsbluff and made selections for bacterial blight. One of the first lines developed was Nebraska 1 Sel. No. 27, a line widely used in U.S. bean growing regions as a source of common bacterial blight. The University of Idaho Agricultural Research Station and the USDA introduced great northern UI No. 59 and 1140 in 1960. Both cultivars were susceptible to common bacterial blight and bacterial wilt.

The Nebraska dry bean breeding program has contributed to the private and public sector with several lines released as germplasm with resistance to various diseases impacting bean growers in the Midwest and in the Dominican Republic, where USAID supported a collaborative bean improvement project. Coyne's first releases, the great northern cultivars Tara, Jules, and Harris, are common bacterial blight resistant germplasm. Starlight, a bright white seeded great northern released in 1991, has the Ur-3 rust resistant gene and good avoidance of white mold. Emerson, which has a large bright white seed coat, was released in 1971 and has resistance to bacterial wilt, halo blight, brown spot, and bean common mosaic. The pinto cultivar Chase, released in 1993, has resistance to halo blight, bacterial brown spot, rust, moderate resistance to common bacterial blight, moderate avoidance of white mold, and resistance to potato leafhopper injury. Richard Perrin, an agricultural economist, estimated



Use of DNA for parental analysis: DNA samples, shown here in an amplified view, are separated and stained so markers are visible as bands. Every lane is a DNA sample from a different bean plant. Lane 2 and 3 are the female (P1) and maile (P2) used for the hybrid cross. Individuals from lane 4 to 10 are progenies from the cross of P1 x P2. Lane 4 to 10 carry the second band from the bottom (*) as the male (P2).

Seed increase, disease screening, and developing of new hybrid combinations are carried out in the greenhouse at the Panhandle Research and Extension Center.

the value of Chase, during its five year commercial life in the US at $5 million. In cooperation with the University of Puerto Rico and the Secretary of Agriculture in the Dominican Republic, through the USAID/Bean/Cowpea CRSP, the UNL breeding program released Arroyo Loro, PC50, Anacaona, Negro Sureño, JB-17B, Arroyo Loro Negro, CIAS-95, and Saladin-97. In honor of Coyne's contributions, a new variety DPC-40 using Coyne's initials has been released this year.

Coyne's career studies into the genetics of resistance to the bacterial blight pathogen in common beans culminated in major impacts on bean production in Nebraska as well as Africa and the Americas. He published pioneering work on the effect that photoperiod and temperature had on plant response to bacterial blight. He made the crucial discovery that bean pods and leaves react differently to both the common blight and halo blight pathogens, which means that selection for resistance must be made in both pods and leaves. Dermot Coyne advised and guided 43 graduate students.

Transition

Coyne retired in 2001, and Plant Pathologist Jim Steadman advanced and intercrossed elite lines from many American bean breeding programs. The germplasm developed over the years have been important to the current bean breeding program.

Dry Bean Breeding, Continued

Present

Because of the difficulty of maintaining a large, effective breeding program at the Panhandle REC from the University of Nebraska-Lincoln campus 400 miles away, the dry bean breeding position was moved in 2005 from Lincoln to Scottsbluff, aided by a recommendation from Dermot Coyne and with support from the Nebraska Dry Bean Industry. This placed the bean breeder specialist near the center

Dr. Carlos Urrea, dry bean breeding specialist, speaks to a group of high-school students in the greenhouse.

of dry bean production in western Nebraska. Dry bean production is scattered across 26 counties in western Nebraska, with 11 counties in the Panhandle accounting for the largest share of the crop. Scotts Bluff, Box Butte, and Morrill counties, account for nearly half of Nebraska's dry bean production. Carlos A. Urrea joined the program in April 2005.

Objectives of the Nebraska Dry Bean Breeding Program are:

1) to develop and select improved high-yielding great northern, pinto, light red kidney, cranberry, black, and small red bean cultivars/germplasm for western Nebraska with multiple disease resistance. This includes selecting for plants that have upright plant architecture, earliness (95 days), and high quality seed;

2) to develop disease resistance. Exotic dry bean germplasm is screened for resistance to the most limiting diseases in the Panhandle (common bacterial blight, rust, bean common mosaic, and white mold). Material found resistant through these screens is then recombined with our elite bean lines through crosses to develop lines with disease resistance;

3) to introgress drought tolerance into Nebraska elite germplasm;

and 4) to collect data to help with the release of great northern and pinto dry bean germplasm/cultivars. In addition, to screen breeding lines for molecular DNA markers.

Specific Projects Completed or in Progress

Recently, the Nebraska dry bean breeding program has released two germplasm accessions, ABCP-8 and ABC-Weihing, pinto and great northern, respectively, with enhanced common bacterial blight resistance. Both accessions have been used by public and private breeders not only in the USA but in Mexico. In 2008, a great northern cultivar named Coyne was released, named in honor of Dermot P. Coyne. This cultivar was bred specifically for adaptation to the common bean growing conditions of Nebraska and for enhanced resistance to common bacterial blight, a major disease of common bean, and for improved resistance to common bean rust. Coyne has high yield potential, broad adaptation to western Nebraska, good seed quality and resistance to bean common mosaic virus. Seed increase in under way.

The program is also working on identification of bacterial wilt resistance in common bean germplasm. Study of the genetics and mapping the genes for bacterial wilt resistance are in progress. Chickpea trials under chemical and non chemical control to assess yield effects due to Ascochyta blight incidence are also being investigated. Several bulks selected for Ascochyta blight resistance are showing promising results for eventual variety development.

The University of Nebraska dry bean breeding program has been collaborating with Colorado, North Dakota, and Michigan through the Mid-West Regional Performance Nursery (MRPN), and recently with Idaho, Washington, and Colorado through the Western Regional Bean Trial (WRBT). Collaboration with Tim Porch (USDA-TARS-PR) and Steve Beebe [International Center for Tropical Agriculture (CIAT)] on drought studies has also been implemented.

Contributions to western Nebraska economy

ProVita Inc., which sells most of the seed used by Nebraska growers, has seen the following results with their varieties (varieties patented in the last 5 years) which incorporated public developed germplasm: varieties incorporating germplasm developed at the University of Nebraska are planted on 42,000 acres, and varieties incorporating germplasm developed at both Michigan State University and the University of Nebraska are planted on 150,000 acres. These acres are responsible for gross revenue of about $99 million, based on average yields and process as of early 2010.

Centennial Profile:

Dryland Crop Research in Western Nebraska

By Dr. Drew Lyon, Dryland Cropping Systems Specialist Panhandle Research and Extension Center

On April 7, 1967, the U.S. Government made available to the University of Nebraska 2,410 acres of land, which had been part of the Sioux Army Ordnance Depot, for agricultural research and educational purposes. The work of the Cheyenne County Rural Area Development (RAD) Committee, largely through its crops committee, was instrumental in getting the Laboratory established. The officers of this crops committee were: Ralph Spearow, president; Ray Cruise, vice president; and Harold Tremain, secretary.

The need for the field laboratory was underscored in 1964 when there was a severe outbreak of black stem rust, wheat streak mosaic, and crown and root rot of wheat in the Panhandle of Nebraska. In the same year it was announced that the Department of Defense was phasing out the Sioux Army Ordnance Depot. The RAD Committee immediately explored the possibility of utilizing some of the land and facilities for an "experiment station".

After extended negotiations, the Government issued an interim use permit for the University to initiate operations (the deed was issued August 1970). On April 17, 1967, Ray Cruise and Colonel Williams drew a symbolic furrow on what had now been named the High Plains Agricultural Laboratory (HPAL). Thus, after much effort, time, and travel expenses by the members, RAD had succeeded in getting the Laboratory established.

When the RAD Committee was terminated on July 1, 1971, Director John L. Weihing of the Panhandle Station prevailed upon the members to become the advisory group for the HPAL. The HPAL Advisory Board continues to provide valuable input and support to the HPAL.

Under the guidance of Charles Fenster, a research program was initiated immediately upon the University's obtaining possession of the Sioux Army Depot property. The emphasis of his program was on the efficient use of soil and water and optimizing crop yields under the semiarid conditions prevailing in the High Plains. This has remained the focus of the dryland cropping systems effort. The research program has grown in extent and depth since its inception, and today is recognized internationally for its many and continuing accomplishments.

Charles Fenster was hired by the university in 1956 and appointed to a newly created position to study the total management system for winter wheat production. He began his university career at the Northwest Agricultural Laboratory near Alliance. His headquarters were moved to the Panhandle Station near Scottsbluff in 1967. Fenster was known internationally for his work with stubble-mulch and no-till conservation tillage systems. He and Dr. Gary Peterson, soil scientist in Lincoln, established the Long-Term Tillage plots in 1969 at the HPAL. These plots compare various tillage regimes (moldboard plow, stubble-mulch, and chemical) during the fallow portion of a winter wheat-fallow rotation on winter wheat production and soil quality. More than forty years later, these plots continue to result in new knowledge about the effects of fallow tillage on soil quality. Fenster also worked with colleagues in weed science on some of the first chemical fallow work with atrazine, paraquat, and glyphosate. Professor Fenster retired in 1982 after a distinguished career at the Panhandle Station.

Lt. Col. Cyril Williams. commander of the Sioux Army Depot, and Ray Cruise plow the first furrow at the High Plains Agricultural Laboratory on April 17, 1967.

Over the next eight years, three individuals led the dryland cropping systems program in the Panhandle. They were Dr. Mark Hooker (1983), Dr. John Havlin (1984-1985), and Dr. Duane Martin (1986-1988).

In 1990, Dr. Drew Lyon was hired to lead this program. Dr. Lyon emphasized cropping system intensification and di-

Dryland Crop Research, Continued

versification to reduce the frequency of summer fallow, increase precipitation use efficiency, reduce the risk of soil erosion, and break weed, disease, and insect pest cycles of winter wheat.

Dr. Lyon was named the first Fenster Distinguished Professor of Dryland Agriculture in 2008. This professorship was the first at the University of Nebraska-Lincoln established for faculty not located on the main campus in Lincoln. The professorship was established with a $250,000 gift to the University of Nebraska Foundation from Charles and Eunice Fenster.

Dr. Lyon worked closely with Dr. David Baltensperger through 2006 when he left to become a Department Head at Texas A&M University, and then subsequently with Dr. Dipak Santra, both of whom served in the role of Alternative Crops Breeding Specialist, to identify promising crops that could be profitably incorporated into dryland crop rotations. Proso millet, sunflower, and corn are now grown as an integral part of the crop rotation on a significant number of dryland acres that previously produced only wheat in a winter wheat-fallow rotation.

Charles Fenster inspecting winter wheat stubble in a chemical fallow field in 1974.

Centennial Profile:
Entomology Research in Western Nebraska

By Gary L. Hein, Former Extension Entomologist
Panhandle Research and Extension Center
Now Director of UNL Doctor of Plant Health Program

Entomology was established early in the history of Panhandle Research and Extension Center with numerous insect studies occurring during the first 50 years. These efforts encompassed numerous insects, but focused on potato insect pests. Studies were undertaken by entomologists who primarily spent summers or shorter periods working in the Panhandle. Their work had a significant impact on the potato industry, but also impacted other agricultural commodities through the development of cultural and chemical recommendations for managing numerous pests.

Full-time entomologist

In the late 1950s, the importance of entomology research was recognized and an entomologist became one of the few disciplines to warrant a full-time position. Art Hagan began at the Panhandle Station in 1957, and his responsibilities at first were predominately research. However, once in the position, the demand from clientele for information resulted in his becoming more involved in extension, and his efforts eventually developed into a split assignment in both research and extension.

Hagan provided support for all aspects of entomological expertise. He became the expert on western bean cutworm on corn and dry beans in the 1960s, as this insect became established as an important pest on these two crops in the region. Hagan also made an impact through his work on the identification, feeding and management of grasshoppers, one of the most important insect problems in western Nebraska. He generated information on the management of numerous other insect pests of sugarbeet, dry beans, and other crops. Hagan provided consistent entomological expertise for the Panhandle until 1987, when he moved to North Platte to become survey entomologist.

Changing Pest Issues

Through the years insect pest issues in the Panhandle have constantly evolved. The Russian wheat aphid was introduced into Nebraska in 1987, and the rapid occurrence of this devastating pest was an important stimulus for the hiring of the next entomologist in 1988. Gary Hein began as entomologist at the Panhandle Center in 1988 with a 50 percent research and 50 percent extension appointment.

Wheat

The severity of the Russian wheat aphid in the late 1980s required a rapid response (photo at right). Research and extension efforts were targeted at establishing threshold, sampling, and control recommendations to manage this serious threat. Later efforts have also documented the importance of natural enemies in limiting the continued seriousness of this pest.

In 1993, serious wheat streak mosaic infections in Cheyenne County brought about efforts to investigate the virus's vector, the wheat curl mite. Extensive research efforts have provided better understanding of the mite's ecology and movement and have resulted in improved recommendations for managing the mite and virus. In addition, efforts to screen resistant varieties have resulted in the release of Mace, a variety with much improved virus resistance.

Severity of Russian wheat aphid damage seen after introduction of the insect in the late 1980s.

Another new pest of wheat was found in the Panhandle in the mid 1990s. The wheat stem sawfly became a serious issue in fields along the Wyoming border. Investigations into the timing of emergence of the insect led to recommendations for managing this insect. However, this insect slowly continues to spread into additional wheat growing areas in western Nebraska.

Dry Dean Insects

Beginning in the mid-1990s, mild winter conditions led to the Mexican bean beetle becoming a more serious pest of dry beans in the North Platte Valley. Research has established an egg mass sampling plan, improved thresholds, and better understanding of the insect's biology and management.

Entomology, Continued

Western bean cutworm has been an important pest across the region in both dry beans and corn. Efforts in the 1960s began to uncover important aspects of the biology of the insect. Research through the last 15 years has increased our knowledge and helped to improve the efficiency of management of this insect in both crops. Recent movement of this insect into the central and eastern Corn Belt has increased the importance of this insect and increased the impact of the work done on the western Nebraska pest.

Rangeland devastation (note light vs. green areas) caused by army cutworm in Sioux county.

Sugarbeet Insects

A serious insect problem in sugarbeets was first observed in the North Platte Valley with the introduction of the sugarbeet root maggot in the late 1970s. Research efforts in the 1980s and 90s identified the extent of the spread of the maggot and management options. Further understanding of the biology of the maggot has explained the recent reductions of this insect since 2000 due to drought conditions and the potential for the return of the problem with adequate spring rains.

Serious infestations of sugarbeet root aphid in 1997 brought about extensive effort to establish the value of resistant varieties and develop better aphid screening procedures. The result was an increased emphasis on the use of varieties resistant to the aphid and better management recommendations.

Insect Diversity

Numerous other insect pests have been studied through the years in an effort to maintain effective and up-to-date recommendations on their management. These efforts have targeted insect pests that affect both commonly grown crops as well as some of the specialty crops being developed and grown in the region.

In addition, the Center entomologist deals with the public in identifying and explaining often dramatic occurrences of insect issues in the Panhandle. Many of these insect issues are unique to the region, and they can often be spectacular. Perhaps the most impressive insect invasions that occur in western Nebraska are the cyclical infestations of grasshopper hoards. But one of the more troublesome insect events in the Panhandle is the annual migration of "millers" to the mountains. The migration is often preceded by invasions of crops, gardens and/or buildings by the millers' immature form, the army cutworm (see photo at left). Amazing entomological invasions have occurred from time to time, including the carabid beetle invasion of downtown Sidney, mayflies that descended on Scottsbluff, or the almost regular infestations of houses by a series of nuisance invaders. The often spectacular flights of dispersing winged ants in late summer after a significant rain stirs questions of potential invasions, but more practically, the cleaning of greasy windshields.

The diversity of insect occurrences in the panhandle keeps the entomologist's job interesting with no lack of problems to pursue. The torch of entomological research and extension work has recently been passed (January 2010) to Jeff Bradshaw, who became only the third entomologist to work in the Panhandle in the last 50 years.

Through the years, the efforts of the entomologist have been supported by numerous technicians and summer students. These individual have contributed greatly to these accomplishments. During the last 22 years, a trio of technicians (Rick Patrick, John Thomas, and Susan Harvey) has combined for over 50 years of service to the entomological efforts in the Panhandle.

Centennial Profile:
Human Nutrition

By Dr. Linda Boeckner, Former Nutrition Specialist, Now Director of Panhandle Research and Extension Center

Like some other areas of specialization, work in human nutrition research and extension education has become a more recent component of the work done at the Panhandle Research and Extension Center. Dr. Linda Boeckner arrived as the first nutrition specialist and Home Economics Program Coordinator for the Panhandle District in January 1987. In the initial years program responsibilities were divided, with three-fourths of the effort going toward developing community nutrition education and wellness programs for the Panhandle District and statewide, and one-fourth of effort working with county-based extension educators to coordinate the delivery of family-based programming in the District.

Projects included development and educational delivery of curricula focused on weight wellness, nutrition, fitness, and youth, Eating Today for a Healthier Tomorrow, and ABCs for Good Health delivered to participants in the Every Woman Matters Program, a statewide cervical and breast cancer screening program. Collaborations were formed with local community health coalitions and eventually relationships were formed with the Panhandle Partnership for Health and Human Services.

As program coordinator, Boeckner initiated child care and early childhood education conferences in the Panhandle District as a way of building educational expertise of child care providers and enhancing professionalism within child care. Exploring multiple ways to deliver educational materials was integral to nutrition program development. Some of the delivery methods explored included interactive website programs, asynchronous website learning, podcasting, webinars as well as serial classroom education and educational conferences. Master Preserver classes to train volunteers on food preservation were coordinated and offered in the early years.

In the late 1990s the program coordinator responsibilities of the position were dropped as the statewide extension system moved more toward statewide action teams. Boeckner was a co-leader of a statewide action team focused on preventive health and wellness education which later transitioned to nutrition, health and food safety. In 2001, the position was changed from 100 percent Extension focus to also include 25 percent responsibility for nutrition research. Boeckner joined a multi-state research team consisting of faculty from 10 other states to conduct research in nutrition behavior change among young adults who received tailored nutrition messages. This work had implications for the delivery of nutrition education within extension systems and the factors that drive decision making when nutritional changes are advised. Another research focus was a collaborative effort on a University of Nebraska Medical Center College of Nursing project to reach post-menopausal women with tailored educational messages to help them make healthful lifestyle changes in eating and physical activity behaviors. Both projects are on-going to the present time.

Dr. Lisa Franzen-Castle joined the UNL Panhandle Research and Extension Center faculty in September 2009 as the nutrition specialist, and is continuing the statewide and district work in nutrition education program development and delivery. Her work in adaptation and acceptance of nutritional behaviors among new immigrant populations will be useful in a state that has a growing number of new immigrants and which is changing the face of Nebraska clientele.

Centennial Profile:
Alternative Crop Breeding Program

By Dipak K. Santra, Alternative Crop Breeding Specialist
Panhandle Research and Extension Center

Agricultural scientists at Scotts Bluff Experiment Station, now known as the Panhandle Research and Extension Center, recognized the need of alternative crops to diversify dryland farming systems in western Nebraska. Proso millet was recognized as one of the most effective alternative crops and research was initiated in the early 1960s.

Prior to 1970:

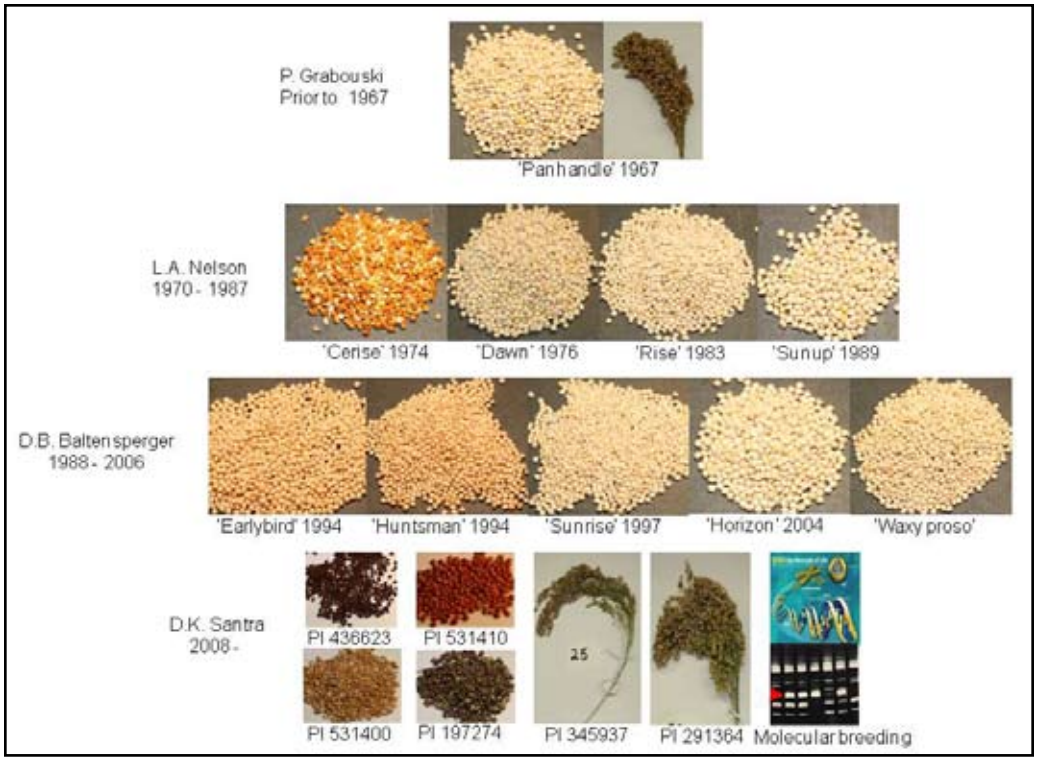
In the early 1960s, Phil Grabouski first initiated proso millet research at Scotts Bluff Experiment Station in conjunction with Glen Vemeier at North Platte Station (now West Central Research and Extension Center). Together they developed the first white proso millet (variety Panhandle) for western Nebraska in 1967. In 1968, a separate proso millet breeding program was initiated by two specialists who worked about two years.

1970 – 1987

In 1970, Lenis Nelson began the real proso millet breeding at Scotts Bluff Station. He developed the first red proso millet variety Cerise followed by three white-seeded varieties: Dawn, Rise, and Sunup. Dawn was the most popular variety and it served as a common parent for future proso millet variety improvement. Since more crop diversity was needed in western Nebraska, Nelson also initiated research on other alternative crops like dryland corn, sorghum, other millets (pearl, finger, and foxtail), sunflower, and edible amaranth. He worked for 17 years at the Center before moving to Lincoln to direct crops variety testing and extension program for the University of Nebraska.

1988 – 2006

Soon after Nelson's departure, David Baltensperger took charge of the alternative crops breeding program in 1988 at the PREC. Since the proso millet market was limited due to its exclusive use as bird seed, he realized that diversity was the key to success for alternative crops and their limited, niche markets. During his 18-year career, he tested about 20-25 different crops, which included various millets, oil-seed crops, grasses, forages, and grain legumes in western Nebraska. Baltensperger developed four white proso varieties (Earlybird, Huntsman, Sunrise and Horizon), which are popular and most extensively grown today. The most significant contribution of Baltensperger was his initiative in developing waxy proso millet.



Progress of proso millet variety development at the UNL Panhandle Research and Extension Center since its initial inception.

2008 - onwards

Dipak K. Santra joined the Panhandle Center to direct the alternative crops breeding program in 2008. He envisions integrating novel traits available within proso millet germplasm (PI lines) through molecular breeding to develop high-yielding varieties for alternative uses of the millet (such as fuel or food). Santra foresees the development of alternative crops with biodiesel potential to meet the challenges of fossil fuel shortage in 21st century. In the era of biotechnology, it may not take a decade before western Nebraska farmers can grow these high-valued alternative crops that Santra envisions.

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